# Initial Environmental Examination

**PUBLIC**

Project Number: 57042-001
July 2026

# India: Assam Sustainable Wetland and Integrated Fisheries Transformation Project

Prepared by Assam Rural Infrastructure and Agricultural Services (ARIAS) Society, Government of Assam for Asian Development Bank

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**CURRENCY EQUIVALENTS**

(as of 4 February 2026)

| | | |
|---|---|---|
| Currency Unit | - | Indian Rupee (₹) |
| 1 USD | = | 90.43₹ |
| 1 ₹ | = | 0.011 USD |

## ABBREVIATIONS

| | | |
|---|---|---|
| ADB | - | Asian Development Bank |
| APART | - | Assam Agri-Business and Rural Transformation Project |
| ARIAS | - | Assam Rural Infrastructure and Agricultural Services Society |
| ASRLM | - | Assam State Rural Livelihood Mission |
| BDC | - | Beel Development Committee |
| CPIU | - | Cluster Project Implementation Unit |
| DO | - | Dissolved Oxygen |
| DOF | - | Department of Fisheries |
| EA | - | Executing Agency |
| EMP | - | Environmental Management Plan |
| FGD | - | Focus Group Discussion |
| GIS | - | Geographical Information System |
| GRM | - | Grievance Redress Mechanism |
| IA | - | Implementing Agency |
| IEE | - | Initial Environmental Examination |
| IUCN | - | International Union for Conservation of Nature |
| MOEFCC | - | Ministry of Environment, Forests and Climate Change |
| NGO | - | Non-government Organizations |
| OHS | - | Occupational Health and Safety |
| PMU | - | Project Management Unit |
| REA | - | Rapid Environmental Assessment Checklist |
| SPS | - | Safeguard Policy Statement (2009) |
| SWIFT | - | Sustainable Wetland and Integrated Fisheries Transformation Project |
| TA | - | Technical Assistance |
| VDC | - | Village Development Council |
| WHO | - | World Health Organization |



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**Weight and Measures**

| | | |
|---|---|---|
| dB(A) | - | A-weighted decibel |
| ha | - | hectare |
| km | - | kilometre |
| $km^2$ | - | square kilometer |
| Leq | - | equivalent continuous noise level |
| µg | - | microgram |
| m | - | meter |
| $m^2$ | - | square meter |
| PM | - | particulate matter of 2.5 micron or 10-micron size |

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## EXCUTIVE SUMMARY

1. Assam, a predominantly rural state in northeast India, is home to a population of over 31 million, with nearly 86% residing in rural areas and primarily dependent on agriculture and fisheries for their livelihoods. Despite steady economic growth, the state's per capita gross domestic product remains significantly below the national average, and one-third of the population remains multidimensionally poor. The state's aquatic ecosystems viz. beels, ponds, rivers, and swamps support one of India's largest inland fisheries sectors, providing employment to nearly 70% of the rural population. However, fish production falls short of demand, requiring the state to import about 65,000 metric tons annually to meet consumption needs. This gap is largely attributed to the underutilized productivity of beel fisheries, hampered by declining indigenous fish populations, habitat degradation, and invasive species.

2. Environmental disruptions such as siltation, weed infestation, loss of river-beel connectivity, and unsustainable agricultural runoff have significantly reduced the auto-stocking capacity and ecological health of beels. Overfishing, weak enforcement of fishing bans, and a fragmented regulatory framework further exacerbate these challenges. Compounding this are climate-related risks rising temperatures, erratic rainfall, and extreme weather that threaten fish farming and traditional capture practices.

3. Recognizing these pressing issues, the Government of Assam has requested the Asian Development Bank (ADB) to support Sustainable Wetland and Integrated Fisheries Transformation Project (SWIFT or the Project). Administered by Assam Rural Infrastructure and Agricultural Services (ARIAS) Society and the Department of Fisheries (DoF), Government of Assam, SWIFT is strategically designed to boost fish production and enhance fisheries' sustainability in Assam. By addressing both ecological and socio-economic vulnerabilities, SWIFT aims to ensure long-term sustainability, improved food security, and enhanced rural livelihoods.

4. The Project will have three outputs:

Output 1: Institutional capacity and governance for sustainable beel ecosystem and fisheries management strengthened
Output 2: Community-based fisheries business developed and beel community income diversified; and
Output 3: Beel conservation and restoration planned and managed.

5. Output 1 will focus on reforming beel management systems, especially the leasing model. It includes updating policies for community-based management, developing guidelines tailored to wetland types, training government staff, supporting research and development (including on climate adaptation and endangered species), and building digital platforms to monitor and manage beel fisheries. Output 2 will enhance the viability of beel cooperatives by training them in business, finance, and value chain activities. It supports infrastructure development, encourages private investment through matching grants, and promotes income diversification for self-help groups, especially women and marginalized communities. Output 3 will restore degraded beels through demarcation, weed removal, desilting, and improving hydrological connectivity. Infrastructure improvements like embankments, silt traps, and biofilters will help increase productivity and ecological resilience.

6. The proposed project aims to cover 102 beels (wetlands), encompassing over 4,000 hectares across 32 districts, divided into 5 clusters representing all the geographical areas of Assam. During the



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project's readiness, 74 beels, located in 23 districts, were selected for study during project processing and due diligence. The draft IEE (June 2026) is based upon these 74 surveyed beels, but the impacts and risks can be extrapolated to the remaining beels which are still to be confirmed and detailed designed due to their homoegenous nature. These remaining beels and other infrastructures (i.e., on-beel and off-beel, eco-tourism and government buildings), which will be covered during project implementation, have not yet been assessed in detail in the draft IEE. Their site-specific environmental assessment will be conducted in accordance with the provisions outlined in the environmental management plan (EMP) and the IEE updated and finalized in respect of each beel for review and clearance by ADB before bidding documents are issued. However, all 102 potential *beels* have been screened to ensure impacts on environmentally sensitive sites are adequately addressed.

7. During the project readiness phase, 74 beels, totaling 1432 hectares, were selected for project processing and due diligence. These beels are undergoing similar interventions, such as desilting, de-weeding, construction of earthen mounds, cleaning of inlets, embankment construction, installation of Hume pipes, composting, and the development of fish-rearing ponds. Given the uniform nature of the interventions, the impact assessment was initially conducted based on a detailed evaluation of 74 beels spread across 23 districts in all 5 clusters. The findings from these assessments were extrapolated to estimate potential impacts for the remaining beels. This approach allows the assessment of 74 beels to be considered sufficient for identifying appropriate mitigation and monitoring measures provided that all selected sites meet the established site selection eligibility criteria. The IEE may be updated accordingly to include specific details of each beel before execution, detailed assessments are carried out, and meaningful consultations are completed.

8. This draft IEE does not yet provide site-specific assessment for other or future developments or activities at the subproject locations. To guide this future process, a guideline for site selection (criteria) and updating of the environmental assessment has been prepared and included in the IEE to ensure all the subprojects still to be confirmed and subject to detailed design comply with environmental safeguards requirements under ADB SPS, 2009. The IEE report should be updated and finalized before bidding documents are issued plus during or before construction if there is a change in the scope, design, or location of subproject activities or construction works once contractors are on board.

9. The primary purpose of the IEE is to assess the potential impacts of the project on the existing environment. Specifically, the study aims to predict the likely impacts of subproject activities and recommend mitigation and abatement measures for any impacts during the pre-construction, construction, and operational stages that are considered potentially adverse to the surrounding environment. The IEE serves as the basis for the environmental assessment of the subprojects and provide guidelines for on-site environmental management activities, ensuring compliance with National and State Government regulations regarding environmental management

10. In compliance with national environment regulation, none of the components of the subprojects falls under the ambit of the environmental impact assessment (EIA) Notification 2006, and therefore EIA study and environmental clearance are not required for the Project. The subprojects do not require forest land diversion, and there are no protected areas within the area of influence (e.g. national parks, tiger reserve and wildlife sanctuaries). Therefore, no clearance is required from National Board of Wildlife (NBWL), the Ministry of Environment, Forestry and Climate Change (MoEFCC), Government of India.

11. Project state Assam, located at the foothills of the eastern Himalayas, is the largest state in northeast India, positioned in the middle reaches of the Brahmaputra and B. Rivers. Assam spans an area of 78,438 km², accounting for approximately 2.4% of India's total geographical area. The Brahmaputra basin encompasses an area of 580,000 km², of which 70,634 km² lies within Assam. The



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state's topography is varied, comprising hills, plains, and numerous rivers. Assam shares borders with West Bengal and Bangladesh to the west, Bhutan to the north, and Nagaland, Manipur, Mizoram, Meghalaya, and Tripura to the south. Geographically, it extends between 88.25°E to 96.00°E longitude and 24.50°N to 28.00°N latitude.

12. The climate of Assam is categorized as a "Tropical Monsoon Rainforest Climate," marked by high humidity and substantial rainfall. Summer temperatures range from 27°C to 38°C, while winter temperatures drop between 3.4°C and 11°C. Humidity levels remain consistently high throughout the year, varying from 74% to 87%. The climate is predominantly influenced by the South-West Tropical Monsoon, which brings substantial rainfall from June to September, although non-monsoon rains also occur intermittently. Assam's average annual rainfall is approximately 2,454.4 mm, with some regions, such as southern Karbi Anglong and Nagaon, receiving less than 1,500 mm annually due to a rain shadow effect.

13. The ambient air quality in Assam is generally good, except in some settings cause localized air pollution. The Pollution Control Board, Assam (PCBA), monitors ambient air quality under the National Air Quality Monitoring Programme (NAMP), covering 12 districts and 14 towns across Assam. The analysis reveals that air quality in most towns adheres to the National Ambient Air Quality Standards (NAAQS) for residential areas, though elevated particulate matter (PM) levels are observed in a few towns. As most project sites (beels) are in rural areas, the air quality at these locations is expected to be within the NAAQS. Noise levels are also within acceptable limits.

14. The water quality assessment for 15 beels across five zones in Assam was undertaken as part of the ADB-funded SWIFT Project. A total of 25 water quality parameters were analyzed, with pH, DO, and conductivity measured on-site, and the remaining parameters analyzed in the MOEFCC, GoI recognized laboratory. The pH values ranged from 6.3 to 7.8, averaging at 6.9, indicating slightly acidic conditions, likely influenced by the organic matter richness of the wetlands. Secchi depth, an indicator of water clarity, ranged from 0 to 1.5 meters, with an average of 0.7 meters. These values align with the characteristics of hyper-eutrophic systems, which typically exhibit transparency values of ≤1.5 meters and ≤0.7 meters as maximum and minimum thresholds, respectively. This suggests that the beels are highly productive ecosystems, although water hyacinth overgrowth contributes to a shallow euphotic zone, potentially disrupting limnological balance and fish diversity.

15. Surface water DO levels ranged from 6.2 to 7.8 mg/L, consistently exceeding the Class C water standard of 5.0 mg/L, indicating adequate oxygenation. However, BOD values ranged between 2.5–3.9 mg/L, slightly surpassing the inland surface water threshold of 3 mg/L, indicating moderate organic pollution. COD ranged from 6.5 to 10.2 mg/L, and total nitrogen levels were relatively high, ranging from 2.1 to 5.2 mg/L. Nitrate concentrations varied between 0.5 and 3.2 mg/L. Elevated inorganic phosphate levels, ranging from 0.02 to 0.65 mg/L (exceeding the U.S. EPA eutrophic condition threshold of 0.035 mg/L), further highlight the risk of nutrient enrichment. Coliform bacteria count, although present, remained within safe limits, with total coliforms at 2290–2900 MPN/100 mL and fecal coliforms at 1060–1610 MPN/100 mL, both below the Class C standard.

16. Sediment analysis revealed Total Organic Carbon (TOC) content between 0.8% and 1.3%, reflecting varying organic matter levels across the beels. Sediment phosphorus levels ranged from 30.6 to 56.1 kg/ha, suggesting differential nutrient inputs, likely influenced by agricultural runoff. Nitrogen levels ranged from 483 to 604.8 kg/ha, impacting primary productivity and increasing the risk of eutrophication. Heavy metals, including arsenic, lead, manganese, and zinc, were generally within safe limits, although localized variability was noted. These findings provide valuable insights into the water and sediment quality of Assam’s beels, emphasizing the need for integrated nutrient and vegetation management to sustain their ecological health.



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17. A biodiversity survey was conducted by a MOEFCC-accredited lab to assess the flora and fauna found in and around 15 beels, utilizing a combination of primary site surveys and analysis of secondary information from various research articles and reports. The findings indicate that no threatened species were recorded within the examined village beels during the survey period, suggesting that the current biodiversity status in these areas does not include any species classified as threatened.

18. Applying the precautionary principle, a Critical Habitat Assessment (CHA) was conducted using biodiversity data from concerned departments, laboratory findings, species records from iNaturalist, and an IBAT (Integrated Biodiversity Assessment Tool) analysis. The assessment area included subproject locations and a buffer zone, accounting for species movement and habitat connectivity to comprehensively assess potential ecological impacts. The Area of Analysis (AoA) for the critical habitat assessment focused on the beels and their surrounding areas. Although the impacts of the project are expected to be confined to these areas particularly within the beel boundary, it is important to note that no National Parks or Wildlife Sanctuaries are located in close proximity to the beels. However, two of the subproject beels, Paranm Beel and Tatinga Mekheli Barbeel, situated in Majuli Island which is a KBA. Planned project activities related to these two wetlands have been carefully designed to minimize ecological impacts. It is important to note that the majority of the biodiversity found on Majuli is closely linked to the Brahmaputra River rather than the beels. Furthermore, several other beels not included in the project are also present nearby, and these two beels are not the sole habitats supporting the biodiversity of Majuli. Therefore, no significant impacts are expected on the island's unique landscape, biodiversity, or ecological balance due to these activities.

19. In addition to the two Majuli Island beels, Bera Na Beel, located in Dhemaji District, falls within the Dibru-Saikhowa Complex Key Biodiversity Area (KBA), a globally recognized biodiversity landscape covering approximately 1,000 km². The KBA comprises the Dibru-Saikhowa National Park, adjoining reserve forests, river islands (chaporis), wetlands, and the interconnected river systems of the Brahmaputra and Lohit Rivers. A preliminary site assessment undertaken by ARIAS indicates the need for conservation and ecological management of the beel. However, considering its location within this biodiversity-rich landscape, it is recommended that detailed biodiversity surveys, habitat assessments, and appropriate environmental due diligence be undertaken prior to implementation of any interventions. It is further recommended that the IEE be updated based on the findings of these studies for Bera Na Beel as necessary. No physical works should proceed until the required due diligence has been completed and all applicable safeguard measures have been incorporated in accordance with the requirements of the ADB SPS, 2009.

20. Development activities are restricted to the beel areas and their immediate surroundings to avoid any significant disturbance to the broader landscape of Majuli Island. This approach ensures that the island's unique biodiversity, ecological balance, and cultural heritage remain protected. Furthermore, stringent monitoring and environmental safeguards are in place to ensure that these activities align with conservation priorities and support the long-term preservation of Majuli's ecosystems.

21. The CHA for threatened flora and fauna in Assam has been carried out, focusing on species associated with the beels, the Brahmaputra River, and its floodplain. The selection of species for the CHA assessment was based on their presence in these ecosystems. Following an initial review of over 100 species, a further screening process was applied to identify those most likely to be impacted by the project activities. This screening resulted in 32 species (mostly aves, reptiles and fishes) that could possibly affected by the project activities and identified as potentially vulnerable. These species were further assessed against CHA thresholds. Critical Habitat Assessment confirmed that none of the



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critical habitat criteria or numerical thresholds are triggered by the subprojects. However, as a precautionary measure, a Tortoise and Avi-fauna management Plan has been prepared to ensure that the project does not cause any significant biodiversity impact. The plan aligns with government regulations and ADB's Safeguard Policy Statement (2009) and follows the mitigation hierarchy (avoid, minimize, restore, and offset) to manage biodiversity risks while maintaining ecological health and integrity.

22. The ARIAS Society, in coordination with the DoF, conducted site visit to the Mariampur Eco-Tourism Lake, which is located within Bardamal Athiabari revenue village under the Rangjuli Revenue Circle. According to the Divisional Forest Officer the beels falls within the Athiabari Reserved Forest. Although situated within the boundary of a reserved forest, the lake lies along the fringe of a open forest patch and a modified habitat zone. The Department of Forest proposed this beel to be part of SWIFT Project under Output 3 that will be alternative livelihood for people dependent on forest. The project will enhance the condition of the beel for eco-tourism and shall be managed by Forest Department, Goalpara Forest Division by constituting Joint Forest Management Committee involving the local population.

23. The socio-economic livelihoods across Assam's districts are deeply rooted in agriculture, complemented by allied sectors that provide resilience and diversity to rural communities. In districts such as Bongaigaon, Dhemaji, and Dhubri, rice cultivation forms the economic foundation, supported by the production of mustard, jute, pulses, maize, and vegetables. Livelihoods are further sustained through livestock rearing, fish farming, dairy activities, and traditional practices like sericulture. Regions like Goalpara, Jorhat, Sribhumi, and Lakhimpur show a similar pattern, where agriculture is the mainstay, but tea cultivation, horticulture, and poultry farming significantly contribute to household incomes and employment opportunities. In island areas such as Majuli and agriculturally rich zones like Morigaon and Nagaon, rice-based livelihoods are augmented by aquaculture, dairy, and small-scale meat production. Other districts, including Sivasagar, Tinsukia, Barpeta, Biswanath, and Golaghat, have diverse rural economies driven by a mix of agriculture, tea plantations, animal husbandry, and fruit cultivation, particularly in floodplain zones. Kamrup Metro supports peri-urban livelihoods through market-linked farming, while Kamrup Rural sustains traditional livelihoods with rice, jute, and vegetable farming supported by river-fed irrigation. Across all these districts, rural livelihoods are sustained by a multifaceted socio-economic system, where agriculture remains central but is increasingly integrated with fisheries, horticulture, and livestock to improve income stability and adaptive capacity.

24. As required under ADB's Safeguard Policy Statement (SPS) 2009, a three-tier Grievance Redress Mechanism (GRM) has been established for the project to ensure timely and culturally appropriate resolution of grievances. Grievance Redress Committees (GRCs) are formed at Field level (Tier 1), CPIU (Tier 2), and PMU (Tier 3) levels. Unresolved grievances at lower levels are escalated to the next tier, with the PMU-level GRC acting as the appellate body. The GRM does not limit affected persons from accessing the judicial system or ADB's Accountability Mechanism for safeguard-related complaints.

25. Environment assessment disclosed that the subprojects are not likely to have any severe negative impact on the environment and people of the subproject area. The type and extent of activities anticipated for implementation would be well within the principles of wetland conservation and promote sustainable fishery practices. Project aims to deliver positive environmental impacts by enhancing floodplain wetlands or beels conservation and promoting sustainable fishery production and marketing. Key activities include removal of unwanted aquatic weeds, restoring beel connectivity to rivers, protection against siltation, installation of silt traps to reduce turbidity, conserving habitats and indigenous fish species, and monitoring beel health. These measures are expected to benefit both the



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environment and local communities. However, some civil works and fisheries activities such as the establishment of hatcheries, rearing tanks, fish landing sites, and pen culture may cause temporary and localized environmental impacts. Potential impacts include release of nutrient-rich water from fish-rearing ponds and hatcheries, waste discharge from worker camps, and temporary degradation of water quality from desilting and de-weeding activities. For the rehabilitation of beels, use of vehicles for desilting and transporting materials may result in minor noise and air pollution, primarily from dust and particulate matter. Construction activities also pose occupational health and safety risks. The operations stage will focus on preserving the ecological health of the beels by implementing sustainable management practices, monitoring water quality, and ensuring the conservation of aquatic habitats.

26. Most of environmental impact and risks are predicted to be of minor to moderate, short-term, and localized that will be avoided (adhering with national and/or international design standards and construction planning), minimized to acceptable levels or mitigated through implementation of appropriate measures during the design, construction, and operation phase of the project. Further, the environmental monitoring plan will also provide adequate opportunity for course correction to address any residual impacts during construction or operation stages.

27. An IEE including environment management plan (EMP) is prepared to cover beel restoration components. The specific management measures laid down in the IEE will successfully address any environmental impacts due to the proposed subprojects. Implementation of appropriate measures during the design, construction, and operation phases will minimize negative impacts to acceptable levels. To ensure that these mitigation measures are implemented and negative impacts avoided, the measures will be included in the contract specification. Contractors' conformity with contract procedures and specifications and implementation of the approved EMP during construction will be carefully monitored. Further, the environmental monitoring plans are also providing adequate opportunities towards course correction to address any residual impacts during construction or operation stages.

28. With implementation of proposed mitigation measures, most of the impacts will be minimized, and no residual and cumulative impact is expected. On the other hand, the project will rejuvenate degraded beels and protect crucial habitats of native fish species, ensuring the long-term health of the ecosystem. By fostering ecological balance and providing better habitats, the project will also contribute to increased fish stocks and enhance livelihood opportunities and income generation.

29. Contractual staff, additional manpower and financial resources are also suggested at PMU and CPIU level to strengthen technical capacity and support in subprojects design engineering, supervision, monitoring, review and reporting of environment due diligence and safeguard compliance.

30. As far as institutional arrangements are concerned, project's executing agency is the Government of Assam, represented by the Assam Rural Infrastructure and Agricultural Services (ARIAS) Society. The DoF, Government of Assam, serves as the implementing agency. The Project Management Unit (PMU), based in Guwahati and hosted by the ARIAS Society, will be led by the State Project Director (SPD) of the ARIAS Society. The Project Implementation Unit (PIU), hosted by the DoF and headed by the Director of Fisheries, will manage the activities of five Cluster Project Implementation Units (CPIUs). Each CPIU will be led by a Zonal Project Coordinator (Deputy Director, Zonal Office) and include the District Fisheries Development Officer (DFDO) of the respective district as part of its team.

31. In addition, contractual staff will enhance the capacity and operational effectiveness of the PMU, PIU and CPIUs including for environmental safeguard matters. PIU will have Environmental



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Safeguards Specialist (ESS) at the head office while each CPIU will have a cluster level Environmental Safeguards coordinator (ESC).

# INTRODUCTION

## 1.1 Project Background and Rational

1. Assam, the largest state in India's northeast region, has an estimated population of 31.2 million[1]. While its gross domestic product per capita grew by 5.3% in fiscal year (FY) 2020, it remains 35% lower than the national average. Thirty-two percent of its population remain multidimensionally poor and live below the national poverty line[2]. In rural areas, 86% of the state's population reside, and are mostly engaged in agriculture including fisheries. In Assam, agriculture is a key pillar of the economy, contributing 30% to the gross state domestic product of $57 billion[3].

2. The state is gifted with rich aquatic ecosystems, including floodplain wetlands (known locally as beels), swamps, ponds, and rivers. Fisheries provide a crucial livelihood for rural communities, with about 70% of the rural population employed in the sector. Assam ranks as the fourth-largest inland fish-producing state in India, producing 443,000 metric tons (mt) of fish in 2022–2023. Despite this, the current supply does not meet local demand, forcing the state to import about 65,000 mt of fish annually, valued at nearly $100 million, to fulfill per capita requirements[4].

3. Fish production in Assam is primarily sourced from beel fisheries (fish captured from floodplain wetlands) and aquaculture (fish farming in ponds and tanks). The beels, covering over 100,000 hectares, are flooded during the rainy season by water from rivers and catchment areas, making them excellent grounds for spawning and breeding. These wetlands are a crucial fishery resource, contributing up to 11% of the state's total fish production. However, fish yields from beels are significantly below their potential. Currently, the productivity of stocked and unstocked beels averages 450 kg/ha/year and 221 kg/ha/year.[5] respectively, while the potential is between 1,000 and 1,500 kg/ha/year[6]. This shortfall is largely due to decreasing fish stocks and declining indigenous fish populations.

4. The reduced auto-stocking capacity of the beels and limited alternative stocking efforts by beel fishers are caused by habitat loss, anthropogenic pollution, and external factors related to the ecosystem's interconnectivity, particularly the non-practice of environmentally sustainable practices in related ecosystems that feed into the beels. Beel habitats are degrading due to reduced connectivity with adjacent rivers and human-induced pollution. Seasonal flooding, a critical process for rejuvenating aquatic resources, has been severely disrupted by extensive embankment construction, heavy silt loads from the Brahmaputra, deforestation, and intensive agricultural practices, isolating beels from seasonal floods and limiting the influx of riverine fish stocks necessary for maintaining biodiversity and productivity. Agrochemical runoff from agricultural activities further exacerbates eutrophication, leading to rampant weed infestation. Many beels are now choked with weeds such as water hyacinth, which suppress plankton abundance and significantly reduce fisheries productivity. Without urgent interventions like desilting, weed removal, and the adoption of sustainable practices in connected

[1]Government of India. 2011. Census of India. Delhi.
[2] NITI Aayog. 2021. India: National Multidimensional Poverty Index Baseline Report. Delhi.
[3] Government of Assam. State Income Statistics, 2022. Guwahati.
[4] It is estimated that fish requirement is 15 kg per capita, per annum.
[5] Stocked fisheries involve the release of hatchery-raised fish into natural bodies of water as a means of human intervention to increase fish populations. Unstocked fisheries rely on natural fish populations without any human intervention to introduce or enhance fish species.
[6] Das et al. 2018. Open water fisheries of Assam and strategies for its development. Fishing Chimes April and May 2018 (Vol. 38 No. 1 and 2)



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ecosystems, the size and productivity of the beels will continue to decline.

5. Overfishing poses another major threat to fish stocks. The Government of Assam enforces a seasonal fishing ban to protect breeding grounds and improve production, but enforcement is weak. Contributing factors include limited income alternatives, high demand for fish protein, market pressures, inadequate awareness, reduced fishing areas, and a complex leasing system, all of which undermine sustainable inland fisheries.

6. Moreover, the diversity of indigenous fish species in many beels is increasingly under threat from invasive species originating from nearby aquaculture ponds, especially during flood periods. These invasive species multiply rapidly, aggressively compete with and prey upon native fish, spread diseases, and disrupt the genetic integrity of indigenous populations. Although local beel communities understand the critical need for ecological rehabilitation, their efforts are often constrained by limited knowledge of effective management practices and regulatory frameworks. Consequently, establishing a unified framework that consolidates existing departmental regulations and policies is essential. This integrated approach would significantly empower local communities to undertake sustainable, community-driven management of beel ecosystems effectively.

7. Furthermore, climate-related risks are exacerbating the challenges already confronting Assam's fisheries sector. With 23 out of its 27 districts classified among India's most climate-vulnerable regions, Assam faces severe and recurrent impacts from climate change. Fish farming, in particular, is adversely affected by rising temperatures, altered rainfall patterns, and an increase in extreme weather events. These conditions contribute to increased instances of fish escape, higher fish mortality rates, and substantial disruptions to routine fishing activities. Consequently, there is an urgent need to introduce and promote climate-resilient fishing methods and technologies to reduce vulnerability and safeguard the sustainability of the fisheries sector.

8. Recognizing these pressing issues, the Government of Assam has proactively sought assistance from the Asian Development Bank (ADB) through the Sustainable Wetland and Integrated Fisheries Transformation Project (SWIFT). Administered by the Department of Fisheries, SWIFT is strategically designed to boost fish production and enhance fisheries' sustainability in Assam. Given that fisheries underpin the livelihoods of most rural communities in the state, the project aims to comprehensively address critical threats such as habitat degradation, invasive species encroachment, and climate-induced vulnerabilities. By doing so, SWIFT endeavors to improve local fish availability, bolster food security, and ensure the sustained economic well-being of Assam's rural populations, particularly those living in highly vulnerable regions.

## 1.2 Description of the Project and Project Outputs

9. The proposed project aims to cover 102 beels (wetlands) located across 23 districts, organized into 4 clusters representing all the geographical regions of Assam. This initiative aims to enhance the sustainable management and utilization of these wetlands for fisheries, benefiting local communities and promoting biodiversity conservation. It is designed to bring positive changes to both the people and the local environment. The Department of Fisheries, Government of Assam, will oversee the conservation and management of these 102 beels over a total project period of 7 years, including operation and maintenance.

10. During the project readiness phase, 74 beels, were selected for project processing and due diligence. These beels are undergoing interventions such as desilting, de-weeding, construction of earthen mounds, cleaning of inlets, embankment construction, installation of Hume pipes, composting, and the development of fish-rearing ponds. The project ensures sustainability by enhancing the



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governance structure of the beels, which includes updating acts, rules, and regulations, and establishing community-based beel management committees.

11. The project focuses on building the capacity of local communities and stakeholders in sustainable fisheries management, cooperative management, and monitoring of beel health enhancement. It promotes sustainable fisheries practices that prevent overfishing and ensure the long-term health of the beels, while also adopting wetland restoration techniques that are widely recognized as environmentally friendly measures supporting wetland habitat conservation.

12. Social sustainability is achieved through active community participation and an equitable benefit-sharing scheme, transitioning from the current system of leasing to selected individuals. The project empowers women and marginalized groups by providing access to resources, training, decision-making, and income-generating economic activities. Additionally, the project's income diversification measures aim to reduce dependence on a single source of income, thereby increasing resilience to market fluctuations and climate risks.

13. Proposed outputs of the Project are i) Output 1: Institutional capacity and governance for sustainable beel ecosystem and fisheries management strengthened; (ii) Output 2: Community-based fisheries business developed and beel community income diversified; and (iii) Output 3: Beel conservation and restoration planned and managed.

14. These project goals align with several Sustainable Development Goals (SDGs): (i) SDG 1.4: ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources (ii) SDG 2.3: By 2030, double the agricultural productivity and incomes of small-scale food producers (iii) SDG 5.5: Ensure women's full and effective participation and equal opportunities for leadership at all levels (iv) SDG 12.2: achieve the sustainable management and efficient use of natural resources (v) SDG 13.a: Implement the commitment undertaken by developed-country parties.

15. Furthermore, project also responds to all three pillars of ADB's country partnership strategy for India, 2023–2027: pillar 1 (accelerate structural transformation and job creation) by supporting fisher cooperatives' infrastructure to link to value chains and strengthening their credit enhancement; pillar 2 (promote climate-resilient green growth) by providing nature-based solutions for climate-resilient beel restoration; and pillar 3 (deepen social and economic inclusiveness) by increasing fisheries productivity and developing alternative income opportunities for beel-based communities' self-help groups.[12]

16. The project also aligns with the intended impact of enhancing the income of small-scale food producers in Assam, as outlined in the Assam Vision 2030 for the Fisheries Sector. Each of these outputs is designed to support this broader vision and is described in more detail below.

17. **Output 1: Institutional capacity and regulatory framework for sustainable beel ecosystem and fisheries management strengthened**. The output aims to reform the current government system on beel management, particularly the leasing system. It will support the following activities: (i) updating relevant beel management and fishery acts, regulations, and rules for community-based management, and preparing public awareness-raising materials; (ii) preparing rules or guidelines for community-based beel management system, considering various hydrology of wetlands, channels, agroecological situations, and providing necessary training on the subject; (iii) preparing a sustainable operational model as a project exit plan; (iv) capacity building and training of the Department of Fisheries (DoF) staff and other allied public institutions, including the state's wetland authority, in latest fisheries stocking and conservation techniques, community-based beel management best practices, and use of digital technologies; (v) supporting research and development in beel management and fisheries, including carbon sequestration benefits from beel management,



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climate change impacts and adaptation measures, seed production and breeding, and ex-situ conservation of endangered species; (vi) strengthening beel community-based institutions; and (vii) operating beel management monitoring system through the development of project information system and beel fisheries knowledge platform, complementing the state wetland authority's wetland notification process.

18. **Output 2: Community-based fisheries business developed and beel community income diversified.** The project will ensure the sustainability of beel community-based institutions by enhancing their financial viability and strengthening women's and marginalized groups' participation in economic activities. The project will: (i) support the development or strengthening of fisheries cooperatives; (ii) conduct capacity building for these cooperatives through training in organizational and financial management, as well as branding, marketing and processing along the value chain; (ii) provide public sector support for the development of community-based fisheries value chain infrastructure, including fish landing sites and local aggregation points/centres; (iii) promote private sector led fisheries commercialization by creating matching grant facilities for hatchery, feed mill, primary processing and other value addition initiatives; and (iv) support other income generation activities for self-help groups through strengthening or revitalizing self-help groups based on their needs assessment.

19. **Output 3: Beel conservation and restoration planned and managed.** The project addresses habitat loss caused by the loss of connectivity with the adjacent river and decreasing water depth, and macrophyte growth that hinders fisheries productivity in beels. The beel restoration approaches will focus on: (i) beel demarcation; (ii) beel rejuvenation, such as de-weeding and desilting; and (iii) beel's water inflow and outflow control improvement, including desilting, constructing embarkments, installing silt traps, building water retaining structures and peripheral bunds, and installing biofilters.

20. The project also contributes to climate change mitigation by enhancing carbon sequestration through the improved function of beel or wetland ecosystems. It addresses soil erosion and sediment runoff into wetlands, which can release stored carbon, improves hydrological regimes to ensure wetlands maintain their water levels for carbon sequestration, and enforces community-based management to reduce land use changes that alter wetland ecosystems. Beel restoration and community-based management are also important climate change adaptation approaches that will (i) restore wetland functions as natural buffers against the impacts of floods; (ii) enhance water supply stability; and (iii) provide alternative income generation opportunities, reducing vulnerability to climate variability.

### 1.3 Project Location and Beels Covered

21. The project is located in Assam, India, which is situated in the easternmost part of the country, between latitudes 24°07' N to 28°00' N and longitudes 89°42' E to 96°02' E. Assam covers a geographical area of 78,438 square kilometers, constituting 2.39% of India's total area. The state is characterized by a landscape of mountains, valleys, and a complex river system. It shares its borders with Bhutan to the north; Nagaland, and Manipur to the east; Meghalaya, Tripura, Mizoram, and Bangladesh to the south; and West Bengal to the west.

22. The project aims to cover 102 beels (wetlands), encompassing over 4,000 hectares across 23 districts, divided into 4 clusters representing all the geographical areas of Assam. During the project's readiness, 74 beels, and located in 23 districts, were selected. The remaining beels and other infrastructures (i.e., on-beel and off-beel, eco-tourism and government buildings), which will be covered during project implementation, have not yet been assessed. Their environmental assessment will be conducted in accordance with the provisions outlined in the EMP.



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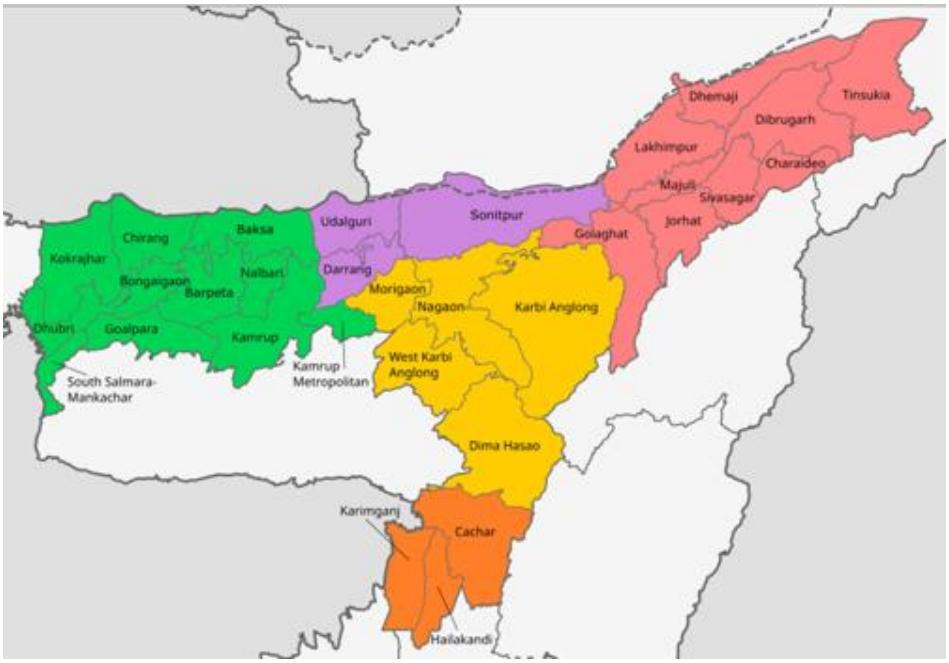



**Figure 0-1. Location Map of Districts Covered under Sustainable Wetland and Inland Fisheries Transformation (SWIFT).**

23. The location map of the subproject district is shown in Figure 1-1 while list of beels covered under the processing stage of the Project is summarized in Table 1-1.



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| Table 0-1. List of Beels Covered under the Processing Stage of the SWIFT Project | | | | | | |
|---|---|---|---|---|---|---|
| **Sl. No.** | **Cluster** | **Name of Beel** | **District** | **Latitude** | **Longitude** | **Beel Area (Ha)** |
| 1. | Central Assam | Bechamari Beel | Morigaon | 26°10'13.01"N | 92°16'17.82"E | 14.55 |
| 2. | | Morakollong Beel | Morigaon | 26°15'3.53"N | 92°24'11.64"E | 13.55 |
| 3. | | Oram Beel | Morigaon | 26°6'28.40"N | 92°15'43.41"E | 16.2 |
| 4. | | Tihulia Beel | Morigaon | 26°9'49.89"N | 92°18'2.06"E | 27.14 |
| 5. | | Solmari Beel | Morigaon | 26°13′43.16″N | 92°22′45.51″E | 34.64 |
| 6. | | Chamkata Beel | Morigaon | 26°18'56.85"N | 92°15'27.16"E | 9.38 |
| 7. | | Bhagamur | Nagaon | 26°25′50.49″N | 92°49′50.74″E | 11.32 |
| 8. | | Borthol Beel | Nagaon | 26°16'39.19"N | 92°36'57.36"E | 19.37 |
| 9. | | Potali Bhatia Khali | Nagaon | 26°30'20.83"N | 92°53'8.62"E | 74 |
| 10. | | Shantijan Beel | Nagaon | 26°24'48.54"N | 92°33'18.37"E | 12.8 |
| 11. | | Bhatiakhali Beel | Nagaon | 26°29'50.59"N | 92°51'33.60"E | 37.29 |
| 12. | | Chola Mikirbheta Beel | Nagaon | 26°14'13.59"N | 92°28'4.45"E | 13.16 |
| 13. | | Na-Kalong Beel | Nagaon | 26°12'18.07"N | 92°31'58.70"E | 10.36 |
| 14. | | Sara Beel | Nagaon | 26°15'36.06"N | 92°33'54.52"E | 12.13 |
| 15. | | Pitkati | Kamrup | 26°14'52.88"N | 91°32'7.86"E | 12.62 |
| 16. | Lower Assam | Borjong | Goalpara | 25°59'54.91"N | 90°26'23.78"E | 22.4 |
| 17. | | Chalantapara Haripani Beel | Bongaigaon | 26°15'51.51"N | 90°35'40.66"E | 11 |
| 18. | | Mariampur Eco Tourism Lake | Goalpara | 25°54'31.10"N | 90°58'54.91"E | 10 |
| 19. | | Deepor Pitoni | Bongaigaon | 26°14'45.08"N | 90°34'8.19"E | 23.7 |
| 20. | | Airmara Beel | Dhubri | 26°8'35.46"N | 89°47'28.51"E | 23.7 |
| 21. | | Gandhi Beel | Barpeta | 26°17'7.01"N | 91°0'58.84"E | 11 |
| 22. | | Kutnikuchi Beel | Nalbari | 26°19'43.42"N | 91°21'37.35"E | 28.94 |
| 23. | | Udmari Chora Beel | Dhubri | 26°16'57.81"N | 90°14'28.58"E | 7.74 |
| 24. | | Kaplimara Beel | Bajali | 26°33'43.19"N | 91°13'39.70"E | 15.6 |
| 25. | | Borai Pani Khowa Beel | Bongaigaon | 26°18'3.60"N | 90°36'56.58"E | 11.9 |
| 26 | | Nayachara Beel | Bongaigaon | 26°29'17.76"N | 90°37'43.36"E | 25.97 |
| 27 | | Khoribari Borbilla Beel | Bongaigaon | 27°15'52.92"N | 95°12'24.10"E | 10 |
| 28 | | Ghritingerkuti Beel | Dhubri | 26°19'39.26"N | 89°49'43.81"E | 16.68 |
| 29. | | Goka Beel | Dhubri | 26°11'4.67"N | 89°46'11.28"E | 6.05 |
| 30. | | Singra Beel | Dhubri | 26°18'50.23"N | 89°52'20.41"E | 6.07 |
| 31. | | Singimari Beel | Goalpara | 26°5'23.64"N | 90°31'58.91"E | 14.07 |
| 32. | | AmritpurSewashram Beel | Kokrajhar | 26°27'12.46"N | 90°1'15.42"E | 18.99 |
| 33. | | Bamunkura Beel | Kokrajhar | 26°26'44.74"N | 90°1'17.76"E | 11.1 |
| 34. | | Barkhang Beel | Kokrajhar | 26°24'26.97"N | 90°0'5.13"E | 14 |
| 35. | | Halowadal Beel | Kokrajhar | 26°26'32.10"N | 90°19'12.65"E | 6.66 |
| 36. | | Inti Beel | Kokrajhar | 26°30'43.23"N | 90°10'9.86"E | 4 |
| 37. | | Mugdi Beel | Nalbarii | 26°19'14.19"N | 91°16'55.78"E | 29.2 |
| 38. | South Assam | Bor Beel | Karimganj | 24°35'44.81"N | 92°18'44.54"E | 42.44 |
| 39. | North Assam | Gomiri Beel | Biswanath | 26°47'38.55"N | 93°27'47.67"E | 10 |
| 40. | | Koupati Beel | Darrang | 26°36'36.04"N | 92°16'54.33"E | 11 |



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| Table 0-1. List of Beels Covered under the Processing Stage of the SWIFT Project | | | | | | |
|---|---|---|---|---|---|---|
| Sl. No. | Cluster | Name of Beel | District | Latitude | Longitude | Beel Area (Ha) |
| 41. | | Mer Beel | Lakhimpur | 27°16'10.73"N | 94°23'12.88"E | 27.27 |
| 42. | | Bhulkaguri Beel | Dhemaji | 27°26'10.31"N | 94°42'44.49"E | 11 |
| 43. | | Guttung Bhattali Beel | Lakhimpur | 27°11′43.96″N | 94°19′57.35″E | 17.85 |
| 44. | | Burisuti Rikseng Beel | Dhemaji | 27°43'16.77"N | 95°7'44.14"E | 6.1 |
| 45. | | Bera Na Beel | Dhemaji | 27°45'27.55"N | 95°15'21.91"E | 5 |
| 46. | | Borakata Beel | Sonitpur | 26°39'2.51"N | 92°40'49.75"E | 18.06 |
| 47. | | Dighali Beel | Sonitpur | 26°40'20.74"N | 92°36'56.07"E | 25.69 |
| 48. | Upper Assam | Mornoi (Masmaroni) Beel | Sivasagar | 26°54'10.30"N | 94°44'53.11"E | 8.37 |
| 49. | | Gabhoru Beel | Sivasagar | 26°49'33.61"N | 94°43'10.69"E | 9 |
| 50. | | Tinsukia Beel | Sivasagar | 27°0'27.54"N | 94°29'11.67"E | 34.46 |
| 51. | | Kurekhona Beel | Sivasagar | 27°2'27.10"N | 94°40'39.27"E | 5.35 |
| 52. | | Hatihuria Beel | Sivasagar | 26°56'52.96"N | 94°42'54.78"E | 10.28 |
| 53. | | Panikheti Beel | Sivasagar | 27°2'27.78"N | 94°50'16.05"E | 6 |
| 54. | | Gudha Beel | Sivasagar | 27°8'59.04"N | 94°43'52.19"E | 16.5 |
| 55. | | Param Beel | Majuli | 26°58′12.48″N | 94°17′29.89″E | 9.2 |
| 56. | | Tatinga Mekheli Barbeel | Majuli | 26°57'28.13"N | 94°15'57.93"E | 13 |
| 57. | | Sawguri Beel | Jorhat | 26°45'21.80"N | 94°0'49.74"E | 10 |
| 58. | | Moridesoi Beel | Jorhat | 26°48'10.41"N | 94°4'33.50"E | 8.43 |
| 59. | | Amguri Beel | Jorhat | 26°48'5.84"N | 94°3'24.44"E | 15 |
| 60. | | Jengoni Beel | Jorhat | 26°47'40.42"N | 94°2'21.62"E | 18 |
| 61. | | Charigaon Beel | Jorhat | 26°46'29.88"N | 94°1'34.02"E | 21 |
| 62. | | 1 No. Hatibandha Dihing Arasuti Beel | Dibrugarh | 27°20'59.77"N | 95°8'29.71"E | 29.08 |
| 63. | | Bamuni Beel | Dibrugarh | 27°19'21.82"N | 95°9'13.42"E | 10 |
| 64. | | Kutuha Beel | Dibrugarh | 27°18′51.56″N | 94°52′32.10″E | 17 |
| 65. | | Mer Beel | Dibrugarh | 27°19'5.46"N | 95°12'40.17"E | 75.28 |
| 66. | | Mirika Beel | Dibrugarh | 27°19'3.65"N | 95°9'39.18"E | 20 |
| 67. | | Natun Bolai Arasuti Beel | Dibrugarh | 27°19′48.46″N | 94°54′34.32″E | 24.13 |
| 68. | | Burhi Beel | Tinsukia | 27°24'44.62"N | 95°49'30.12"E | 27.13 |
| 69. | | Toklong Beel | Tinsukia | 27°19'59.19"N | 95°46'54.76"E | 25 |
| 70. | | Pera Beel | Tinsukia | 27°52'34.62"N | 95°46'54.50"E | 11 |
| 71. | | Sagarbera Beel | Charaideo | 27°2'10.56"N | 94°51'0.76"E | 13.33 |
| 72. | | Borpothorua Beel | Golaghat | 26°24'39.88"N | 93°57'39.31"E | 20.15 |
| 73. | | Borgoria Beel | Golaghat | 26°35'29.38"N | 93°47'55.06"E | 30 |
| 74. | | Kordoiguri Beel | Golaghat | 26°33'56.29"N | 93°50'59.68"E | 25 |



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## 1.4 Purpose of the Initial Environment Examination Report

24. This Initial Environmental Examination (IEE) has been updated in accordance with the ADB's Safeguard Policy Statement (SPS) 2009 requirements for an environment Category B project. The primary purpose of the IEE is to assess and describe the potential impacts of the proposed project on the existing environmental elements. Specifically, the study aims to predict the likely impacts of subproject activities and recommend mitigation and abatement measures for any impacts during the pre-construction, construction, and operational stages that are considered potentially adverse to the surrounding environment.

25. For, 74 beels, totaling 1328.38 hectares, were selected for project processing and due diligence. These beels are undergoing similar interventions, such as desilting, de-weeding, construction of earthen mounds, cleaning of inlets, embankment construction, installation of Hume pipes, composting, and the development of fish-rearing ponds. Given the uniform nature of the interventions, the impact assessment was initially conducted based on a detailed evaluation of priority beels spread across 23 districts in all 5 clusters. The findings from these assessments were extrapolated to estimate potential impacts for the remaining beels. This approach allows the assessment of 74 beels to be considered sufficient for identifying appropriate mitigation and monitoring measures provided that all selected sites meet the established site selection eligibility criteria. The IEE will be updated accordingly to include specific details of each beel once their locations are confirmed, detailed assessments are carried out, and meaningful consultations are completed. A dedicated site selection criteria and environmental due diligence procedure is included in the EMP.

26. The IEE serves as the basis for the environmental assessment of the proposed subprojects and provide guidelines for on-site environmental management activities, ensuring compliance with National and State Government regulations regarding environmental management.

27. This IEE report has been prepared based on the subproject designs and specifications provided in the Detailed Project Reports (DPRs) and field investigations. Environmental screening, scoping, baseline setting, and stakeholder consultations were also carried out in accordance with ADB's SPS 2009 requirements. The report includes an Environmental Management Plan (EMP) based on the identified potential impacts. The EMP addresses these potential impacts and risks, with corresponding mitigation measures designed to minimize, reduce, and mitigate them, to be implemented throughout the entire project cycle.

28. This IEE does not yet provide site-specific assessment for other or future developments or activities at the subproject locations. To guide this future process, a site selection criteria and environmental due diligence procedure has been prepared to ensure all the remaining subprojects comply with environmental safeguards requirements under ADB SPS, 2009. This guidance is reflected in the EMP. The IEE report should be updated and finalized before bidding documents are issued plus during or before construction if there is a change in the scope, design, or location of subproject activities or construction works.

## 1.5 Study Area

29. The study area related to IEE of the subproject comprised the following areas and features:

a. **Core area or primary impact area** where the proposed subproject components are to be implemented includes the beel submergence area, fringe and bund area, inlets and outlets (if any), access road, site for dumping and disposal of weeds and excavated silt, composting site, construction material storage area, contractor's camp (if any), and area where fisheries infrastructure are planned.



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b. **Buffer or secondary impact area** would be the nearby catchment and village area, where impacts (positive or negative) are anticipated during construction and operational phase of the project. For the analysis of the impact on biodiversity, the scope extends well beyond the vicinity of the beel and covers the subproject area up to an extent of 0.5 km.

## 1.6 Approach and Methodology

30. This IEE report has been prepared on the information provided in SWIFT DPR, beel specific information provided by DoF, field investigations and stakeholder consultations to meet the requirements for environmental assessment process and documentation as per ADB SPS 2009. The IEE commenced with reconnaissance survey and review of legal requirements for the subproject. In the next step, technical details were collected and compiled followed by a discussion with the implementing agency to reconfirm the technical details. The following paragraphs provide a concise description of steps adopted during IEE preparation:

- **Reconnaissance Survey and Initial Consultations**: Reconnaissance survey and initial consultations were carried out with the Project proponent and project affected and beneficiaries. It helped to identify data gaps, decide valued environment components, key stakeholders and key informants who can further substantiate the collected information. Reconnaissance survey and initial consultations also recognized the need to conduct site specific survey required for each beel that to be covered under the SWIFT.

- **Review of ADB Safeguard Policy and Govt. of India and State Regulations:** During preparation of IEE, ADB's safeguard policies, International, National and State polices and regulations were taken into consideration to assess regulatory requirements for the proposed schemes.

- **Primary and Secondary Data Collection**: Available information and data (quantitative and qualitative) regarding the proposed project beels have been collected with the help of Dept. of Fishereies, Govt. of Assam and other stakeholders including village community. Primary and secondary data about physical environment including ambient air quality, water quality, noise etc. were collected to establish credible baseline. Details about flora and fauna in and around the beel were also collected with the help of MoEFCC recognized laboratory hired for water and biodiversity assessment of priority beels. Secondary data sources which were explored during the preparation of IEE include previous environmental assessment reports, published government reports, government websites, recognized institutions and relevant government departments (forests and wildlife, pollution control board, Indian Meteorological Department (IMD), etc.) The baseline assessment also builds on the catchment area studies using satellite imagery, contour maps, and studies conducted during preparation of detailed project report and site survey carried out by DoF. Data collected, sources, and application are summarized in Table 1-2.

**Table 0-2: Information Collected and Source of Data**

| Data and Information Collected | Data Source | Application of collected data |
|---|---|---|
| Project design details and project features | Detailed project report (DPR) prepared by DoF and their design consultant | Information used to describe project description and features, to identify environmental footprints of project activities, to carryout alternative analysis etc. |



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| Data and Information Collected | Data Source | Application of collected data |
|---|---|---|
| Environmental baseline data for air, water, noise etc. | Secondary data collected under National Ambient Air and Water Quality Monitoring carried by Central Pollution Control Board<br>Primary data generated by MoEFCC recognized Laboratory<br>, Research articles and reports | Data was used to establish credible baseline and assessment of probable impacts on environment components at the subproject sites. |
| Details/description of natural and physical environment | Assam State and District profile information, Govt. of Assam (GoA)<br>Report of Aquifer Mapping and Management of Groundwater Resources of CGWB GoI (2019),<br>Research articles and Govt. reports<br>Subproject DPRs | Data was used to establish credible baseline and assessment of probable impacts on environment components. |
| Details/description of biological environment | State biodiversity information and reports published by Forest Department, Govt. of Assam<br>Data available on Wildlife institute of India (WII) Environmental Information Awareness Capacity Building and Livelihood Programme (EIACP) portal[7]<br>Reports published by Assam State Biodiversity Board<br>Biodiversity Risk Screening Report by using Integrated Biodiversity Assessment Tool (IBAT)<br>Data collected by DoF subject area experts and Village community for native flora and fauna | Project description, impact assessment and mitigative actions, alternative analysis, and economic assessment. |
| Policy and regulatory requirements | ADB SPS 2009<br>National Environmental Acts, Rules and Regulations compiled from MoEFCC, GoI website, Forest Department, Govt. of Assam<br>Published reports | To describe regulatory and policy requirements and to describe administrative framework for safeguard implementation |
| Details/description of Socio-cultural Environment | Census Report<br>District socio- economic profile available on website and previous reports etc.<br>Socio-economic data provided in the subproject DPRs<br>Primary discussion with community | To establish socio-economic profile of subproject area and to assess subproject impacts |

Note: Appropriate referencing of information and data sources are given at relevant pages of chapters

- **Other Tools and Studies**: Biodiversity risk screening was carried out with the help of data provided on iNaturalist website for the State of Assam[8] and data collected by MoEFCC recognized Laboratory and DoF during environmental due diligence: The International Union for Conservation of Nature (IUCN) Red List of Threatened Species, the Database on Protected Areas, and the World Database of Key Biodiversity Areas. Remote sensing and geographic information system (GIS) tools were used to create of beel pondage area and for the assessment of land use/land cover in and around the beel locations.

[7] EIACP Programme Centre “Wildlife and Protected Areas” | Wildlife Institute of India, an Autonomous Institute of MoEF, Govt. of India (wii.gov.in)

[8] With the intention of connecting people with nature, iNaturalist defines itself as "an online social network of people sharing biodiversity information to help each other learn about nature." iNaturalist is a platform for science and conservation initiatives, providing valuable open data to land managers, research projects, other organizations, and the general public, despite not being a science project in and of itself.



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- **Public Consultations:** Meaningful consultations were organized with local people/beneficiary population and concerned stakeholder departments to know the level of project acceptability, understand their concerns, apprehensions, and overall opinion. Information was gathered about existing baseline environmental condition like ambient levels and water resources, flooding, flora and fauna, wildlife movement, socio-economic standing of local people, impact due to loss of land if any, other assets, and common property resources, accident risk during construction and operation stage, perceived benefits and losses, etc. Information thus gathered was integrated in project design, mitigation measures, and environmental management.

- **Assessment of Potential Impacts:** Initially rapid environmental assessment (REA) checklist has been for screening of environmental impacts of subproject activities to determine the project categorization in view ADB's SPS 2009. Screening and categorization of environmental impacts is carried out based on the likelihood, magnitude and duration. Adverse environmental impacts were identified in relation to pre-construction, construction and operation of the subprojects through environmental risks analysis (see Annexure A1). Environmental risk analysis for the proposed subprojects was carried out using a simple matrix method. This method evaluates two key factors: (i) how likely a risk event is to occur (probability) and (ii) the severity of its impact if it happens (consequence). The analysis involved reviewing project documents, visiting the sites, and engaging with stakeholders. It also considered activities during pre-construction, construction, and post-construction phases to identify potential risks. The matrix helped categorize risks, making it easier to identify significant risks and plan appropriate mitigation measures for the project.
- **Preparation of Environment Management Plan (EMP)**: The EMPs are formulated to avoid, reduce, mitigate, or compensate for adverse environmental impacts/risks and propose enhancement measures. These include: (i) mitigation of potentially adverse impacts; (i) monitoring of impacts and mitigation measures during project implementation and operation; (ii) institutional capacity building and training; (iii) compliance to statutory requirements; and (iv) integration of EMP with subproject planning, design, construction and operation.

### 1.7 Structure of the Report

31. In line with ADB's SPS 2009, this IEE report has been described into ten chapters excluding the executive summary as described below:

- Executive Summary – It summarizes the overall findings of associated environmental impacts and mitigation measures due to proposed components under the Project.
- Chapter I - *Introductio*n: This section describes the background information about the Project and IEE study.
- Chapter II - *Policy, Legal, and Administrative Frameworks*: This section summarizes the National and Provincial legislation and administrative framework including ADB SPS 2009 and international conventions and treaties that guided the environmental assessment.
- Chapter III - *Project Description*: Presents the key features and components of the Project and subprojects beels.
- Chapter IV - *Description of the Environment*: This section discusses the relevant physical, biological, and socioeconomic features that may be affected by the proposed subprojects.
- Chapter V - *Anticipated Environmental Impacts and Mitigation Measures*: Presents the environmental assessment of likely potential and adverse impacts attributed to the proposed subproject and concomitant mitigation measures.



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- Chapter VI – *Analysis of Alternatives*: Covers analysis of alternatives considered to minimize the overall impacts of the proposed subproject and suggest most appropriate alternatives based of the detailed analysis of impacts and risks associated with each alternative.
- Chapter VII - *Information Disclosure, Consultation, and Participation*: Describes the consultation process undertaken during the environmental assessment and its results, their consideration in the subproject design, and manner of compliance to the ADB's Public Communication Policy 2011.
- Chapter VIII - *Grievance Redress Mechanism*: This section describes the formal and informal redress procedures for registering, resolving, and reporting complaints by an affected party/person.
- Chapter IX -*Environmental Management Plan*: This section discusses the action plans to avoid, reduce, mitigate or compensate potential and adverse impacts and reinforces beneficial impacts. EMP has been divided into three sub-sections; mitigation, monitoring, and implementation arrangements
- Chapter X- *Conclusion and Recommendation*: This section discusses the potential for further detailed environmental studies/assessments and highlights key findings and recommendations to be implemented by the executing and impelemnting agencies.



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# 2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

32. As outlined in the Safeguard Policy Statement (SPS) 2009, the ADB mandates adherence to its environmental and social safeguard policy requirements. This policy framework establishes comprehensive guidelines to ensure that all projects financed by the ADB conform to environmental and social protection standards. Key components of the SPS 2009 include stakeholder engagement procedures, thorough environmental assessments, and the implementation of mitigation measures to minimize potential negative effects on impacted communities and ecological systems. By recommending a hierarchy of actions, the SPS 2009 framework aims to maintain social and environmental sustainability. These actions include avoiding adverse impacts wherever possible, minimizing and mitigating negative effects when avoidance is not practical, and enhancing positive social and environmental outcomes throughout the project lifecycle.

33. In parallel, the Government of India has a strong institutional and legal framework in place to address a range of environmental issues, such as soil integrity, water resources, air quality, natural resource management, and the preservation of terrestrial and aquatic ecosystems as well as sensitive habitats. This framework encompasses several laws and regulations, including the Air (Prevention and Control of Pollution) Act of 1981, the Water (Prevention and Control of Pollution) Act of 1974, the Forest (Conservation) Act of 1980, and the Environment (Protection) Act of 1986. These legislative instruments serve as a robust foundation for environmental governance, ensuring that development activities are conducted in a manner that protects the environment and promotes sustainable development.

34. As an active participant in global environmental affairs, India has ratified numerous international agreements, conventions, and guidelines pertaining to social and environmental protection. These include commitments under the Ramsar Convention on Wetlands, the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC), and several other international agreements that address critical issues such as biodiversity conservation, climate change mitigation, and the sustainable management of natural resources. By upholding these international agreements, India demonstrates its commitment to maintaining global standards for sustainable development and environmental preservation.

## 2.1. ADB Safeguard Policy Statement, 2009

35. Ensure that projects funded by ADB are environmentally sound and designed to comply with applicable regulatory requirements. Projects should not pose significant environmental, health, or safety risks. Regarding environmental management, the SPS 2009 is supported by the ADB Operations Manual, Bank Policy (OM Section F1/OP, 2010).[9] ADB SPS requires that during the design, construction and operation of the Project necessary compliance to all applicable laws and international conventions/treaties along with pollution prevention and control technologies and practices consistent with international good practice, are ensured.

### 2.1.1. Screening and Project Categorization as per ADB's SPS 2009

36. ADB will carry out project screening and categorization at the earliest stage of project, screening and categorization is undertaken to (i) reflect the significance of potential impacts or risks that a project might present; (ii) identify the level of assessment and institutional resources required for the safeguard measures; and (iii) determine disclosure requirements.

[9] https://www.adb.org/sites/default/files/institutional-document/31483/om-f1-20131001.pdf

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37. ADB uses a classification system to reflect the significance of a project's potential environmental impacts. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the Project's area of influence. Each proposed project is scrutinized as to its type, location, scale, and sensitivity and the magnitude of its potential environmental impacts. Projects are assigned to one of the following four categories:

(i) **Category A**: A proposed project is classified as Category A if it is likely to cause significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may extend beyond the sites or facilities involved in physical works. An environmental impact assessment (EIA) is required.

(ii) **Category B**: A proposed project is classified as Category B if its potential adverse environmental impacts are less severe than those of Category A projects. These impacts are site-specific, few (if any) are irreversible, and in most cases, mitigation measures can be more readily designed than for Category A projects. An IEE is required.

(iii) **Category C**: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required, although environmental implications must still be reviewed.

(iv) **Category FI**: Projects are classified as Category FI if they involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system unless all projects result in insignificant impacts.

38. The SPS 2009 aims to ensure that ADB-funded projects are environmentally sound and sustainable, while promoting the integration of environmental considerations into the project decision-making process. The environmental safeguard requirements are activated by the potential environmental impacts and risks associated with a project. Consequently, all ADB activities must undergo early screening to determine the appropriate level and type of environmental assessment and studies required to identify potential impacts and suitable mitigation measures

39. The screening and categorization results indicate that the project is unlikely to cause significant adverse impacts and is classified as a "Category B" project. Most environmental impacts and risks are associated with civil works and are expected to be minor to moderate, short-term, and localized. These impacts will be avoided through adherence to national and international design standards and construction planning, minimized to acceptable levels, or mitigated through appropriate measures during the design, construction, and operation phases. Further, the environmental monitoring plan will allow for course corrections to address any residual impacts during construction or operation stages. In line with these findings, this IEE report has been prepared in compliance with the requirements of ADB's Safeguard Policy Statement (SPS) 2009 for a Category B project.

### 2.1.2. Environmental Management Plan

Environmental Management Plan (EMP) has been developed to address the environmental impacts and risks identified during the environmental assessment. The scope and complexity of the EMP, as well as the prioritization of measures and actions, are tailored to the specific impacts and risks associated with the project (refer to Chapter 9 for details). The EMP outlines proposed mitigation measures, environmental monitoring and reporting requirements, emergency response procedures, institutional and organizational arrangements, capacity-building and training programs, an implementation schedule, cost estimates, and performance indicators. These components are designed to ensure effective environmental management throughout the project's lifecycle. This approach aligns with sustainability principles, promoting environmental resilience and compliance with regulatory frameworks.



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### 2.1.3. Associated facility

40. As per ADB's SPS 2009, the associated facility that are not funded as part of the project (funding may be provided separately by the borrower/client or by third parties), and whose viability and existence depend exclusively on the project and whose goods or services are essential for successful operation of the project. However, proposed subprojects do not involve any associated facility.

### 2.1.4. Environmental Audit of Existing Facilities

41. ADB's SPS 2009 requires to perform an environmental audit, if a subproject involves facilities and/or business activities that already exist or are under construction, to determine the existence of any areas where such project may cause or is causing environmental risks or impacts and identify and plan appropriate measures to address outstanding environmental issues. If the project does not foresee any new major expansion, the audit constitutes the environmental assessment for the project. Proposed subprojects do not utilize any existing facilities.

### 2.1.5. Critical Habitat Assessment

42. ADB SPS 2009 prohibited any activities in the critical habitat, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critical endangered species, and (iii) any lesser impacts are mitigated. It is important to note that no national parks or wildlife sanctuaries are located in close proximity to the beels covered under SWIFT. However, two of the subproject beels, Paranm Beel and Tatinga Mekheli Barbeel, situated in Majuli Island which is a KBA and one beel Mariampur Beel is in resrved forest area. Planned project activities related to these beels have been carefully designed to minimize ecological impacts. Critical Habitat Assessment also confirmed that none of the critical habitat criteria or numerical thresholds are triggered by the subprojects. However, as a precautionary measure, a Tortoise and Avi-fauna management Plan has been prepared to ensure that the project does not cause any significant biodiversity impact.

### 2.1.6. Public Disclosure

43. Information disclosure involves providing project-related information to the public, affected communities, and other stakeholders, starting early in the SWIFT Project cycle and continuing throughout its duration. This process aims to foster constructive engagement with affected communities and stakeholders. The IEE report will be made accessible, with a summary translated into the local language for affected people and stakeholders. The following safeguard documents will be available on the ADB website, allowing affected people, stakeholders, and the public to contribute meaningful inputs into the project's design and implementation

- Final and updated IEE;
- Semi-annual environmental monitoring reports submitted during project implementation upon receipt.

44. To ensure transparency and disclosure, executive summaries of the IEE and the EMP will be translated into the local language. Hard copies of these translated documents will be available at the CPIU offices and all active contractor sites. This ensures that project-affected persons and local stakeholders can fully comprehend the identified environmental risks and the proposed mitigation measures, allowing for more informed public participation and feedback throughout the project lifecycle.



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### 2.1.7. Consultation and Participation

45. According to ADB's SPS 2009, meaningful consultation with affected communities is essential to ensure their informed participation. The SWIFT Project has prioritized inclusive consultations, ensuring active participation of women and involving stakeholders such as affected people and relevant nongovernmental organizations early in the preparation of subprojects. The SWIFT Project's consultations emphasized addressing stakeholders' views and concerns, ensuring these are communicated to decision-makers and integrated into project planning and execution. Consultations will also be ongoing throughout the project's implementation to address any emerging environmental concerns. Documentation of the consultation process and its outcomes has been included in the environmental assessment report (refer to Chapter 9 for details), reinforcing transparency and responsiveness to stakeholder input.

### 2.1.8. Grievance Redress Mechanism

46. In line with ADB's SPS 2009, the ARIAS Society, as the executing agency for the SWIFT Project, is required to establish a grievance redress mechanism (GRM) to receive and address concerns, complaints, and grievances from affected individuals regarding subproject performance. This GRM has been tailored to align with the risks and potential adverse impacts associated with the SWIFT Project (refer to Chapter 8 for details), ensuring an efficient and accessible platform for grievance resolution. The GRM will play a key role in maintaining accountability and facilitating community engagement throughout the project's lifecycle.

### 2.1.9. Monitoring and Reporting

47. ARIAS Society will monitor, measure, and document the implementation progress of the EMP for the SWIFT Project. When necessary, PMU under ARIAS Society will identify corrective actions and incorporate them into a corrective action plan. Semi-annual EMRs will be prepared and submitted to ADB, detailing the progress in EMP implementation, compliance issues, and any corrective actions taken from the commencement to the closure of the project. During the operational phase of the project, DoF will continue to submit semi-annual EMRs to ADB until the issuance of the Project Completion Report (PCR).

48. To ensure comprehensive oversight, the project will implement a structured reporting and verification framework. Contractors are required to submit detailed monthly monitoring reports to the CPIU, providing a thorough account of their compliance with established environmental safeguards. To maintain the integrity of these submissions, the CPIU will rigorously verify the reported data through regular site inspections and field audits, ensuring that on-ground activities and mitigation measures align strictly with the documented evidence. All information provided by the contractors will be systematically recorded, and filed to maintain a transparent and accessible project history. This organized database serves as the primary evidence base for the project's broader accountability requirements. Specifically, this data will be synthesized and consolidated by the PMU to prepare the semi-annual EMR.

### 2.1.10. Unanticipated Environmental Impacts

49. If any changes in project design or location are identified during the implementation of the SWIFT Project, the ARIAS Society through its PMU is required to update the IEE report to address any new environmental impacts and corresponding mitigation measures. This update should include a thorough reassessment of potential impacts associated with the design or location modifications, and the EMP should be adjusted accordingly to ensure effective mitigation. If the changes are substantial



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and involve significant new impacts, executing agency may need to conduct a new environmental assessment to comprehensively evaluate these effects. The revised IEE or new assessment, along with the updated EMP, will be submitted to the ADB for review and approval before proceeding with further project activities.

### 2.1.11. Occupational Health and Safety

50. ADB SPS 2009 requires the PMU to ensure that workers[10] are provided with a safe and healthy working environment, taking into account specific risks and hazards in project areas, including physical, chemical, biological, and radiological hazards. PMU and PIU are required to implement measures to prevent accidents, injuries, and diseases associated with or arising from work activities. These measures include: (i) identifying and minimizing potential hazards to workers to the extent reasonably practicable; (ii) implementing preventive and protective actions, including modification, substitution, or elimination of hazardous conditions or substances; (iii) providing appropriate protective equipment and enforcing its use; (iv) training workers and offering incentives to comply with health and safety protocols and use protective equipment; (v) documenting and reporting occupational accidents, diseases, and incidents; and (vi) establishing emergency prevention, preparedness, and response measures to enhance safety and resilience in the work environment.

### 2.1.12. Community Health and Safety

51. ADB SPS 2009 requires the executing and implementing agencies to identify and assess risks to, and potential impacts on, the safety of affected communities during the design, construction, operation, and decommissioning of the subproject, and shall establish preventive measures and plans to address them in a manner commensurate with the identified risks and impacts. The executing agency shall ensure to apply preventive and protective measures for both occupational and community health and safety consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Project Management Unit (PMU) shall also adhere to necessary protocols in response to benefits and opportunities, and implementation issues emerging infectious diseases such as the corona virus disease (COVID-19) consistent with the guidelines of relevant government healthcare agencies and the World Health Organization (WHO).

### 2.1.13. Physical Cultural Resources

52. Executing agency is responsible for siting and designing the subproject to avoid significant damage to physical cultural resources, if any. ADB SPS 2009 requires that such resources likely to be affected by the subproject are identified, and qualified and experienced experts assess the subproject's potential impacts on these resources using field-based surveys as an integral part of the environmental assessment process. When the proposed location of a subproject component is in areas where physical cultural resources are expected to be found as determined during the environmental assessment process, chance finds procedures has been included in the EMP.

### 2.1.14. ADB SPS International Best Practice Requirements

53. ADB's SPS 2009 requires that, during the design, construction, and operation of the project, the executing agency shall apply pollution prevention and control technologies and practices that are

[10] Including non-employee workers engaged by the borrower/client through contractors or other intermediaries to work on project sites or perform work directly related to the project's core functions.



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consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. (IFC's General EHS Guidelines[11] and Sector Specific (Water and Sanitation Guidelines[12]). These standards contain performance levels and measures that are normally acceptable and applicable to projects. These standards contain performance levels and measures that are normally acceptable and applicable to projects. When Government of India regulations differ from these levels and measures, the subproject will achieve whichever is more stringent. If less stringent levels or measures are appropriate given specific project circumstances, the executing agency will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB's SPS 2009.

### 2.1.13. Bidding and Contract Documents

54. This IEE report, which includes the EMP, will be incorporated into the bidding and contract documents for the SWIFT Project and verified by the PMU. The PMU will ensure that these documents contain provisions requiring contractors to comply with all ADB environmental requirements and prepare a construction environmental management plan (CEMP) for PMU review and approval. The CEMP must designate sites for construction work camps, storage areas, hauling roads, laydown areas, and disposal sites for materials such as desilted debris, weeds, solid, and hazardous wastes. It should also include specific mitigation measures outlined in the EMP to minimize environmental impacts, a monitoring program in line with the EMP, and a budget for CEMP implementation. No construction work can commence before CEMP approval, and a copy of both the EMP and the approved CEMP must be kept on-site throughout the construction phase. Any non-compliance or deviation from the conditions set in the EMP and CEMP will be treated as a compliance failure, necessitating immediate corrective action.

### 2.1.14. Conditions for Award of Contract and Commencement of Work

55. ARIAS Society as executing agency and/or PMU for the SWIFT Project must ensure that no works contract under the subproject is awarded until specific environmental safeguards are in place. Firstly, relevant provisions from the EMP must be fully integrated into the contract documents for all works associated with the subproject. This includes detailing the contractor's responsibilities for implementing mitigation measures, environmental monitoring, health and safety requirements, and compliance protocols as outlined in the EMP. These provisions are essential to maintain strict adherence to the environmental management guidelines designed for the SWIFT Project and to ensure that all construction and operational activities are conducted with minimal environmental impact. The PMU will approve the CEMP before any works commence at the construction sites.

56. Secondly, the executing agency and/or PMU must secure all necessary permits and clearances from relevant government agencies before any contract award. This includes obtaining approvals that comply with national environmental regulations, such as clearance from environmental departments, local pollution control boards, or other regulatory authorities as required by law. These approvals are critical to ensuring that the project complies with national environmental laws, such as the Environmental Protection Act, Waste Management Rules, and Water and Air Quality Standards, which regulate activities impacting natural resources, biodiversity, and the overall environment. Only once these requirements are fulfilled can the works contract be awarded, thus ensuring that the SWIFT Project's implementation aligns with both ADB's SPS 2009 and national environmental regulations

[11] World Bank Group, 2007. Environmental, Health and Safety General Guidelines, Washington, DC.
[12] World Bank Group, 2007, Environmental, Health and Safety Guidelines for Water and Sanitation, Washington, DC.



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## 2.2. Regulatory Requirements of the Government of India and Assam State

57. The implementation of subprojects under the SWIFT Project will adhere to the environmental laws and regulations set by the Government of India, the State of Assam, and other applicable legal frameworks. These regulations aim to minimize or mitigate potential environmental impacts from project activities and impose restrictions to ensure environmental protection. It is the responsibility of the project's executing and implementing agencies, including the DoF, to ensure that each subproject complies with the relevant legal requirements, whether international, national, state, or local. Compliance with these environmental regulations and standards is mandatory across all stages of the project lifecycle, including design, construction, operation, and maintenance, ensuring that environmental protection measures are consistently applied.

58. As per the Government of India's EIA Notification of 2006, specific activities and projects are required to undergo an Environmental Assessment to obtain Environmental Clearance (EC) before any construction or land preparation (excluding land acquisition) can commence. This Notification categorizes projects based on their scale and environmental impact, assigning them to either Category A or Category B. The classification determines the level of assessment required and the authority responsible for issuing clearance.

59. Category A projects, typically those with larger-scale impacts, require EC from the central MoEFCC. For these projects, the proponent must submit preliminary project details in a prescribed format with all necessary information. An Expert Appraisal Committee (EAC) of the MoEFCC then prepares detailed Terms of Reference (ToR) for the EIA study. After the EIA study is completed and reviewed by the EAC, the MoEFCC considers the EAC's recommendations and, if deemed appropriate, grants Environmental Clearance.

60. Category B projects require environmental clearance from the State Environment Impact Assessment Authority (SEIAA). The state-level EAC categorizes projects as B1 (requiring an EIA study) or B2 (not requiring an EIA study) and prepares ToR for B1 projects within 60 days. Upon completion of the EIA study and review of the report by the EAC, SEIAA issues Environmental Clearance based on the EAC's recommendations. According to the Notification, any Category B project located within 10 kilometers of protected areas, notified areas, or inter-state/international boundaries will be treated as Category A, requiring clearance from the MoEFCC.

61. In the case of the SWIFT Project, none of the components fall within the scope of the EIA Notification 2006, meaning that an EIA study or environmental clearance is not required. Additionally, the subprojects do not involve forest land diversion, nor are they within 0.5 kilometers of protected areas (e.g., National Parks, Tiger Reserves, or Wildlife Sanctuaries). Therefore, there is no need to obtain clearance from the National Board of Wildlife (NBWL) or the MoEFCC, Government of India.

62. Beyond the EIA Notification 2006, several other acts, rules, policies, and regulations currently govern environmental issues related to infrastructure development in India. These legislations are relevant to the SWIFT Project and are summarized in Table 2-1. Figure 2-1 provides a visual overview of the legislative interface between central and state authorities, illustrating the role of each level of government in enforcing environmental policy and ensuring regulatory compliance throughout the project's implementation.



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**Table 2-1: Applicability of Key National Environmental Legislations**

| S. No. | Legislations | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|---|
| **Environmental Protection Legislations** | | | | | | |
| 1. | National Environment Policy (NEP), 2006 | A comprehensive policy document in India for all environmental conservation programs and legislations by Central, State and Local Government. The dominant theme of this policy is to promote betterment of livelihoods without compromising or degrading the environmental resources. The policy also advocates collaboration method to harness potential resources and strengthen environmental management | Applicable | Project shall adhere to the NEP principle of enhancing and conservation of environmental resources and abatement of pollution | MoEFCC, GOI and Relevant State Govt. Departments | ARIAS Society, Contractor |
| 2. | Environmental (Protection) Act, 1986 and Rules and its amendment till date | To protect and improve overall environment. | Applicable for all the Projects which have environmental impacts associated with its development and operation | Project Implementation Unit/contractor shall fully abide to the Environment Projection Act during planning, construction and operational stages of project. No direct permit is required under this act. However, permit/NOC is required as per various laws and rules framed under the act | MoEFCC, GoI | Contractor and ARIAS Society |
| 3. | EIA Notification 14th Sep 2006 and amendment till date | Requires prior environmental clearance for new, modernization and expansion projects listed in schedule 1 of EIA Notification, 2006 | Not Applicable. None of the components of this subproject falls under the ambit of the notification; no EIA | NA | Expert appraisal committee of MOEFCC and State Environment Impact Assessment Authority (SEIAA) | NA |

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| S. No. | Legislations | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|---|
| | | | study or environmental clearance required. | | | |
| 4. | Air (Prevention and Control of Pollution) Act, 1981 and its amendment till date | An act to prevent and control Air pollution. Establishes standards for air emissions and ambient air quality. Also establishes an institutional structure for preventing and reducing air pollution. Consent for establishment and consent for operation is required when there is impact on air quality. | Applicable. The applicability is due to emission from operation of construction equipment like batching plants and diesel generator (DG) sets. | Consent to Establish (CTE) and Consent to Operate (CTO) during construction phase | Assam State Pollution Control Board | Contractor shall obtain CTE and comply its conditions for setting up each facility, batching plant, DG set as prior to its establishment from SPCB CTO should be taken by contractor for batching plant (if any), before operation and it should be renewed before the expiry of permit. |
| 5. | Water Prevention and Control of Pollution) Act, 1974 and its amendment till date | An act to prevent and control water pollution. Establishes standards for water and effluent quality. Also establishes an institutional structure for preventing and reducing water pollution. Consent for establishment and consent for operation is required when there is impact on water quality. | Applicable. It is applicable for the Projects having potential to generate effluent during any stage of the Project. There is a possibility that effluent may be generated during construction stage from construction camp. | CTE and CTO during construction phase | Assam State Pollution Control Board | Contractor shall obtain CTE and comply its conditions for setting up each facility, batching plant, DG set as prior to its establishment from SPCB CTO should be taken by contractor for batching plant, prior to operation and it should be renewed before the expiry of permit. |
| 6. | Noise Pollution (Regulation and Control Act) 2000 and amendment till date | CPIU and contractor needs to ensure that project activities should not create noise pollution and comply the norms prescribed in the rules during construction and operational stage of project. | Applicable due to generation of noise during construction. | No permits issued under this act. However, noise standards to be comply during construction stage | Assam State Pollution Control Board. | Contractor and ARIAS Society to ensure compliance with ambient noise standards |

| S. No. | Legislations | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|---|
| 7. | Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 | Protection to public against improper handling storage and disposal of hazardous waste. The rules prescribe the management requirement of hazardous wastes from its generation to final disposal. | Applicable. Project may generate hazardous waste (Waste Oil) during construction | Authorization for storage and handling of hazardous waste | Assam State Pollution Control Board | Contractor shall obtain authorization for handling, storage and disposal of hazardous waste (Waste Oil) along with CTE/CTO for air and water act. Also, compliance to the conditions mentioned in authorization should be ensured by contractor/ ARIAS Society |
| 8. | Municipal Solid Waste (Management and Handling) Rules, 2016 | To facilitate and provide methods to manage solid wastes generation in efficient andreusable manner | Applicable. Solid waste generated during the construction phase shall be segregated, transported, recycled and disposed in accordance with the Municipal Solid Waste Management (MSWM) Rules | No permit issued but solid waste generated during the construction phase shall be segregated, transported, recycled and disposed of in accordance with the MSWM Rules | Local administration | Contractor during construction and VEC during operational stage |
| 9. | Construction and Demolition Waste Management Rules, 2016 | To manage the construction and demolition waste | Applicable. Applies to all those wastes resulting from Construction, repair and demolition of any civil structure of individual or organization who generates construction and demolition waste such as building material, rubble, debris etc. | Approval required from local authorities, if waste generation is >20 tons in a day or 300 tons per project in month<br><br>Stage- Construction | Local Municipal Authority<br><br>Segregation, management and disposal of waste as per rules. | Contractor |
| 10. | Plastic waste | To manage the plastic waste | Applicable. | Contractor should ensure that plastic | Local Municipal Authority | Contractor |

| S. No. | Legislations | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|---|
| | Management Rules, 2016 | generated | | waste generation at construction campsites and workers' camps is minimised, those that are generated should be segregated from other types of waste and dispose it in an environmental-friendly manner as directed by the ULB or GP, as appropriate.<br><br>Stage- Construction | Segregation, management and disposal of waste as per rules. | |
| 11. | The National Green Tribunal (NGT) Act, 2010 | NGT provides an effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith. | Applicable. Any person seeking relief and compensation for environmental damage due to proposed subprojects involving subjects in the legislations mentioned in Schedule I of the National Green Tribunal Act, 2010 may approach the Tribunal. NGT has jurisdiction over matters related to Water Act, 1974; Water Cess Act, 1977; Forest (Conservation) Act, 1980; Air Act, 1981; Environment (Protection) Act, 1986; Public Liability Insurance Act, 1991; and Biodiversity Act, 2002. Consequently, | Stakeholders / affected persons may approach NGT to resolve project induced environmental issues in enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith. | NGT | ARIAS Society |

| S. No. | Legislations | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|---|
| | | | no other court will have jurisdiction over the matters related to environment falling under the above referred Acts. Being a dedicated tribunal for environmental matters with the necessary expertise to handle environmental disputes | | | |
| **Wetland, Forest Conservation and Wildlife Protection Legislation** | | | | | | |
| 12. | Wetlands (Conservation and Management) Rules 2017 | Regulatory framework for conservation and management of wetlands in India. The wetland rules are the foundation of the new integrated approach to preserve and develop a system of wetlands conservation in India. | Applicable | Wetland Notification/ Preparation of integrated Management Action Plan | State Wetland Authority/Central Wetland Authority/MoEFCC | ARIAS Society |
| 13. | The Forest (Conservation) Act, 1980 and amendments The Forest (conservation) Rules 1981 and amendments till date | To protect forest by restricting conversion of forested areas into non- forested areas and deforestation | Applicable, as a No Objection Certificate (NOC) has been obtained from the competent authority (Forest Department, Govt. of Assam) for Mariampur Eco-Tourism Lake, which is located within a reserved forest area. However, no forest land will be diverted under this project. | No Objection Certificate (NOC) from the competent authority of the Forest Department, Government of Assam, has been obtained prior to the implementation of subproject activities. Moreover, to avoid any ambiguity and facilitate verification, the project obtained No Objection Certificates (NoCs) from the Forest | State Forest Department and MoEFCC, GoI | ARIAS Society |

| S. No. | Legislations | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|---|
| | | | | Department for all 76 beels during the selection process, even though none of the selected beels fall within forest land. | | |
| 14. | Wildlife Protection Act, 1972, 1993 | To protect wildlife through notifying National Parks and Sanctuaries and buffer areas around these zones | Not Applicable. None of the selected sites located within protected areas | NA | State Board of Wildlife (SBWL) and National Board of Wildlife (NBWL) | NA |
| 15. | Eco Sensitive Zone | The expansion of industrial area, townships, infrastructure facilities and such other activities which could lead to pollution and congestion shall not be allowed within "No development Zone" except with the prior approval of the Central Government. | Not Applicable, None of the selected sites located within protected | NA | MoEFCC, GoI | NA |
| 16. | Biological Diversity Act, 2002 | The act aims at the conservation of biological resources, managing its sustainable use and enabling fair and equitable sharing benefits arising out of the use | Not Applicable | NA | MoEFCC and State Biodiversity Board | NA |

| S. No. | Legislations | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|---|
| | | and knowledge of biological resources with the local communities. | | | | |
| 17. | Indian Fisheries Act 1857 | Regulatory framework for regulation of inland and marine fishery | Applicable | - | - | ARIAS Society |
| 18. | Assam Fishery Rule 1953, 2005 | Under the Assam Fishery Rules, 1953, all fishing without a lease obtained from the Deputy Commissioner of the district concerned or such other officer as he may be appointed for the purpose in the fisheries of the province proclaimed under section 16 of the Assam Land and Revenue Regulation Act 1886 is prohibited and person fishing in the proclaimed areas must carry his/her lease or an authority/ permit from the Lessee or produce. | Applicable | Project Implementation Unit/contractor shall fully abide to provisions of Assam Fishery Rule 1953 | ARIAS Society | Contractor/lessee |
| **Safety and Other Related Legislations** | | | | | | |
| 19. | Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 | Requirement of preparation of onsite and off-site Disaster Management Plans for accident-prone areas. | Not Applicable. The Project does not involve handling of any hazardous chemical during both construction and operation phase which may lead to continuous, intermittent or repeated exposure to death, or injury. | No permits issued under this act | Central, State and District Crisis Group | Not Applicable |
| 20. | Public Liability and | Protection from liability arising due to accidents from handling of | Not Applicable. The Project does not involve storage of any | No permits issued under this act. Owner of project should take | Collector of the Area | Not applicable |

| S. No. | Legislations | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|---|
| | Insurance Act 1991 | hazardous chemicals. | chemicals (HSD) beyond the threshold limit during Construction | out insurance policies providing for contracts of insurance so as he is insured against liability to give relief, before handling any such hazardous material | | |
| 21. | Explosive Act 1884 and Explosive Rules, 2008 | Safe transportation, storage and use of explosive material | Not Applicable as no explosive (as described in act and rules) should be used in the construction and operation stage of the Project. | Permission for storage and usage of explosive | Chief Controller of Explosives | Not applicable |
| 22. | Petroleum Rules, 2002 | Use and Storage of Petroleum products | Not Applicable, it is unlikely that contractor store HSD/LPG or any other petroleum product exceed the permitted quantity | License to store petroleum beyond prescribed quantity. | Chief Controller of Explosives/DC | Contractor |
| 23. | Central Motor Vehicle Act 1988 and amendment Central Motor Vehicle Rules, 1989 and amendments till date | To minimize the road accidents, penalizing the guilty, provision of compensation to victim and family and check vehicular air and noise pollution. | Applicable for all the vehicles at site during construction and operation phase | No permit issued under this Act | Motor Vehicle Department (Licensing authority, registration authority and State Transport Authorities) | Contractor to follow Rules for all the construction vehicles being used at site during construction purposes |
| 24. | The Gas Cylinder Rules 2004 | To regulate the storage of gas / possession of gas cylinder more than the exempted quantity | Not Applicable, it is unlikely that contractor store more than the exempted quantity of gas cylinder. | License to store gas cylinder more than the regulated quantity | Chief Controller of explosives | Contractor. Compliance to the rules should be ensured |
| 25. | Ancient Monuments and Archaeological Sites and | Conservation of cultural and historical remains found in India. According to this Act, area within the radii of 100m and 300m from the designated | Not Applicable | No objection certificate | Archaeological Survey of India, GoI | Not applicable - there are no protected monuments / places of archeological / |

| S. No. | Legislations | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|---|
| | Remains Act, 1958 | as No development activity (including building, mining, excavating, blasting) is permitted development activities likely to damage the protected property is not permitted in the without prior permission of the Archaeological Survey of India (ASI). | | | | historical places in or near the Project areas. In case of chance finds, the contractor/ PIU will be required to follow a protocol as defined in the Environmental Management Plan |
| 26. | Guidelines for evaluation of proposals/requests for groundwater abstraction for drinking and domestic purposes in Notified areas and Industry/Infrastructure project proposals in non-notified areas, 2012 | To regulate extraction of groundwater for drinking and domestic purpose | Applicable if groundwater is extracted for meeting drinking/domestic water needs of contractor workers | No objection certificate | Central groundwater Authority/Board and MoEFCC | Contractor |
| **Other Regulations** | | | | | | |
| | - The Assam Private Fisheries Protection Act, 1935 (Under the Assam Act no. I of 1935.)<br>- Assam Fish Seed Act- 2005<br>- Assam Primitive Fisheries Protection Act -1953<br>- Assam grant of fishery subsidy to private fish farmers and pisciculture rule -1971<br>- Assam grant of fishery subsidy to fishermen/fishery cooperatives rule-1971<br>- Guwahati Building Construction (Regulation) Act 2010 Guwahati Building Construction (Regulation) Byelaws 2014<br>- Assam Fire and Emergency Service Act, 1985 (as Amended in 2012) and Assam Fire Service Rules 1989 and other related Act and Rules and Bye Laws<br>- Workmen's Compensation Act 1923<br>- Contract Labour (Regulation and Abolition) Act, 1970<br>- Minimum Wages Act, 1948<br>- Payment of Wages Act, 1936 | | | | | |

| S. No. | Legislations | Key Requirement | Applicability | Type of permit and stage of applicability | Administrative Authority | Responsibility |
|---|---|---|---|---|---|---|
| | - Equal Remuneration Act, 1979<br>- Child Labour (Prohibition and Regulation) Act, 1986 and 2016<br>- The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979<br>- The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996<br>- The Factories Act, 1948<br>- Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 | | | | | |

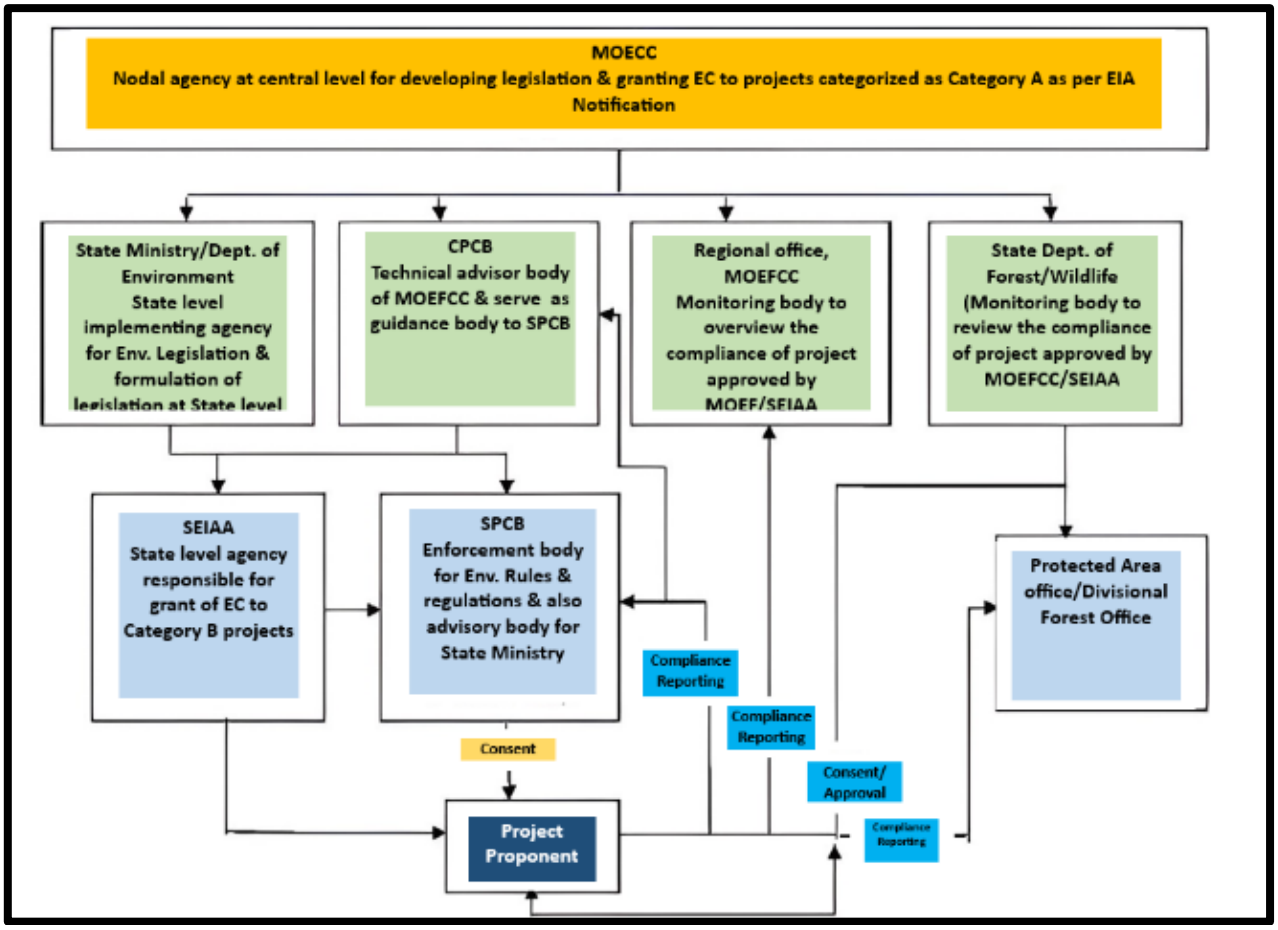



**Figure 2-1.Legislative interface between Central and State Authorities responsible for Environment Protection**

## 2.3. International Treaties and Relevance to the Project

63. In addition to national and state rules and regulations, international conventions are applicable for selection and screening of subprojects under restricted/sensitive areas. India is a party to these conventions. Relevance of the international agreements to the subproject is explained in the following:

(i) **Convention Concerning the Protection of the World Cultural and Natural Heritage (Ratified by India in 1972)**: The most significant feature of the 1972 World Heritage Convention is that it links together in a single document the concepts of nature conservation and the preservation of cultural properties. The Convention recognizes how people interact with nature, and the fundamental need to preserve the balance between the two. None of the beels are located near to any World Cultural and Natural Heritage site.

(ii) **Convention on Biological Diversity (Ratified by India in 1994)**: This is an international treaty and considered a key document for "sustainable development". This entered into force in 1993 to develop national strategies for the conservationand sustainable use of biological diversity. It has 3 major goals: (1) conservation of biodiversity, (2) sustainable use of its components, and (3) fair and equitable sharing of benefits arising from genetic resources. As an impact of this convention, the year 2010 was considered as International Year of Biodiversity. Proposed subproject component will promote preservation and conservation of biodiversity.



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(iii) **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Ratified by India in 1976)** – It is a multilateral treaty to protect endangered plants and animals and known as "Washington Convention". Opened for signature in 1973 and entered into force in 1975, it ensures that international trade in specimens of wild animals and plants does not threaten the survival of the species in the wild. This treaty protects about 5,950 species of animals and 32,800 species of plants by listing them in 3 specific appendices that affords different levels or types of protection from over-exploitation. Appendix I lists species that are the most endangered, Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled, and Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of othercountries to prevent unsustainable or illegal exploitation. Contractor to though create awareness amongst workers to desist from illegal wildlife activities including poaching, hunting and fishing by workers

(iv) **Convention on the Conservation of Migratory Species of Wild Animals (CMS)(India is signatory since 1983):** This treaty is also known as "Bonn Convention" and aims to conserve terrestrial, marine and avian migratory species throughout their range. The convention has 133 parties and the depository is the government of the Federal Republic of Germany. This treaty facilitates the cooperation of different countries to protect the migratory species. There are 176 threatened migratory species that are conserved under this treaty. it is important to note that no National Parks or Wildlife Sanctuaries are located in close proximity to the beels covered under SWIFT. However, two of the subproject beels, Paranm Beel and Tatinga Mekheli Barbeel, situated in Majuli Island which is a KBA and one beel Mariampur ecotourism beel is in forest area. Planned project activities related to these beels have been carefully designed to cover conservation aspects and to minimize ecological impacts. and it is expected subproject will not impact any of the threatened migratory species listed in CMS.

(v) **Ramsar Convention on Wetlands of International Importance (Ratified by India in 1982)**. It is an international treaty for the conservation and sustainable utilization of wetlands by recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It was signed in 1971 and came into force in 1975. Currently, The Ramsar List of Wetlands of International Importance (Ramsar Sites) includes 2,471 sites having an area of 256,190,602 hectares. There are 80 wetlands are designated as wetlands of international importance in India that also include Deepor beel of Assam. However, it is well away from subproject influence area.



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# 3. PROJECT DESCRIPTION

## 3.1. About Subproject

64. The proposed project is in Assam, India, which is situated in the easternmost part of the country, between latitudes 24°07' N to 28°00' N and longitudes 89°42' E to 96°02' E. Assam covers a geographical area of 78,438 square kilometers, constituting 2.39% of India's total area. The state is characterized by a landscape of mountains, valleys, and a complex river system. It shares its borders with Bhutan to the north; Nagaland, and Manipur to the east; Meghalaya, Tripura, Mizoram, and Bangladesh to the south; and West Bengal to the west.

65. The proposed project aims to cover 102 beels (wetlands), encompassing over 4,000 hectares across 23 districts, divided into 5 clusters representing all the geographical areas of Assam. Proposed project intended to enhance the sustainable management and utilization of these wetlands for fisheries, benefiting local communities and promoting biodiversity conservation. It is designed to bring positive changes to both people and the local environment. However, interventions may have unintended impacts that can affect people and the environment if not properly managed. Given the uniform nature of the interventions, the impact assessment was initially conducted based on a detailed evaluation of priority beels spread across 23 districts in all 5 clusters. The findings from these assessments were extrapolated to estimate potential impacts for the remaining beels. This approach allows the assessment of 74 subprojects to be considered sufficient for identifying appropriate mitigation and monitoring measures provided that all selected sites meet the established site selection eligibility criteria.

## 3.2. Subprojects Beels Covered under Processing

66. During the project's readiness phase, 74 beels, and located in 23 districts, were selected for project processing and due diligence. The remaining beels and other infrastructures (i.e., on-beel and off-beel, eco-tourism and government buildings), which will be covered during project implementation, have not yet been assessed. Their environmental assessment will be conducted in accordance with the provisions outlined in the EMP. These beels are undergoing similar interventions, such as desilting, de-weeding, construction of earthen mounds, cleaning of inlets, embankment construction, installation of Hume pipes, composting, and the development of fish-rearing ponds. List of Beels and Interventions Proposed under the Phase -I of the SWIFT Project is provided in Table 3.1 and Table 3.2. In addition to this, distribution of subprojects in that to be covered under processing and implementation also depicted in Figure 3-1.

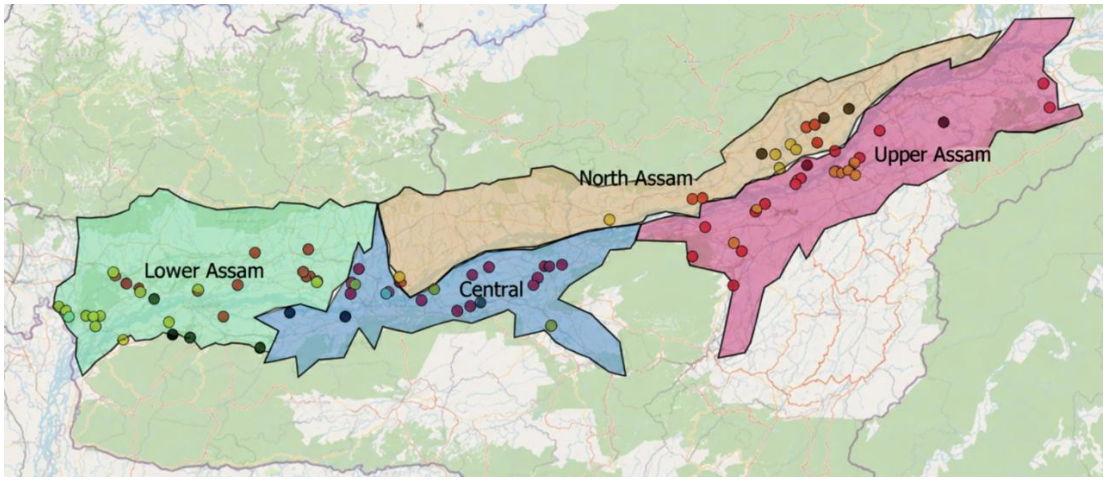



**Figure 3-1. Cluster Wide Distribution of subprojects to be covered under the Project**

**Table 3-1. List of Beels and Interventions under the Phase 1 of the SWIFT Project (Interventions Part-1)**

| Sl. No. | Cluster | Name of Beel | District | Beel Area (Ha) | Weed Area (Sqm) | De-weeding Area (sq. m.) | Desilting Area (sqm) | Island | De-siltation of Beel connecting channel length (m) | Embankments length (m) | Silt Trap Length (m) | WRS area ($m^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Central Assam | Bechamari Beel | Morigaon | 14.55 | 116168 | 94210 | 1.23 | 0 | 0 | 1080 | 0 | 0 |
| 2. | | Morakollong Beel | Morigaon | 13.55 | 128160 | 102954 | 2100 | 0 | 0 | 100 | 25 | 0 |
| 3. | | Oram Beel | Morigaon | 16.2 | 44,576 | 35,660.80 | 40000 | | 100 | 1900 | 58 | 0 |
| 4. | | Tihulia Beel | Morigaon | 27.14 | 207600 | 176503 | 10936 | 0 | 0 | 1325 | 0 | 0 |
| 5. | | Solmari Beel | Morigaon | 34.64 | 275900 | 235450 | 66752.7 | 0 | 0 | 3341 | 0 | 0 |
| 6. | | Chamkata Beel | Morigaon | 9.38 | 85000 | 72250 | 59604.22 | 0 | 0 | 1465 | 0 | 0 |
| 7. | | Bhagamur | Nagaon | 11.32 | 50,000 | 40000 | 9200 | 0 | 250 | 325 | 35 | 0 |
| 8. | | Borthol Beel | Nagaon | 19.37 | 193408 | 156715 | 3.37 | 0 | 0 | 2740 | 0 | 0 |
| 9. | | Potali Bhatia Khali | Nagaon | 74 | 4,38,830 | 3,54,665.00 | 25800 | 0 | 0 | 1205 | 0 | 0 |
| 10. | | Shantijan Beel | Nagaon | 12.8 | 1,23,042 | 1,01,194 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11. | | Bhatiakhali Beel | Nagaon | 37.29 | 285300 | 242679.25 | 31154.06 | 0 | 0 | 1752 | 0 | 0 |
| 12. | | Chola Mikirbheta Beel | Nagaon | 13.16 | 101500 | 86614.5 | 36706.84 | 0 | 0 | 1650 | 0 | 0 |
| 13. | | Na-Kalong Beel | Nagaon | 10.36 | 15440 | 13175 | 63487.36 | 0 | 0 | 310 | 0 | 0 |
| 14. | | Sara Beel | Nagaon | 12.13 | 109100 | 98190 | 13780 | 0 | 0 | 0 | 0 | 0 |

| Sl. No. | Cluster | Name of Beel | District | Beel Area (Ha) | Weed Area (Sqm) | De-weeding Area (sq. m.) | Desilting Area (sqm) | Island | De-siltation of Beel connecting channel length (m) | Embankments length (m) | Silt Trap Length (m) | WRS area ($m^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15. | | Pitkati | Kamrup | 12.62 | 1,22,575 | 98,264.46 | 37900 | 1 | | 763 | 250 | 0 |
| 16. | Lower Assam | Borjong | Goalpara | 22.4 | - | 112000 | 44151 | 0 | 0 | 1893 | 1 Check Dam | 1 Check Dam |
| 17. | | Chalantapara Haripani Beel | Bongaigaon | 11 | 0 | 0 | 3340 | 0 | 0 | 334 | 0 | 0 |
| 18. | | Mariampur Eco Tourism Lake | Goalpara | 10 | 0 | 0 | 3026.32 | 0 | 0 | 1106 | 0 | 0 |
| 19. | | Deepor Pitoni | Bongaigaon | 23.7 | 0 | 0 | 0 | 0 | 0 | 85 | 0 | |
| 20. | | Airmara Beel | Dhubri | 23.7 | 98000 | 29000 | 20049 | 3 | 0 | 1291 | 0 | 0 |
| 21. | | Gandhi Beel | Barpeta | 10 | 0 | 0 | 29428 | | | 1600 | | |
| 22. | | Kutnikuchi Beel | Nalbari | 28.94 | 9,905.91 | 9,233.10 | 29800 | 0 | 0 | 2788 | 50 | 0 |
| 23. | | Udmari Chora Beel | Dhubri | 7.74 | 77400 | 62000 | 1968 | 0 | 0 | 810 | 53 | 1 Check Dam |
| 24. | | Kaplimara Beel | Bajali | 15.60 | 136580 | 112036.52 | 19725 | 0 | 0 | 1469 | 0 | 0 |
| 25. | | Borai Pani Khowa Beel | Bongaigaon | 11.90 | 73735 | 48773.76 | 9010.00 | 0 | 0 | 601 | 0 | 0 |
| 26. | | Khoribari Borbilla Beel | Bongaigaon | 10 | 55127 | 55127 | 19772 | 0 | 0 | 1198 | 0 | 0 |
| 27. | | Nayachara Beel | Bongaigaon | 25.97 | 173051 | 155235 | 31605 | 0 | 0 | 2204 | 0 | 0 |
| 28. | | Ghritingerkuti Beel | Dhubri | 16.68 | 139870 | 100035 | 16350 | 0 | 0 | 1035 | 0 | 0 |
| 29. | | Goka Beel | Dhubri | 6.05 | 29040 | 27297 | 14770 | 0 | 0 | 877 | 0 | 0 |

| Sl. No. | Cluster | Name of Beel | District | Beel Area (Ha) | Weed Area (Sqm) | De-weeding Area (sq. m.) | Desilting Area (sqm) | Island | De-siltation of Beel connecting channel length (m) | Embankments length (m) | Silt Trap Length (m) | WRS area ($m^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30. | | Singra Beel | Dhubri | 6.07 | 41844 | 36974 | 9130 | 0 | 0 | 613 | 0 | 0 |
| 31. | | Singimari Beel | Goalpara | 14.07 | 82998 | 68996 | 10617 | 0 | 0 | 875 | 0 | 0 |
| 32. | | Amritpur Sewashram Beel | Kokrajhar | 18.99 | 139133 | 117003 | 33130 | 0 | 0 | 2638 | 500 | 0 |
| 33. | | Bamunkura Beel | Kokrajhar | 11.10 | 94350 | 77569 | 12800 | 0 | 0 | 830 | 0 | 0 |
| 34. | | Barkhang Beel | Kokrajhar | 14 | 122962 | 101336 | 25500 | 0 | 0 | 2250 | 0 | 0 |
| 35. | | Halowadal Beel | Kokrajhar | 6.66 | 34570 | 28412 | 6340 | 0 | 0 | 184 | 0 | 0 |
| 36. | | Inti Beel | Kokrajhar | 4 | 17404 | 14303 | 4650 | 0 | 0 | 165 | 0 | 0 |
| 37. | | Mugdi Beel | Nalbarii | 29.20 | - | 0 | 46034 | 0 | 0 | 2565 | 0 | 0 |
| 38. | **South Assam** | Bor Beel | Sribhumi | 42.44 | 112724 | 94253 | 42100 | 0 | 0 | 1220 | 0 | 0 |
| 39. | | Gomiri Beel | Biswanath | 10 | 21002 | 19005.4 | 2 | 0 | 146.89 | 1120 | 46 | 0 |
| 40. | | Koupati Beel | Darrang | 11 | 45900.00 | 39023.52 | 33557.14 | 0 | 0 | 1867.00 | 0 | 7 |
| 41. | **North Assam** | Mer Beel | Lakhimpur | 27.27 | 60883 | 48706.4 | 30000 | 0 | 100 | 845 | 67 | 3 |
| 42. | | Bhulkaguri Beel | Dhemaji | 11 | 107244 | 85795.36 | 25100 | 0 | 0 | 615 | 295* | 0 |
| 43. | | Bera Na Beel | Dhemaji | 5 | 39990.207 | 35287.56 | 12560.00 | 0 | 0 | 956.00 | 0 | 0 |
| 44. | | Guttung Bhattali Beel | Lakhimpur | 17.85 | 20980 | 14136 | 0 | 0 | 147 | 0 | 62 | 0 |

| Sl. No. | Cluster | Name of Beel | District | Beel Area (Ha) | Weed Area (Sqm) | De-weeding Area (sq. m.) | Desilting Area (sqm) | Island | De-siltation of Beel connecting channel length (m) | Embankments length (m) | Silt Trap Length (m) | WRS area ($m^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45. | | Burisuti Rikseng Beel | Dhemaji | 6.10 | 4758.294 | 4758.29 | 8200.00 | 0 | 0 | 520.00 | 0 | 0 |
| 46. | | Borakat Beel | Sonitpur | 18.06 | 150000.00 | 127500.00 | 45833.21 | 0 | 0 | 1922.00 | 0 | 0 |
| 47. | | Dighali Beel | Sonitpur | 25.69 | 196907.46 | 196907.46 | 103291.20 | 0 | 0 | 4600.00 | 0 | 0 |
| 48. | Upper Assam | Mornoi (Masmaroni) Beel | Sivasagar | 8.37 | 84514 | 67611.2 | 20000 | 0 | 0 | 300 | 0 | 1 |
| 49. | | Gabhoru Beel | Sivasagar | 9 | 72726 | 65536.4 | 27800 | 0 | 120 | 959 | 43 | 0 |
| 50. | | Tinsukia Beel | Sivasagar | 34.46 | 343548 | 304938 | 63400 | 0 | 0 | 3750 | 0 | 0 |
| 51. | | Kurekhona Beel | Sivasagar | 5.35 | 2743.38 | 2576.2 | 15500 | 0 | 0 | 1220 | 0 | 0 |
| 52. | | Hatihuria Beel | Sivasagar | 10.28 | 88169.978 | 79366.67 | 16050 | 0 | 0 | 1305 | 0 | 0 |
| 53. | | Panikheti Beel | Sivasagar | 6 | 46155.914 | 37612.68 | 8340 | 0 | 0 | 534 | 0 | 0 |
| 54. | | Gudha Beel | Sivasagar | 16.5 | 97766.86 | 82821.19 | 33730 | 0 | 0 | 3073 | 0 | 0 |
| 55. | | Param Beel | Majuli | 9.2 | 85551 | 70577.4 | 15600 | 0 | 0 | 625 | 0 | 0 |
| 56. | | Tatinga Mekheli Barbeel | Majuli | 13 | 47521.03 | 38016.82 | 29800 | 0 | 0 | 1516 | 0 | 0 |
| 57. | | Sawguri Beel | Jorhat | 10 | 90093.4 | 80654 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58. | | Moridesoi Beel | Jorhat | 8.43 | 82113 | 65690 | 24536 | 0 | 354 | 2290 | 61 | 0 |
| 59. | | Amguri Beel | Jorhat | 15 | 12000 | 10800 | 13850 | 0 | 0 | 935 | 0 | 0 |

| Sl. No. | Cluster | Name of Beel | District | Beel Area (Ha) | Weed Area (Sqm) | De-weeding Area (sq. m.) | Desilting Area (sqm) | Island | De-siltation of Beel connecting channel length (m) | Embankments length (m) | Silt Trap Length (m) | WRS area ($m^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 60. | | Jengoni Beel | Jorhat | 18 | 10800 | 86400 | 12000 | 0 | 0 | 600 | 0 | 0 |
| 61. | | Charigaon Beel | Jorhat | 21 | 176620.6 | 144695.492 | 17680 | 0 | 0 | 168 | 0 | 0 |
| 62. | | 1 No. Hatibandha Dihing Arasuti Beel | Dibrugarh | 29.08 | 224664.63 | 26650.22 | 26500 | 0 | 0 | 2050 | 0 | 0 |
| 63. | | Bamuni Beel | Dibrugarh | 10 | 70991.92 | 57003.76 | 6900 | 0 | 0 | 1090 | 0 | 0 |
| 64. | | Kutuha Beel | Dibrugarh | 17 | 124083.56 | 112408.748 | 15200 | 0 | 0 | 920 | 0 | 0 |
| 65. | | Mer Beel | Dibrugarh | 75.28 | 634803 | 513919 | 49383.8 | 0 | 0 | 1560 | 0 | 0 |
| 66. | | Mirika Beel | Dibrugarh | 20 | 195000 | 156000 | 4500 | 0 | 0 | 0 | 0 | 0 |
| 67. | | Natun Bolai Arasuti Beel | Dibrugarh | 24.13 | 221996 | 219681 | 38900 | 0 | 0 | 2420 | 0 | 0 |
| 68. | | Burhi Beel | Tinsukia | 27.13 | 229992 | 183993.6 | 2400 | 0 | 0 | 0 | 0 | 0 |
| 69. | | Toklong Beel | Tinsukia | 25 | 167350 | 135780 | 64800 | 0 | 50 | 2197 | 0 | 0 |
| 70. | | Pera Beel | Tinsukia | 11 | 99000.269 | 79200.2452 | 25565.2 | 1 | 0 | 2200 | 0 | 0 |
| 71. | | Sagarbera Beel | Charaideo | 13.33 | 98864.528 | 82023.35 | 19200 | 0 | 0 | 1620 | 0 | 0 |
| 72. | | Borpothorua Beel | Golaghat | 20.15 | 163904 | 131123.2 | 33065 | 0 | 100 | 2750 | 134 | 0 |
| 73. | | Borgoria Beel | Golaghat | 30 | 149451 | 120398 | 2.85 | 0 | 0 | 2280 | 95 | 0 |

| Sl. No. | Cluster | Name of Beel | District | Beel Area (Ha) | Weed Area (Sqm) | De-weeding Area (sq. m.) | Desilting Area (sqm) | Island | De-siltation of Beel connecting channel length (m) | Embankments length (m) | Silt Trap Length (m) | WRS area ($m^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 74. | | Kordoiguri Beel | Golaghat | 25 | 33495 | 26796 | 50200 | 0 | 355 | 2021 | 0 | 0 |

**Table 3-2. List of Beels and Interventions under the of SWIFT Project (Interventions Part-2)**

| Sl. No. | Clusters | Name of Beel | Beel Area (Ha.) | Seed Rearing (Yes/ No) | Hume Pipes (Nos.) | Pen Culture Area (Ha. ) | Fish Landing Shed (Nos.) | Fingerling Stocking Area (Ha.) | Habitat Management (Nos.) | Vermi-compost (Nos.) | Katal Fishing (Nos.) | Approach Road Length (m) | Water Pool Area (Ha.) | Solar Lamp Nos. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Central Assam | Bechamari Beel | 14.55 | Yes (6 Nos) | 15 | 1.5 | 1 | 0 | 0 | 0 | 3 | 250 | 0 | 10 |
| 2. | | Morakollong Beel | 13.55 | Yes (3 Nos) | 5 | 1.5 | 1 | 0 | 0 | 0 | 3 | 0 | 0 | 5 |
| 3. | | Oram Beel | 16.2 | Yes (2 Nos) | 2 | 1.5 | 1 | 0 | 0 | 0 | 4 | 70 | 4 | 8 |
| 4. | | Tihulia Beel | 27.14 | Yes (6 Nos) | 0 | 1.6 | 1 | 0 | 0 | 0 | 2 | 628 | 0 | 23 |
| 5. | | Solmari Beel | 34.64 | Yes (9 Nos) | 2 | 1.6 | 1 | 0 | 0 | 0 | 2 | 160 | 0 | 10 |
| 6. | | Chamkata Beel | 9.38 | Yes (4 Nos) | 2 | 1.4 | 1 | 0 | 0 | 0 | 2 | 294 | 2 | 13 |
| 7. | | Bhagamur Beel | 11.33 | Yes (3 Nos) | 5 | 1.5 | 1 | 0 | 0 | 0 | 3 | 0 | 0 | 6 |
| 8. | | Borthol Beel | 19.37 | Yes (3 Nos) | 10 | 1.5 | 1 | 0 | 0 | 0 | 3 | 470 | 3.37 | 21 |
| 9. | | Potia Bhatiakhali Beel | 74 | Yes (6 Nos) | 4 | 1.5 | 1 | 0 | 0 | 0 | 4 | 630 | 0 | 28 |
| 10. | | Shantijan Beel | 12.8 | Yes (3 Nos) | 0 | 1.5 | 1 | 0 | 0 | 0 | 3 | 115 | 0 | 9 |
| 11. | | Bhatiakhali Beel | 37.29 | Yes (6 Nos) | 4 | 1.6 | 2 | 0 | 0 | 0 | 6 | 0 | 0 | 28 |
| 12. | | Chola Mikirbheta Beel | 13.16 | Yes (7 Nos) | 3 | 1.6 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 7 |
| 13. | | Na-Kalong Beel | 10.36 | Yes (7 Nos) | 2 | 1.0 | 1 | 0 | 0 | 0 | 2 | 73 | 0 | 7 |

| Sl. No. | Clusters | Name of Beel | Beel Area (Ha.) | Seed Rearing (Yes/ No) | Hume Pipes (Nos.) | Pen Culture Area (Ha. ) | Fish Landing Shed (Nos.) | Fingerling Stocking Area (Ha.) | Habitat Management (Nos.) | Vermi-compost (Nos.) | Katal Fishing (Nos.) | Approach Road Length (m) | Water Pool Area (Ha.) | Solar Lamp Nos. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14. | | Sara Beel | 12.13 | Yes (7 Nos) | 2 | 1.0 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 15 |
| 15. | | Pitkati Beel | 12.62 | Yes (4 Nos) | 10 | 1.5 | 1 | 0 | 0 | 0 | 4 | 310 | 0 | 16 |
| 16. | **Lower Assam** | Borjong | 22.4 | Yes (2 Nos) | 7 | 1.5 | 1 | 0 | 0 | 0 | 3 | 480 | 2 | 22 |
| 17. | | Chalantapara Haripani Beel | 11 | Yes (4 Nos) | 8 | 0 | 1 | 0 | 0 | 0 | 3 | 340 | 0 | 20 |
| 18. | | Mariampur Eco Tourism Lake | 10 | No | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 480 | 0 | 8 |
| 19. | | Deepor Pitoni | 23.7 | Yes (3 Nos) | 2 | 1.25 | 1 | 0 | 0 | 0 | 4 | 250 | 0 | 12 |
| 20. | | Airmara Beel | 23.7 | Yes (1 No) | 6 | 0.25 | 1 | 0 | 0 | 0 | 0.75 | 200 | 0 | 17 |
| 21. | | Gandhi Beel | 10 | Yes (4 Nos) | 2 | 0 | 1 | 0 | 0 | 0 | 3 | 62 | 0 | 15 |
| 22. | | Kutnikuchi Beel | 28.94 | 0 | 22 | 0 | 1 | 0 | 0 | 0 | 4 | 128 | 0 | 10 |
| 23. | | Udmari Chora Beel | 7.74 | Yes (4 Nos) | 5 | 1.6 | 1 | 0 | 0 | 0 | 4 | 110 | 0 | 12 |
| 24. | | Kaplimara Beel | 15.60 | Yes (2 Nos) | 12 | 0 | 0 | 0 | 0 | 0 | 4 | 1200 | 2 | 44 |
| 25. | | Borai Pani Khowa Beel | 11.90 | Yes (2 Nos) | 7 | 0.6 | 1 | 0 | 0 | 0 | 2 | 226 | 0 | 12 |
| 26. | | Khoribari Borbilla Beel | 10 | Yes (2 Nos) | 6 | 0 | 1 | 0 | 0 | 0 | 2 | 1198 | 0 | 44 |
| 27. | | Nayachara Beel | 25.97 | Yes (6 Nos) | 8 | 2.0 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 4 |
| 28. | | Ghritingerkuti Beel | 16.68 | Yes (4 Nos) | 8 | 2.0 | 1 | 0 | 0 | 0 | 4 | 75 | 0 | 7 |
| 29. | | Goka Beel | 6.05 | Yes (4 Nos) | 7 | 1.0 | 1 | 0 | 0 | 0 | 2 | 220 | 0 | 12 |
| 30. | | Singra Beel | 6.07 | Yes (2 Nos) | 0 | 1.0 | 1 | 0 | 0 | 0 | 2 | 50 | 0 | 6 |

| Sl. No. | Clusters | Name of Beel | Beel Area (Ha.) | Seed Rearing (Yes/ No) | Hume Pipes (Nos.) | Pen Culture Area (Ha. ) | Fish Landing Shed (Nos.) | Fingerling Stocking Area (Ha.) | Habitat Management (Nos.) | Vermi-compost (Nos.) | Katal Fishing (Nos.) | Approach Road Length (m) | Water Pool Area (Ha.) | Solar Lamp Nos. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31. | | Singimari Beel | 14.07 | Yes (3 Nos) | 6 | 2.0 | 1 | 0 | 0 | 0 | 4 | 170 | 0 | 10 |
| 32. | | Amritpur Sewashram Beel | 18.99 | Yes (4 Nos) | 14 | 0 | 1 | 0 | 0 | 0 | 4 | 110 | 0 | 8 |
| 33. | | Bamunkura Beel | 11.10 | Yes (3 Nos) | 10 | 0 | 1 | 0 | 0 | 0 | 4 | 657 | 0 | 27 |
| 34. | | Barkhang Beel | 14 | Yes (2 Nos) | 12 | 2.0 | 1 | 0 | 0 | 0 | 4 | 220 | 0 | 4 |
| 35. | | Halowadal Beel | 6.66 | Yes (3 Nos) | 5 | 1.0 | 1 | 0 | 0 | 0 | 2 | 60 | 0 | 6 |
| 36. | | Inti Beel | 4 | Yes (2 Nos) | 4 | 1.0 | 1 | 0 | 0 | 0 | 2 | 270 | 0 | 13 |
| 37. | | Mugdi Beel | 29.20 | Yes (4 Nos) | 3 | 2.1 | 0 | 0 | 0 | 0 | 0 | 270 | 0 | 22 |
| 38. | **South Assam** | Bor Beel | 42.44 | Yes (3 Nos) | 2 | 1.5 | 1 | 0 | 0 | 0 | 4 | 910 | 0 | 30 |
| 39. | | Gomiri Beel | 19.81 | Yes (3 Nos) | 2 | 1.5 | 1 | 0 | 0 | 0 | 4 | 370 | 3 | 16 |
| 40. | | Gutung Bhattali | 17.85 | Yes (3 Nos) | 0 | 0.75 | 1 | 0 | 0 | 0 | 3 | 365 | 0 | 18 |
| 41. | | Bhulkaguri Beel | 11 | Yes (3 Nos) | | 1.5 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 15 |
| 42. | | Mer Beel | 27.27 | Yes (3 Nos) | 3 | 1.5 | 1 | 0 | 0 | 0 | 4 | 190 | 0 | 12 |
| 43. | **North Assam** | Koupati Beel | 11 | Yes (1 Nos) | 2 | 1 | 1 | 0.65 | 0 | 1 | 2 | 0 | 0 | 7 |
| 44. | | Bera Na Beel | 5 | Yes (2 Nos) | 5 | 1 | 1 | 0 | 0 | 0 | 2 | 130 | 0 | 9 |
| 45. | | Burisuti Rikseng Beel | 6.10 | Yes (2 Nos) | 8 | 0 | 1 | 0 | 0 | 0 | 2 | 280 | 2 | 14 |
| 46. | | Borakat Beel | 18.06 | Yes (6 Nos) | 2 | 1.6 | 1 | 3 | 0 | 1 | 2 | 465.5 | 2 | 22 |
| 47. | | Dighali Beel | 25.69 | Yes (5 Nos) | 1 | 2.1 | 1 | 0 | 0 | 0 | 5 | 315 | 4 | 42 |

| Sl. No. | Clusters | Name of Beel | Beel Area (Ha.) | Seed Rearing (Yes/ No) | Hume Pipes (Nos.) | Pen Culture Area (Ha. ) | Fish Landing Shed (Nos.) | Fingerling Stocking Area (Ha.) | Habitat Management (Nos.) | Vermi-compost (Nos.) | Katal Fishing (Nos.) | Approach Road Length (m) | Water Pool Area (Ha.) | Solar Lamp Nos. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 48. | Upper Assam | Mornoi (Masmaroni) Beel | 8.37 | Yes (4 Nos) | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 50 | 1 | 16 |
| 49. | | Gabhoru Beel | 9 | Yes (3 Nos) | 3 | 1.0 | 1 | 0 | 0 | 0 | 4 | 50 | 0 | 8 |
| 50. | | Tinsukia Beel | 34.46 | Yes (4 Nos) | 14 | 2.0 | 1 | 0 | 0 | 1 | 4 | 85 | 0 | 10 |
| 51. | | Kurekhona Beel | 5.35 | Yes (2 Nos) | 8 | 0 | 1 | 0 | 0 | 0 | 2 | 155 | 3 | 10 |
| 52. | | Hatihuria Beel | 10.28 | Yes (2 Nos) | 6 | 2.0 | 1 | 0 | 0 | 1 | 4 | 90 | 0 | 07 |
| 53. | | Panikheti Beel | 6 | Yes (2 Nos) | 3 | 1.0 | 1 | 0 | 0 | 0 | 2 | 90 | 0 | 08 |
| 54. | | Gudha Beel | 16.50 | Yes (2 Nos) | 9 | 2.0 | 1 | 0 | 0 | 0 | 4 | 75 | 0 | 07 |
| 55. | | Param Beel | 9.2 | Yes (2 Nos) | 3 | 2.0 | 1 | 0 | 0 | 0 | 4 | 50 | 0 | 8 |
| 56. | | Tatinga Mekheli Barbeel | 13 | Yes (3 Nos) | 1 | 1.0 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 8 |
| 57. | | Sagarbera Beel | 11.5 | Yes (2 Nos) | 11 | 2.0 | 1 | 0 | 0 | 0 | 4 | 430 | 0 | 19 |
| 58. | | Moridesoi Beel | 8.43 | Yes (3 Nos) | 3 | 1.0 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 6 |
| 59. | | Sawguri Beel | 10 | Yes (3 Nos) | 1 | 1.0 | 1 | 0 | 0 | 0 | 4 | 120 | 0 | 10 |
| 60. | | Amguri Beel | 15 | Yes (3 Nos) | 5 | 2.0 | 1 | 0 | 0 | 0 | 4 | 935 | 0 | 7 |
| 61. | | Jengoni Beel | 18 | Yes (4 Nos) | 7 | 2.0 | 1 | 0 | 0 | 0 | 4 | 10 | 0 | 5 |
| 62. | | Charigaon Beel | 21 | Yes (4 Nos) | 5 | 2.0 | 1 | 0 | 0 | 0 | 4 | 10 | 0 | 5 |
| 63. | | Burhi Beel | 27.13 | Yes (2 Nos) | 0 | 2.0 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 9 |
| 64. | | Toklong Beel | 25 | Yes (4 Nos) | 7 | 2.0 | 1 | 0 | 0 | 0 | 4 | 980 | 0 | 42 |

| Sl. No. | Clusters | Name of Beel | Beel Area (Ha.) | Seed Rearing (Yes/ No) | Hume Pipes (Nos.) | Pen Culture Area (Ha. ) | Fish Landing Shed (Nos.) | Fingerling Stocking Area (Ha.) | Habitat Management (Nos.) | Vermi-compost (Nos.) | Katal Fishing (Nos.) | Approach Road Length (m) | Water Pool Area (Ha.) | Solar Lamp Nos. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65. | | 1 No. Hatibandha Dihing Arasuti Beel | 29.08 | Yes (4 Nos) | 11 | 2.0 | 1 | 0 | 0 | 0 | 4 | 415 | 0 | 18 |
| 66. | | Bamuni Beel | 10 | Yes (5 Nos) | 5 | 1.0 | 1 | 0 | 0 | 0 | 2 | 240 | 0 | 12 |
| 67. | | Kutuha Beel | 17 | Yes (4 Nos) | 5 | 2.0 | 1 | 0 | 0 | 0 | 4 | 41 | 0 | 6 |
| 68. | | Mer Beel | 75.28 | Yes (6 Nos) | 1 | 2.1 | 1 | 0 | 0 | 0 | 3 | 850 | 0 | 1 |
| 69. | | Mirika Beel | 20 | Yes (3 Nos) | 5 | 2.0 | 1 | 0 | 0 | 0 | 4 | 542 | 0 | 23 |
| 70. | | Natun Bolai Arasuti Beel | 24.13 | Yes (4 Nos) | 8 | 2.0 | 1 | 0 | 0 | 0 | 4 | 10 | 0 | 5 |
| 71. | | Pera Beel | 11 | Yes (2 Nos) | 22 | 2.0 | 1 | 0 | 0 | 0 | 4 | 1035 | 0 | 39 |
| 72. | | Borgoria Beel | 30 | Yes (3 Nos) | 16 | 2.0 | 1 | 0 | 0 | 0 | 3 | 790 | 0 | 9 |
| 73. | | Kordoiguri Beel | 25 | Yes (2 Nos) | 4 | 2.0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 5 |
| 74. | | Borpothorua Beel | 20.15 | Yes (3 Nos) | 9 | 2.0 | 1 | 0 | 0 | 0 | 4 | 370 | 0 | 6 |

## 3.3. SWIFT Detailed Project Description

67. The project is designed to strengthen the capacity of local communities and stakeholders in sustainable fisheries management, cooperative governance, and the monitoring of beel health. By fostering collaboration between local groups, the project aims to create a foundation for long-term stewardship of the wetlands, ensuring that all involved parties are equipped with the knowledge and skills necessary to manage these vital ecosystems effectively.

68. A key focus of the project is promoting sustainable fisheries practices that prevent overfishing and maintain the ecological balance of the beels. These practices are intended to support the livelihoods of local fishers while safeguarding the long-term productivity of the wetlands. By encouraging responsible fishing techniques, the project ensures that fish populations remain viable and the health of the wetland ecosystem is preserved.

69. In addition to fisheries management, the project incorporates wetland restoration techniques that are widely recognized as environmentally friendly and essential for habitat conservation. These methods focus on improving the natural functioning of the wetlands, enhancing biodiversity, and increasing the resilience of these ecosystems against environmental changes. Through these measures, the project aims to support both the ecological sustainability of the beels and the well-being of the communities that depend on them.

70. Outputs of the Project are: (i) Output 1: Institutional capacity and governance for sustainable beel ecosystem and fisheries management strengthened; (ii) Output 2: Community-based fisheries business developed and beel community income diversified; and (iii) Output 3: Beel conservation and restoration planned and managed. Detailed description of each output and activities are described below:

71. **Output 1: Institutional capacity and governance for sustainable beel ecosystem and fisheries management strengthened.**

72. Activity 1.1. Update relevant beel management and fishery acts, regulations, and rules.

73. *Sub-activity 1.1.1. Identify critical areas for updates for community-based beel ecosystem and fisheries management.* To achieve this, there is a need to build consensus on core principles and objectives across multiple stakeholders to foster aligned, coherent and complementary actions and interventions in the areas of beel administration, beel management, and beel-use. Drawing on the participatory discussions with local beel communities, the PMU will initially facilitate a series of stakeholder consultation meetings and workshops to sensitize stakeholders to the issues and to discuss beel fisheries and management regulations[13]. This will be followed up with further policy dialogue[14] and workshops to identify the issues and regulations that need updating or which need formulating – these could include leasing arrangements to promote inclusiveness, fishery settlement policies, other governance arrangements and policy integration (ensuring broad-based coordination and alignment with other existing policies such as agricultural, environmental, hydrological/ water-use policies). As policy and regulatory change requires comprehensive buy-in, the stakeholder workshops will take place both at the State-level with high-level representation, as well as at sub-regional or 'cluster'/ 'zonal' level with more field-based stakeholder participation and representation.

74. Key activities include the preparation of communication and awareness-raising material, stakeholder consultation workshops, and the preparation of policy briefs[15]. It is expected that the requisite policy/ regulatory documentation will be drafted by project year 3, with the policy and

[13] This includes State-level workshops (10) and cluster-level workshops (28)
[14] The PSC will guide and monitor progress on these policy-level issues.
[15] Specific services to support preparation may be considered.

regulation in effect before project completion. The necessary administrative and legal procedures (administrative orders, etc.) to constitute any updates or reform of the institutional and regulatory framework for beel governance will be guided and supported by a high-level sub-committee of the Project Steering Committee.

75. *Sub-activity 1.1.2. Prepare a sustainable operational model and guidelines for community-based beel ecosystem and fisheries management.* Promoting community-based beel ecosystem and fisheries management is a fundamental premise and core project principle. The project will draw on technical expertise (research), previous initiatives, experience, best practices and the knowledge and lessons learned and generated during project implementation, to prepare a comprehensive set of guidelines for community-based sustainable beel ecosystem management. These guidelines offer a sustainable operational model that will be the basis for wider applicability and replication of the beel management model State-wide, and potentially for adoption in other states. This operational model as presented in the guidelines, also serves as the project's exit strategy.

76. The sustainable operational model and guidelines will specify key principles, procedures and modalities related to the institutional framework for beel management and fisheries (leasing arrangements, administration, management, fishing regulations, benefit sharing, stakeholder responsibilities (public, private and local)); the guidelines will also progressively include a set of technical guidelines on the following: (i) community-based management through the Beel Development Committee (BDC) model (establishment, operations, principles, rights and decision-making, etc.); (ii) environmental and biodiversity conservation, aligned with Wetlands Rules 2017 and taking into account hydrological and geo-ecological considerations and best practices; (iii) sustainable fisheries management and practices (e.g. stock management), aligned with Wetlands Rules 2017; (iv) economic development opportunities; and (v) monitoring and evaluation.

77. The preparation of the guidelines will draw on the material, reports, research publication and other knowledge products, including the traditional knowledge developed and generated under the project and across its outputs over the first two years of project implementation and will be prepared ahead of the project's mid-term evaluation for review. Further consultations with the BDCs will be initiated and by project year 4, these guidelines will be updated, refined, and packaged for wider dissemination.

78. Activity 1.2. Train and build capacity of DOF and other allied public institutions staff

79. *Sub-activity 1.2.1. Conduct training and exposure visit for DOF staff and other allied public institution staff including state wetland authority.* The simultaneous focus on sustainable fisheries development and environmental/ ecosystem conservation necessitates that Department of Fisheries (DOF) staff and extensionists, as well as those of other allied public institutions (such as the State Wetlands Authority) are adequately trained and capacitated to promote and support the adoption of best practices and technological roll-out over the long-term, as well as monitor developments. These DOF field functionaries and those of other relevant Government Departments and Agencies closest to the field level will be able to serve in an advisory function to the BDCs over the long-term.

80. As part of the capacity building and training activities, the project will partner with institutions such as Wetlands International (South Asia) to develop a comprehensive training program and the requisite training material/ modules (varied for different training 'audience') that incorporates modules on wetlands ecosystem conservation (principles, best practices, etc.), and beel management planning and implementation[16]. The partner/ service provider for promoting ecosystem conservation and beel

[16] In cooperation with the Beel Development Committee (BDC), the technical partner/ service provider will also be responsible for facilitating the development and preparation of: (i) the beel integrated management plan (BMP) under activity 1.3; and (ii) the beel (wetlands) brief documents and health cards under activity 1.4. Note that training on fisheries science and practices will be supported by other technical service providers such as CIFRI and WorldFish under output 2.

management is referred to as the service provider for beel management (SP-BM).

81. A training of trainers (ToT) approach will be adopted, with selected staff (approximately 50 public staff, BDC facilitators and the initial selection of beel animators) receiving in-depth training, who will in turn train other staff, service providers and project stakeholders (lead fisher/farmers, BDMC members, etc.).

82. To strengthen the communication and cooperation with local communities, approximately 50 staff will also be trained in group facilitation and dynamics; specific in-depth training will be given on gender equality, women's empowerment and social inclusion[17], with complementary and/or refresher training provided every other year. Overall, capacity building will include a mixture of workshops and field-level/ (beel) on-site training.

83. Given the sizable investment and expectation of increasing investment in Assam's fisheries and beel fisheries sector, DOF and the PMU/PIU will also be supported with training in financial management, procurement, and safeguards to more effectively carry out their responsibilities, including due diligence.

84. For technical know-how, knowledge building and in promotion of innovation, selected DOF staff will also be supported to benefit from national and international exposure visits. These exposure visits would be an opportunity for learning on best practices and innovations in inland – particularly beel – fisheries, processing and/or commercialization. National exposure visits may be arranged in West Bengal, Andhra Pradesh, Odisha and Chhattisgarh States, whilst international opportunities may include travel to Bangladesh, Cambodia, Vietnam and other countries as relevant. Project design estimated that approx. 36 staff may undertake the national exposure visits, which will take place 1x per annum for up to 6 staff at a time. International exposure visits may be carried out up to 4x during the project duration, for approximately 6-8 eligible staff at a time (a total of 26 staff could be eligible to participate in international visits). Each national and international exposure visit will require a proposal to assess its added value and identify the expected results and deliverables.

85. Activity 1.3. Strengthen beel community-based institutions (beel development committee).

86. Community institutions surrounding the beel play a crucial role in the local economy, especially for those whose livelihoods are deeply connected with the beel ecosystem. The beel ecosystem encompasses a variety of institutions, including fisheries cooperative societies, beel development committees, village development committees, informal community-based organizations (CBOs), and cultural and religious institutions that manage both registered and unregistered beels. These institutions face numerous challenges that impact their operation, sustainability, and level of engagement in the beels.

87. To foster coherency in the engagement with community-based institutions and support their development and capacity to participate in beel management, these institutions will be formalized under the project as the Beel Development Committee (BDC); the BDCs shall be registered under the Society Registration Act 1860 in those cases where it is not yet registered as a society. BDC membership comprises representation from each and every household within the beel vicinity (including multiple villages where this is the case), both fisherman households and non-fisherman households – and where each beel will be served by one BDC. The project will promote the BDC model to be 'institutionalized' across the State for replicability over the long term.

88. *Sub-activity 1.3.1. Support beel development committees to prepare the beel development committee operational guidelines.* The project will formalize and strengthen the institutional mechanism

[17] This will be done in cooperation with ASRLM, as reflected in the draft MoU given in Annex xx.

and capacitate the Beel Development Committee (BDC) to: (i) engage in the sustainable management of the beels (registered and unregistered), serving as 'conservators' of the beel; and (ii) undertake business operations for economic development in a sustainable and transparent manner. Service providers (SPs) will be engaged[18] by the project to support BDC institutional strengthening and capacity building in beel management and business practices these SPs are referred to as the SP-BDC, and they will: (i) undertake the BDC needs assessment; (ii) develop the corresponding training program for the BDC; and (iii) provide in-depth training and mentoring of the beel 'animator' – where the animator is identified as an active local person at the beel level, who will be the key interlocuter between the project and the BDC, and provide key operational support to the BDC. The SP-BDC will comprise at least four specialist staff[19], in addition to BDC facilitators who will be appointed to have coverage over up to 5 beels, and where the BDC facilitator will be the focal person to provide continuous mentorship of the BDCs in general and the animator in particular for a 3-year period[20].

89. In both the case of registered and unregistered beels, the BDC will undergo formalization under the Society Registration Act[21], with one male and one female household member (from the beel vicinity) becoming BDC members. This formalization includes extensive community sensitization and consultation processes, establishing governance structures (including by-law preparation, General Assembly meetings), formation and election of the Beel Development and Management Committees (BDMCs) and setting up dedicated bank accounts. The SP-BDC will support BDC formation and institutional strengthening for registered and unregistered beels to enable effective beel management and maintenance. Where the beels might be under a lease agreement, the SP-BDC will also facilitate profit-sharing negotiations with the existing lessees (such as Fisheries Cooperative Societies (FCS) or SC community). Once the lease has expired, the BDC is expected to effectively become the beel leaseholder.

90. The BDC operational guidelines will be developed collaboratively to prioritize community ownership and adapt to local context. It shall be developed in the local language with illustrations and figures for a better understanding by the local communities and other users. The project will progress through phases: recruitment and training of local beel animators, formalizing the BDCs, establishing governance structures, and negotiating profit-sharing agreements where required. The SP-BDC will also facilitate community discussions to customize these guidelines according to local needs, prioritizing community ownership in managing the Beel effectively. The operational guidelines will be comprehensive, including outlining core principles, processes and procedures for BDC establishment, membership composition, governance (responsibilities, rights and decision-making), and other operational aspects, etc. The SP-BDC engaged by the project will prepare a first template of the guidelines as a reference to be utilized and adapted throughout the community sensitization and consultation process. Following the consultation process, the (final) draft guidelines specific to each beel, will be reviewed by the BDC facilitator, who will in turn, recommend the operational guidelines for the BDMCs endorsement.

91. *Sub-activity 1.3.2. Conduct training in group management, facilitation, financial management, community-based procurement for beel development committees.* The SP-BDC, engaged to provide

[18] The full scope of responsibilities and tasks of the service provider to support BDC development (SP-BDC) are provided in the draft TORs in Annex 3.

[19] Institution building and rural finance coordinator (acting team leader); fisheries value chain officer; finance officer/ accountant; and marketing and enterprise development officer. Multiple BDC facilitators (essentially beel development officers) will also be mobilized, with each BDC facilitator covering up to 5 beels.

[20] The full support of the SP-BDC for each beel/ BDC is limited to 3 years. However, it is expected that the beel animator will continue to provide support to the BDC, becoming a professional staff hire, with remuneration expenses covered by the BDC itself following the 3 years of project support. Some provision is made to extend the support for the beel animator for an additional 2 years if deemed necessary and on an exceptional basis if the BDC is not yet able to cover the related beel animator remuneration expenses.

[21] Including facilitating the registration process (such as travel expenses to the district office, and not payment for the registration fees) and compliance with the society registration act.

support to the BDC for a total of three years, will develop and implement a training program for capacity building in group management, facilitation, financial management, and community-based procurement under the leadership of the BDC facilitator. This training will be primarily directed at the beel animators and BDMC members, with beel animators receiving additional in-depth training and mentoring. In cooperation with the community and community leaders, the BDC facilitators will be responsible during the early sensitization efforts, to identify the best candidate from the local community population to serve as the beel animator.

92. *Sub-activity 1.3.3. Conduct training of beel development committee members in sustainable beel ecosystem management best practices and climate change.* Building on activity 1.2, an on-training program will have been customised to equip Beel Development Committee (BDC) and Beel Development and Management Committee (BDMC) members specifically, with essential sustainable beel ecosystem management skills – including the skills and know-how for climate change adaptation. Participants will engage in sessions covering best practices for maintaining an ecological balance within the beel ecosystem, such as clearing water hyacinth and its economic use, strengthening bunds, monitoring water quality, and managing silting on inlet and outlet channels. Special emphasis will be placed on understanding the impacts of climate change on beel ecosystems and developing strategies to mitigate these effects. The training will empower BDC members to manage their responsibilities effectively, enhance ecosystem resilience, foster community-based approaches for sustainable resource utilization, and adapt to climate change. The technical expertise of the service provider (such as Wetlands International (South Asia)) engaged under activity 1.2 as the SP-BM , will be leveraged for this initiative.

93. *Sub-activity 1.3.4. Support beel development committees to prepare beel integrated management plans including operations and maintenance procedures and in consideration of wetland notification processes.* In line with Wetlands Rules 2017 and wise use principles, and cognizant of the interlinked and mutually reinforcing relationship between beel health and sustainable fisheries, the project will facilitate and support the preparation of the beel integrated management plans (BMP) with the strong participation of the beel community and ownership by the BDC (where the BMP is endorsed by the BDMC).

94. The service provider responsible for promoting ecosystem conservation and beel management (SP-BM), in coordination with the State Wetlands Authority, will provide the on-hand technical guidance and training at zonal cluster-level for the planning process, development, and monitoring (implementation) of the BMP. Following an initial training, a participatory approach for preparation/ development of the BMP is envisaged – whilst the SP-BM will lead the BMP development process for the first phase of high priority beels, this will be done in collaboration with the SP-BDC (and the BDC facilitator specifically), who will replicate the process for the next phased selection of priority and remaining beels. The scope and content of the BMPs could tentatively include the following aspects: description of the wetland and its values; identified threats; management goals and objectives; institutional arrangements; identified management actions; budget and source of financing; and operations and maintenance (O&M) requirements and procedures. The BMPs will be living documents that will be updated and adapted to the beel environment and context as it evolves and develops. Specific attention will be made to ensuring that these BMPs are user-friendly for the beel community, and not overly complex documents. The SP-BM will also lead the preparation of the beel 'brief document' and health card for each of the 102 beels, and these will serve as complementary documents to the BMPs.

95. *Sub-activity 1.3.5. Support beel development committees with a performance-based incentive scheme.* The capacity building support for the BDCs is comprehensive, intended to capacitate and enable them to operate in a dual function as effective business entities and community institutions practicing sustainable beel management. To encourage the BDCs in their development and operations, a performance-based incentive scheme will be established to provide the eligible BDCs with additional financial support to be utilized for their business or management needs. The performance of the BDCs

will be appraised against indicators and criteria set forth in the BDC performance appraisal matrix – these relate to both BDC performance in relation to their function in beel health and management (such as compliance/ alignment with the BMP, water quality and de-weeding monitoring and management, infrastructure maintenance, etc.), as well as their performance in terms of their governance and function as a business entity (such as capacity to generate revenue and profit, accounting/ book-keeping and financial transparency, upholding by-laws, etc.). In the initial years, it is estimated that only 20% of BDCs will have reached the threshold level of performance to be eligible for the annual performance-based incentive grant (equivalent to INR 2.5 lakhs); after receiving 2 years of project support from the SP-BDC, the expectation is that at least 50% of the BDCs will have reached a level of performance that enables them to become eligible for the incentive grant.

96. The performance appraisal matrix and guidelines and procedures of the performance-based incentive scheme will be finalized as part of project readiness activities.

97. *Sub-activity 1.3.6. Conduct beel development committee audit and performance appraisal.* The project will support effective and transparent management of beel development efforts through regular audits and performance appraisals of the Beel Development Committees (BDCs). This activity will involve systematic evaluations of BDCs to assess their adherence to governance and financial management protocols, and the execution of beel management plans (BMPs) and business plans (BPs). The audits will scrutinize financial records, operational activities, and compliance with established guidelines. Performance appraisals will measure key indicators such as business outcomes, beel health status, and the effectiveness of water management practices. By identifying strengths and areas for improvement, this process will promote accountability, enhance the operational efficiency of BDCs, and drive the sustainable development of beels. Overall, the practice of audit and performance appraisals will also contribute to improving the BDC's financial standing vis-à-vis the banking sector, which is critical for their longer-term access to finance and doing business.

98. Activity 1.4. Establish and operate the beel management monitoring system. Long-term conservation and sustainable management of Assam's beels requires a robust culture and system of monitoring and knowledge management.

99. *Sub-activity 1.4.1. Develop project MIS and beel fisheries KM platform, complementing the wetland notification process.* A project management information system (MIS) will be developed as a core management tool for improving project planning, monitoring, efficiency, transparency, communication and knowledge management in general. The MIS will facilitate oversight and monitoring of the wetlands ecosystem and complement the wetlands notification process, as a specific beel ecosystem and beel fisheries knowledge management platform will be established as part of the MIS.

100. The MIS will serve as a central repository for all project-related data and all beel-related information and data (including findings of the feasibility studies and any other studies as they develop). The MIS will integrate real-time data collection and analysis, sex-disaggregated, and is supported by the development of a complementary MIS app for field use by the beel animators, BDC facilitators, DFDOs and other project staff as necessary (who will be provided with training on the use of the app). From a management perspective, the MIS will enable timely and informed decision-making and offers a means to ensure transparency and accountability in project implementation; the system also ensures that up-to-date information on project progress and outcomes is accessible to all stakeholders. The system will also monitor the socio-economic progress of the beel communities, including marginalized groups.

101. From a knowledge management perspective, the MIS beel platform serves as the key consolidated repository of all beel information and data (including beel fisheries); the platform offers a forum for sharing best practices, research findings and lessons learned across stakeholders (from community members to policymakers). In particular, the platform facilitates beel communities to access

valuable knowledge resources, thereby supporting their capacity to engage in sustainable and best practices related to their economic activities (such as beel fisheries) and allowing them to act as conservators of the beel ecosystem and make wise use of the beel resources. Finally, the MIS will also integrate the data and information related to beel ecosystem and beel health monitoring.

102. Key users of the MIS will be trained on the system itself; in complement, DOF and other allied public institution staff will also be equipped with and trained to utilize modern and digital technologies and tools for monitoring and evaluation purposes, designed to enhance their engagement with local communities and to feed into the MIS.

103. *Sub-activity 1.4.2. Establish beel health and water quality monitoring system*. As part of the beel fisheries knowledge management system, physical beel health and water quality is a key focus area for the long-term conservation and sustainability of the beel ecosystem, central to the economic livelihood and well-being of the beel communities. Sound and robust monitoring of beel health and water quality is therefore critical for informed and timely interventions and decision-making by the beel community through their BDCs.

104. Beel health and water quality management will require technical training of stakeholders and physico-chemical and biological water quality and soil testing and monitoring in all the beels (this is an in-depth monitoring exercise, requiring capture of baseline information and follow-up laboratory-based testing and monitoring)[22]. In terms of more regular and field-based monitoring that can be done frequently and routinely by the beel communities, field water testing kits will be procured for use by the BDCs and public institutions as part of their regular monitoring responsibilities.

105. In line with wetlands rules and notification processes, and with the technical guidance of the service provider for beel management (SP-BM), beel 'brief documents and health cards will be developed, capturing available data and information from multiples sources. To complement this, an inventory of beel flora and fauna will also be undertaken. Finally, the project will also support the development of the beel conservation protocols including for small indigenous fish (SIF) species[23].

106. Activity 1.5. Establish and operationalize the Project Management Unit (PMU) and Project Implementation Unit (PIU)

107. A Project Management Unit (PMU) will be established within ARIAS Society, headed by the CEO/ ARIAS Society, and is responsible for overall project execution – including the overall coordination, management and implementation of the project and its activities – and ensuring the achievement of project objectives. As a basis, the PMU will prepare the annual work program and budget at least 2 months ahead of the state annual budget planning exercise, as well as the procurement plan, and place the annual budget before the Steering Committee for approval. The PMU will also be responsible for timely and sound monitoring of project progress – including quality control and assurances – from baseline, mid-term, and through to completion, with regular progress reporting. The progress reports will cover technical and operational progress, including compliance with environmental and social safeguards, the gender action plan, as well as financial management, accounting and audit. The SWIFT PMU will be led and coordinated by the Chief Project Coordinator, supported by the Output Coordinator(s), core administrative team (financial management officer, accountant, and procurement officer), and team of contractual staff.

108. The Project Implementation Unit (PIU) will be established under the leadership of the Director of Fisheries and is spread across the five Zonal Offices of the Department of Fisheries, each headed by the Deputy Director of the Zonal Office. At the level of the Zonal offices, the PIU is supported by a team of contractual staff, as well as the District Fisheries Development Officers (DFDO) serving as the

[22] This will be undertaken in collaboration with MoEFCC and a certified/ accredited lab to be contracted by the PMU.
[23] For conservation protocols for small indigenous fish species, the expertise of a technical institute such as WorldFish or CIFRI will also be leveraged.

District Project Coordinators.

109. Providing support – capacity building and operational support – for an effective and well-functioning PIU is critical for the long-term sustainability (and potential scaling up) of the beel fisheries sector. The Department of Fisheries through the Directorate of Fisheries is the lead technical body to guide and coordinate the efforts in sustainable beel fisheries development, having specialized knowledge, access to policy and regulatory processes, and serving as a reliable reference and contact point for the local beel communities – i.e. ensuring proximity to the communities and enhanced community engagement. The project will therefore provide operational support to DOF, ensuring that the DOF structure is sufficiently capacitated to technically lead implementation at field-proximity level, and ensure effective and proactive monitoring of activities.

110. **Output 2: Community-based fisheries business developed and beel community income diversified**

111. Beels, or floodplain wetlands, serve as habitats for fish production, supporting diverse aquatic biodiversity and providing essential ecosystem services. The beel fisheries sector plays a significant role in providing livelihoods to millions of people, particularly those in rural areas, thereby contributing to poverty reduction and socio-economic development. Additionally, fish from beel fisheries are a vital source of nutrition, helping to address food security challenges and improve dietary diversity among communities. Furthermore, the sector's economic significance is underscored by its potential for income generation, value addition, and export earnings, thereby stimulating economic growth and rural development. By promoting sustainable fisheries management practices and value chain development initiatives, Assam can harness the full potential[24] of its beel fisheries sector, ensuring environmental sustainability, social equity, and resilience to climate change while fostering inclusive economic growth and prosperity for its population. Details of beel fisheries value chain of Assam is represented in Fig. 3.1.

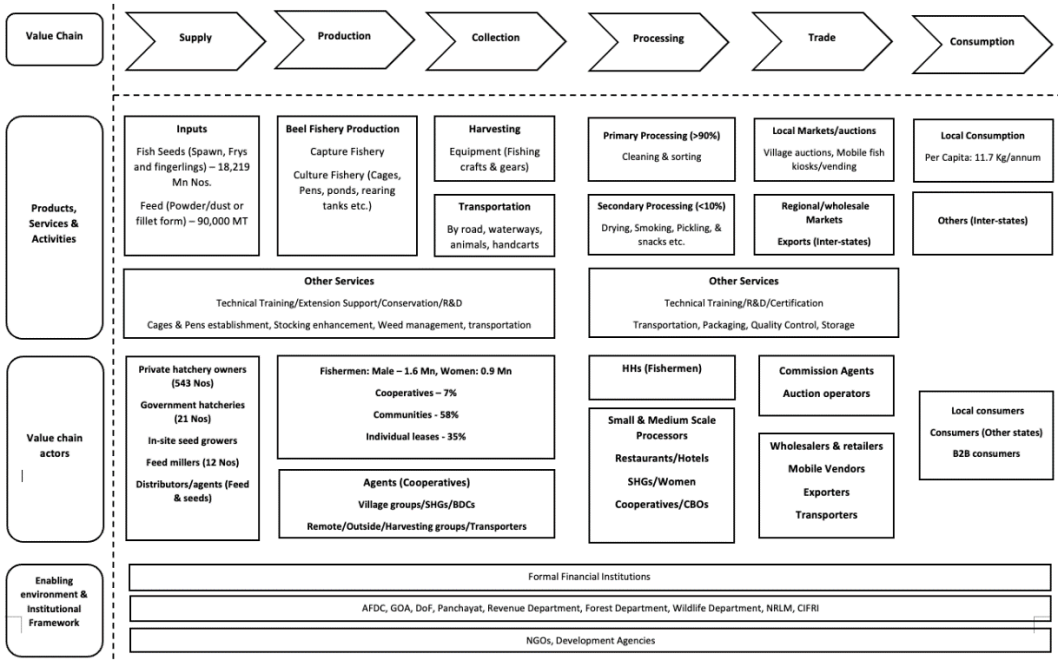



**Figure 3-2. Beel Fisheries Value Chain in Assam**

[24] In terms of fish production potential, floodplain wetlands in Assam have a potential range of 1,000 to 1,500 kilograms per hectare per year based on management practices. Wetlands practicing culture-based fisheries yield approximately 704.60 kilograms per hectare per year, while those without supplementary stocking produce around 206.4 kilograms per hectare per year.

112. Activity 2.1. BDC capacity building and inclusion in fisheries value chain.

113. *Sub-activity 2.1.1. Provide training in organizational management, facilitation, business plan development and financial management*. To ensure the sustainable management of beels, the project will equip the BDCs with comprehensive training in organizational management, facilitation, business plan development, financial management, and fine-tuning their business model. In complement, the project will facilitate digital payments to support the operation of all these transactions, ensuring efficient and transparent financial management. This combined support and training aims to empower BDC and BDMC members with the skills necessary to effectively coordinate activities, facilitate stakeholder engagements, develop robust business plans tailored to local contexts, manage finances transparently, and optimize their operational strategies. By enhancing their capacity in these areas, BDCs can play a proactive role in maintaining beel health, implementing sustainable practices, and fostering community-driven initiatives that support both ecosystem/ ecological conservation and livelihood enhancement.

114. The SP-BDC will be tasked with developing the comprehensive training program for the BDC/ BDMC and mobilizing the requisite resource persons to conduct centralized training; alongside, continuous training and hand-holding will take place at the BDC-level, with the BDC facilitators and beel animators providing this level of close mentoring. At the BDC-level, the project also makes provision for BDC office equipment in the form of a desktop computer, simple (single-user) accounting system, office chair and table, and record-keeping books.

115. *Sub-activity 2.1.2. Technical advisory and extension support (for fish production and productivity enhancement; and post-harvest management and value addition).* To promote adoption of best practices for sustainable fisheries production, the project will support provision of technical advisory and extension services. These services will be coordinated by the Project Management Unit (PMU) and delivered initially through clustered or centralized Training of Trainers (ToTs) – with DoF and allied public institution staff as recipients of the training. Following this, the Farmer Field School (FFS) method will be adopted for training beel animators, a selection of lead fishermen and BDC members. Technical advisors specializing in beel fisheries, such as those from the Central Inland Fisheries Research Institute (CIFRI) and/ or WorldFish will provide training focused on productivity enhancement for both capture and culture fisheries. Key areas of technology dissemination will include the quality of inputs such as fish seed and feed, improved and innovative rearing techniques, and the use of proper fishing gear and craft.

116. A service provider will also be engaged to provide technical advisory and extension services covering best practices in harvesting and aggregation, post-harvest management (including transportation and storage), and value addition through primary processing techniques like sorting, grading, and drying. Additional preservation practices, such as smoking and pickling and other value addition targeting exports, will also be promoted through advisory support prioritizing innovative techniques to reduce post-harvest loss, as well as enhanced food safety.

117. To support business development, the program will facilitate business planning, provide business training and mentoring, and facilitate financial access and market linkages[25].

118. *Sub-activity 2.1.3. Conduct a value chain study and market survey.* In the first year of project implementation, a comprehensive value chain study for the beel fishery sector will be conducted in collaboration with an external technical expert such as WorldFish. This study aims to identify and validate necessary project interventions, ensuring that they are data-driven and specifically tailored to the unique needs of the beel fishery sector. The study will closely examine all stages of the value chain – from input supply and production to processing, marketing, and distribution – analyzing the key issues at each stage and the dynamics of value chain actors. The study will also analyze and assess the

[25] The SP-BDC (budgeted under output 1.3) will be tasked to support BDC business development.

associated enabling environment to develop targeted solutions which could enhance productivity and sustainability along the value chain.

119. This value chain study will look into market dynamics, including the (high) demand and price for small indigenous fish (SIF) and the limited value addition currently observed. It will assess the potential for increasing production through sustainable practices such as habitat restoration, improved water management, and the introduction of modern technology and inputs. Additionally, the study will explore socio-economic factors driving youth migration from beel communities and propose strategies to transform beel fisheries into attractive, revenue-generating ventures. By providing a detailed analysis of existing challenges and opportunities, the value chain study will establish a foundation for effective and impactful project interventions, aiming to create a more efficient, productive, and sustainable beel fishery value chain.

120. The project will also support a comprehensive market survey to be conducted following the project's mid-term (years 3-4) to assess the impact of project interventions on the beel fishery production levels and productivity. This survey aims to evaluate the effectiveness of interventions such as habitat restoration, improved stocking practices, and enhanced water management in boosting productivity. By analyzing market trends, demand fluctuations, and price variations, the survey will provide critical insights into the economic benefits realized (or unrealized) by the communities and identify the opportunities for enhanced market participation of the local population, particularly the business opportunities arising in the beel fisheries sector. The findings will also identify any gaps or challenges that persist, enabling the refinement and optimization of ongoing and future interventions to ensure sustainable growth and maximum value addition in the beel fishery value chain.

121. In terms of branding and marketing, the opportunity to promote or establish an "Assam Beel Fishery" brand for regional and national markets will be explored and costed, to capitalize on the unique features and additional value of fisheries products originating from Assam's beels.

122. Activity 2.2. Public sector support for community-based fisheries value chain infrastructure development.

123. *Sub-activity 2.2.1. On-beel infrastructure development*. Public sector support is vital for the development of community-based fisheries value chain infrastructure, emphasizing beel fisheries production, harvest, and immediate post-harvest handling. This support will be provided as a 100% grant for community-use through the BDCs.

124. On-beel infrastructure improvements and investment will include the construction of nursery rearing ponds and pens for raising fingerlings to the optimum size for stocking (including the initial stocking seed/ material), fishing boat and the establishment of fish landing sites as aggregation points. These landing sites will be equipped with enhanced hygiene and sanitation facilities, temporary storage solutions such as cool boxes with ice, and appropriate handling crates and bins. Additionally, the provision of fishing gear and crafts will be tailored to the specific business needs of the respective BDCs, with grant ceilings determined by the size of the beel (small, medium, and large).

125. Support for the on-beel activities and infrastructure requirements will be subject to a maximum ceiling and will be based on the BDC business plan; activities are demand-driven and based on small, medium and large financial models (profit and loss and balance sheet projections).

126. *Sub-activity 2.2.2. Off-beel infrastructure development.* Off-beel infrastructure support will focus on establishing or upgrading existing auction centers[26] (as village aggregation points) with necessary sanitation and hygiene aids, including washing bins, cooling tanks, and mini-ice flake units, while promoting transparency through the installation of weighing scales and price list displays. The location of auction centers is expected to be in proximity to medium/large beels, provided that other

[26] On average, one auction center should be able to serve 3 beels.

infrastructure (road accessibility, etc.) needs are met. If not, the auction center can be established near the publicly owned rural market.

127. Activity 2.3. Private sector and entrepreneurial-led fisheries commercialization.

128. *Sub-activity 2.3.1. Beel fisheries business development fund operation*. This will be a demand-driven initiative to promote private sector engagement and entrepreneurship development specifically targeting youth in villages surrounding selected beels under the project[27]. The fund will be utilized to support both upstream and downstream revenue generating activities with the objective of enhanced commercialization of the beel fisheries value chain. The operational modalities of the fund are outlined below.

- **The fund is a matching grant facility**, supporting, but not limited to culture fishery (pens/ponds culture for table fish production (particularly relevant for youth engagement)), seed hatchery, feed mill, primary processing and other value addition initiatives, and marketing *(branding, premium market access, certification, traceability)*.
- **The implementation plan for inviting and processing proposals** under the SWIFT project is structured to ensure transparency, inclusivity, and efficiency from the initial call for proposals to the disbursement of matching grants. This plan details the sequential steps involved in the proposal process, emphasizing the project's commitment to enhancing the fisheries value chain in Assam through strategic partnerships with the private sector, farmer/fisher organizations, SHGs, and cooperatives.
- **Call for Proposals through Advertisement:** The PMU will officially launch the call for proposals by publishing advertisements in prominent newspapers, digital platforms, and official government websites. The advertisement will detail the project's objectives, eligibility criteria, application process, and deadlines to ensure widespread visibility.
- **Providing the Required Format:** Alongside the call for proposals, the PMU will provide detailed guidance documents and application formats available for download from the official website. These documents will include templates for business plans, financial projections, and other necessary details to standardize the submission process and ensure that applicants provide comprehensive information.
- **Business Planning:** Applicants will be required to prepare their business plans according to the provided format, focusing on how they intend to engage with and support Beel fishermen, the expected outcomes, and how their project aligns with the SWIFT project's objectives. The business plan should also detail the proposed investment, the innovation introduced, and the sustainability measures.
- **Submission of the Proposal:** Proposals can be submitted both online through a dedicated portal and offline at specified submission centres. The deadline for submission will be clearly communicated in the call for proposals. Applicants must ensure that their proposals are comprehensive, adhering to the provided templates and guidelines.
- **Review of the Proposal:** Submitted proposals will undergo a rigorous evaluation process by a panel consisting of experts from the fisheries sector, financial analysts, and value chain experts. This panel will assess proposals based on their viability, impact on Beel fishermen, sustainability, and alignment with the SWIFT project's goals.
- **Matching Grant and 60% Contribution by the Private Sector:** Upon approval, projects will receive a matching grant covering 40% of the total project investment. It will be mandatory that applicants must have already arranged funding to finance the remaining 60% of the requisite funds ahead of final approval of the matching grant. This requirement is designed to ensure that participants have a significant stake in the project's success and are committed to its execution.

[27] Whilst youth engagement is a priority, the fund is open to applicants from the targeted beel population/ vicinity as individuals or 'groups'.

- **Bank Linkage:** Entrepreneurs will be linked to banks under various schemes, such as the MUDRA scheme, to secure bank financing. This linkage is essential in scenarios where the entrepreneurs' own savings are insufficient to cover the required 60% contribution.
- **Disbursement of Funds:** The matching grant will be disbursed in stages based on the project milestones and upon verification of the 60% contribution by the applicant. This staged disbursement aims to monitor progress and ensure accountability throughout the project implementation.
- **Monitoring:** To ensure transparency and accountability, a dedicated monitoring framework is established to track the investments made by private sector entities that have received a 40% matching grant from the SWIFT project. This framework aims to validate that the private sector contributions (representing the required 60% of the total project cost) are effectively utilized towards achieving the goals of enhancing the fisheries value chain and supporting Beel fishermen.

129. *Sub activity 2.3.2. Conduct training and exposure visit in branding, market development, and innovative processing and packaging along the value chain*. To strengthen the beel fisheries value chain, specifically downstream activities, targeted training and exposure visits will be conducted, focusing on branding, market development, and innovative processing and packaging. These initiatives are tailored for entrepreneurs, SMEs and MSMEs engaged in value addition, trade, and export activities; in particular, training and exposure visits are directed at those entrepreneurs who have successfully obtained approval for a matching grant under business development fund. Exposure visits will be arranged for larger processors and traders to observe best practices in the industry.

130. The training will also align with the efforts to establish a distinctive brand for Assam Beel Fishery products, highlighting their unique qualities and regional heritage. Training will encompass brand creation, effective marketing strategies, and the adoption of modern processing and packaging technologies to enhance product appeal and durability. Certification, traceability and quality assurance support will be provided to ensure that Beel Fishery products meet high standards, making them competitive in markets across India and internationally. These efforts aim to create a strong market presence for Beel Fishery products, driving the commercialization objective under the output.

131. Routinely, participation in trade shows, knowledge-sharing and other networking events will be promoted to foster deeper networking, visibility and the exchange of innovative ideas. A service provider to guide and provide the requisite training for enhanced business and marketing/ commercialization will be mobilized as needed.

132. Activity 2.4. Extend other income generation activities through women’s self-help groups

133. Fishing communities in Assam face significant challenges that necessitate targeted interventions to create alternative livelihood activities. Due to the seasonal fishing ban, primary income source for many households gets disrupted, leading to financial instability. In registered and unregistered beels, restricted access and poor maintenance further limit fishing yields, intensifying poverty and food insecurity. This dependence on a single source of income makes these communities particularly vulnerable during lean periods, highlighting the need for diversified and sustainable livelihood options.

134. Project interventions aim to address these vulnerabilities by promoting alternative income sources that provide stability, especially during the fishing ban. Encouraging agricultural activities, such as rice and lentil cultivation, as well as areca nut plantations, vegetable farming, and livestock rearing, can diversify income streams. Skill development and vocational training can further empower community members by creating new employment opportunities, reducing reliance on fisheries, and minimizing migration.

135. Across the beels, water hyacinth (*Eichhornia crassipes*) is in abundance, and there is opportunity to turn the challenge that water hyacinth presents to the beels, into livelihood options. Water hyacinth has several practical applications i.e., handicraft, aerobic composting, bio energy and animal feed. Some of these applications can be adopted by the local communities as a livelihood option. Creating handicrafts from water hyacinth has become a transformative initiative, particularly in regions like Majuli, Assam. This innovative approach turns an invasive plant into a valuable resource, providing sustainable livelihoods for local communities. Artisans craft a variety of products, including baskets, mats, bags, and furniture, showcasing their skills and creativity. Supported by organizations like the Assam State Rural Livelihood Mission (ASRLM), these efforts not only help in managing the water hyacinth problem but also empower women and local artisans economically.

136. In particular, Self-Help Groups (SHGs), predominantly composed of women, are pivotal in driving these initiatives, fostering community support, and ensuring the sustainability of alternative livelihood activities.

137. *Sub-activity 2.4.1. Self-help groups (SHGs) mapping and needs assessment.* The Community Resource Person (CRP) of ASRLM, reporting to the specific cluster-level SHGs federation and working in the SWIFT villages, will lead the mapping and needs assessment of Self-Help Groups (SHGs). This exercise will cover various aspects, including the current status of the SHGs, their last assessment grade, existing loans, livelihood needs and preference, and skill levels of the members. A detailed report will be generated for each Block Development Cluster, reviewed by the service provider engaged for BDC development support (SP-BDC) and beel animators, and submitted to the cluster PIUs (SWIFT) for further action.

138. *Sub-activity 2.4.2. Strengthen SHGs including revitalization of defunct SHGs.* To strengthen SHGs, including the revitalization of defunct SHGs, targeted support and training will be provided with the assistance of the Community Resource Persons (CRPs). Defunct SHGs will receive orientation training on financial literacy, intra-lending practices, and bookkeeping, along with assistance in developing simple business plans to aid their revitalization. Functioning SHGs will continue to receive support through ongoing ASRLM activities and additional assistance in creating and implementing business plans.

139. *Sub-activity 2.4.3. Start-up capital for performing SHGs.* Start-up capital is provided to performing Self-Help Groups (SHGs) - categorized grade A or B – through the BDCs, encouraging them to diversify their livelihood activities according to their specific business plans. This capital support is complemented by targeted skills development training in collaboration with the ASRLM, which includes enhancing financial literacy, promoting internal lending practices, and facilitating annual grading. Defunct SHGs become eligible for this start-up capital only if they improve their status to minimum grade B. The application for the start-up grant would be vetted by the beel animator (at the BDC level) and approved by the BDMC before forwarding to the CPIU.

140. *Sub-activity 2.4.4. Conduct SHG skills development and vocational training.* The project will recruit two technical advisors to be assigned to each (DOF) Zonal Office, specializing in skills such as livestock rearing and pearl farming, etc. These advisors will be responsible for providing specific technical training before the SHGs start their business activities, as well as ongoing support thereafter.

141. Alongside the advisors, the SP-BDC will offer coaching and mentoring to the SHGs once they have initiated their business activities. This support will focus on developing the specific skills required for these activities, including the intricacies of pearl farming, technical aspects of livestock rearing, such as breed management, disease management, feed management etc. For the SHGs, training will also be provided on branding, market development, innovative processing and packaging; other specialised technical trainings may also be supported as needed.

142. As a partnership, and whilst leveraging the institutional knowledge, network and resources of ASRLM, the project will also provide an honorarium to CRPs, not exceeding INR 3000 per month, for their additional work under the SWIFT project. However, to prevent confusion regarding the roles and responsibilities of CRPs, the respective ASRLM office will provide a monthly work plan for CRPs, and this plan will include all SWIFT activities per the agreement to be entered into by the project and ASRLM – the work plans will be designed to integrate SWIFT activities with ongoing ASRLM initiatives, promoting synergy and avoiding duplication of efforts. It is further expected that the CRPs will work closely with BDC animators in the field to ensure effective implementation and coordination of activities

143. *Sub-activity 2.4.5. Pilot eco-tourism initiatives.* The project will pilot community-based eco-tourism in up to six selected beels, aimed at boosting the local fish business, generating sustainable employment and income opportunities for communities, and promoting conservation and awareness raising.

144. As a rationale, eco-tourism presents a unique opportunity for environmentally responsible travel, fostering appreciation for undisturbed natural areas while promoting conservation and benefiting local communities. By adhering to eco-tourism principles, which include minimizing negative environmental impacts, building awareness and respect for culture and nature, and providing direct financial benefits for conservation and local empowerment, eco-tourism can serve as a catalyst for sustainable development and resource conservation.

145. Across the 102 beels to be supported under the project, a number of beels are characterized by their diverse biodiversity, including native and migratory bird species, which is appealing to the public from a tourism perspective. In the case where a beel is favoured with characteristics such as good road connectivity, absence of water hyacinth, and rich biodiversity, they may be prioritized for eco-tourism initiatives. These landscapes provide a haven for nature enthusiasts and offer a plethora of recreational opportunities, ranging from boating and fishing to birdwatching and bushwalking. Whilst a feasibility study and detailed eco-tourism proposal will have to be developed for each pilot, within this scope, key features of the eco-tourism development initiative may likely include the following:

- Visitor centers: Establishing visitor centers near prominent beels to provide information, maps, and educational exhibits about the wetland ecosystem, local culture, and biodiversity.
- Nature trails and birdwatching platforms: Creating well-maintained trails and observation platforms around the beels to allow visitors to explore the natural beauty and observe wildlife, particularly birds.
- Boat tours and kayaking: Organizing guided boat tours and kayaking trips on the beels, allowing visitors to experience the serene beauty of the wetlands and observe aquatic flora and fauna.
- Cultural experiences: Incorporating cultural activities such as traditional music and dance performances, local cuisine tastings, and craft demonstrations to provide visitors with an immersive cultural experience.
- Eco-friendly accommodation: Developing eco-lodges or homestay facilities near the beels that adhere to sustainable practices and offer visitors a comfortable stay amidst nature.

146. The proposal(s) – including infrastructure needs–will be developed and submitted during the course of project implementation, with a strong attention to safeguarding the ecological integrity and cultural heritage of the beels.

147. **Output 3: Beel conservation and restoration planned and managed.**

148. A dedicated focus on conserving and restoring wetlands and beels is essential from an environmental perspective, and in keeping with the efforts to promote *sustainable* fisheries. The project will support beel conservation and restoration through various measures; these include enhancing beel infrastructure by demarcating and rejuvenating areas, controlling inflow and outflow, and managing nutrient inflow through nature-based solutions. Additionally, a monitoring system will be established to

assess beel health and water quality. These conservation measures will also be outlined in the beel integrated management plans (BMP). For the further protection and sustainable management of the beel wetlands, the project may support the additional necessary steps to be taken to formally notify wetlands as may be required.

149. Activity 3.1. Beel demarcation.

150. The present lack of clearly defined beel boundaries has led to a number of issues, in particular encroachment and unauthorized access. Given the expansive size of the beel, monitoring the entire area is also a significant challenge.

151. To effectively address some of these issues, the project will support the demarcation of the beel boundary, which once defined, will serve as a critical foundation for subsequent activities in the area. The demarcation process should involve detailed satellite mapping, especially utilizing 1.5-meter satellite images. Additionally, marking the boundary with the assistance of revenue maps and a trace map of the beel will be essential.

152. Following the completion of satellite mapping, ground truthing becomes imperative to validate the accuracy of the delineated boundary. Ground truthing entails physically verifying the boundary on-site, ensuring alignment with the mapped boundary. This comprehensive approach enhances the reliability of the demarcation process, addressing concerns related to encroachment and unauthorized access effectively.

153. The project will also install visible markers, such as pillars, along the boundary to enhance visibility and enforceability. These markers clearly indicate the beel boundary, aiding in regulatory enforcement and protecting the ecosystem's integrity. To clarify and enforce the beel boundary, boundary pillars will be installed at regular intervals (every 50 or 100 meters, or as site conditions dictate); these markers will aid in easy identification and delineation of the boundary, with corresponding GPS coordinates for precise referencing.

154. Overall, a clear boundary allows stakeholders to efficiently enforce regulations (preventing encroachment and unauthorized activities) and supports improved monitoring of the beel and activities within the designated area. This will serve as a basis for building a strong foundation for sustainable management and conservation of the beel. The EA will ensure that the project actively engages local community and fishery stakeholders through consultations and collaborative planning to integrate their inputs effectively during beel demarcation. This approach will not only enhance the effectiveness of the demarcation process but also foster a sense of ownership.

155. *Activity 3.2. Beel rejuvenation.*

156. *Sub-activity 3.2.1. De-weeding and macrophyte management.* Macrophytes, and floating aquatic weeds such as water hyacinth especially, build up a huge biomass on the water surface and choke the water body. This can lead to: (a) obstruction to light penetration required for photosynthesis by primary producers causing reduction in dissolved oxygen level (b) impediment to water flow, causing sedimentation, flooding and soil erosion; (c) enormous water loss through transpiration; (d) biomass that accumulates after the death and decay of weeds reduces water storage capacity; (e) drastic change in the physical and chemical properties of water with detrimental effects on the biota; (f) hindrance to navigation; and (g) fishing is hampered, reducing the catch, source of food and income of local population. Weeds also cause environmental as well as public health problems, as they may create a microhabitat suitable for the breeding of many vectors of human diseases and for harboring poisonous snakes. Therefore, removal of floating weeds is necessary to make wetlands/beels productive. The method chosen for de-weeding by manual or mechanical can vary depending on factors such as the size of the beel, the extent of weed infestation, available resources, and

environmental considerations.

157. The project will support de-weeding to be undertaken in beels where the macrophyte coverage exceeds 25%. To the extent possible, complete removal of water hyacinth is recommended following verification by DoF on macrophyte and water hyacinth coverage. It should be noted that submerged macrophytes will not be removed due to environmental safeguards issue. Removing submerged macrophytes from beels can disrupt aquatic ecosystems, leading to the loss of habitat for fish. Additionally, it can result in reduced water quality due to the release of nutrients and sediments previously stabilized by the plants.

158. Both manual and mechanical methods for macrophytes control and weed removal may be utilized based on beel situation and site-specific conditions. Manual removal could play a role in comparatively smaller beels (up to the size 10-15 Ha) while for larger areas (size >15 Ha), a combination of both manual and mechanical methods could be a more efficient solution. Sample pictures of manual and mechanical removal of weeds is depicted in Figure 3-3.



**Figure 3-3. Sample pictures of Proposed Manual and Mechanical Removal of Weeds[28]**

159. *Sub-activity 3.2.2. Desilting.* Assam's beels, crucial for the state's freshwater ecosystem, are threatened by siltation. Accumulating sediment, muck, and organic matter degrade their ecological health, reducing water retention and increasing nutrient loads that promote excessive weed and macrophyte growth. Increased nutrients fuel weed growth, which decomposes and accumulates on the bottom, further reducing water depth, diminishes water quality and harming the entire ecosystem.

160. The project will support the removal of silt and sediment through strategic desilting efforts that are essential for wetlands restoration. Dry excavation and dry desilting in the beel periphery will be promoted during the lean period, as well as desilting in inlet and outlet channels where there is need to ensure proper water flow and hydrological gradient for healthy exchange of water, preventing stagnation and promoting oxygen levels. In consideration of environmental safeguards, no underwater

[28] ASLRM, Assam and Deccanherald.com

dredging will be undertaken in the beels. Sample pictures of Proposed Dry exaction or Desilting is depicted below.



**Figure 3-4. Sample pictures of Proposed Dry exaction or Desilting[29]**

161. *Sub-activity 3.2.3. Earthen mounds.* The project will support the creation of earthen mounds in a few select beels on a pilot basis. The development of a well-designed and robust (flood-resistant) earthen mound within a beel could provide a wide range of environmental benefits. Primarily, it creates a new habitat and is used by birds and other biota for resting, roosting, and nesting. By incorporating different elevations and a series of native plants, the aesthetic of the beel can also be improved. The earthen mound will be constructed using desilted material.

162. *Activity 3.3. Beel inflow and outflow control improvement*

163. *Sub-activity 3.3.1 Desilting of beel connecting channels*. The project will specifically support desilting in the beel connecting channels to reduce silt and nutrient load into the beels and improve the water flow. This activity will help maintain the ecological balance and ensures the effective drainage and replenishment of the beel, preventing flooding. This would also facilitate auto recruitment of fish and breeding migration. An initial effort to desilt the channels will be financed by the project, with subsequent periodic silt removal as part of the maintenance efforts under the responsibility of the beel development committees (BDCs).

164. *Sub-activity 3.3.2 Construction of embankments* / peripheral bunds – site specific; use beel silt disposal; strengthen existing bunds; raising bund height; new bunds as required. The project will support the construction of embankments or peripheral bunds based on site-specific requirements and needs. Existing bunds may be strengthened or raised in height, and new bunds may also be constructed where required. The rationale for constructing embankments or peripheral bunds is to protect adjacent land from flooding, prevent soil erosion, and manage water levels within the beel. The silt (disposal) from the desilting activities will be repurposed for the embankments/ bunds.

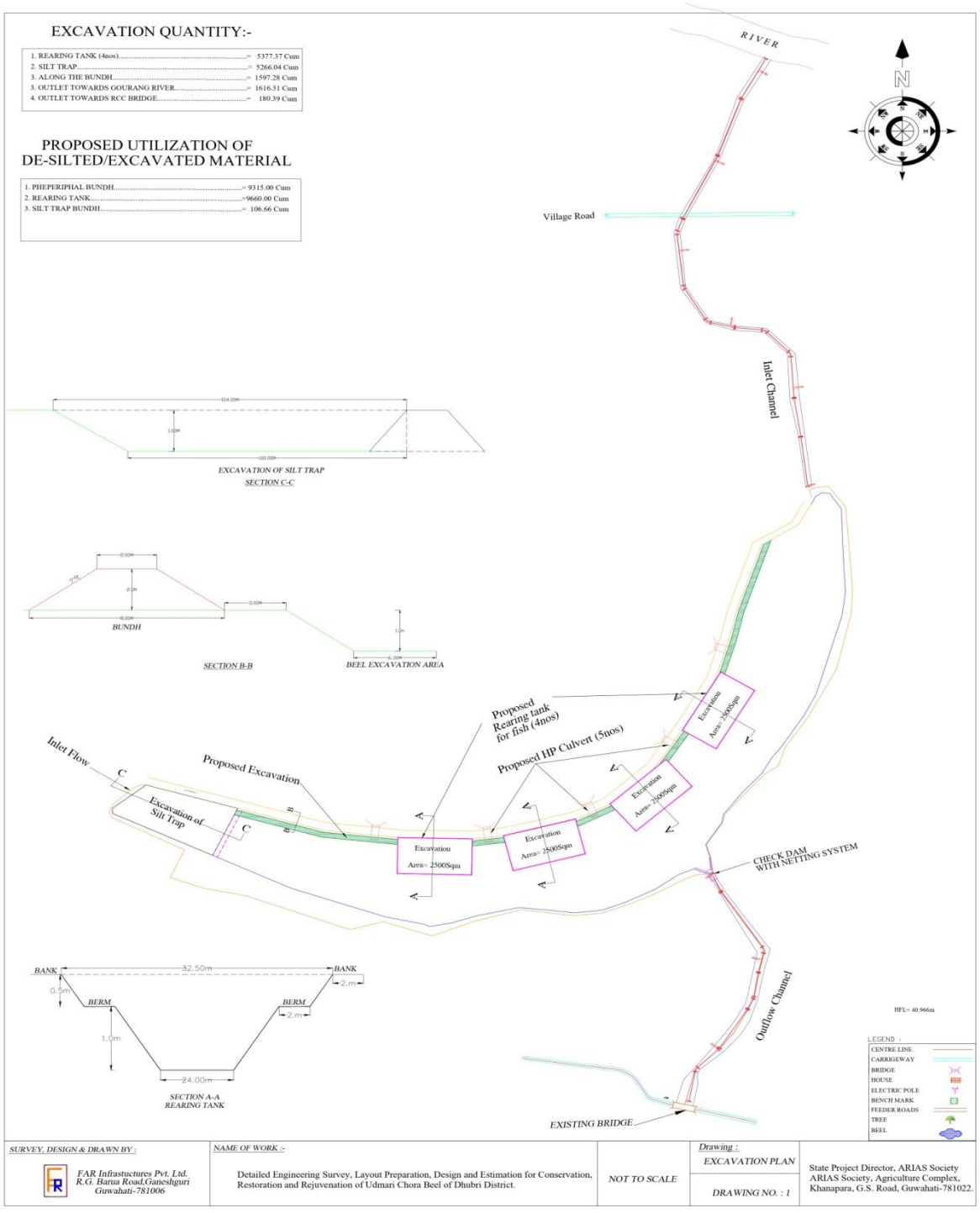
165. *Sub-activity 3.3.3 Installation of silt traps*. The project will support the installation of silt traps in the inlet, where it is confluent to the beel; this will trap the flow of sediment-laden runoff and nutrient loading in the beels. These silt traps will be constructed at low heights and arranged in a cascade formation, ensuring strategic placement for the effective capture of silt and sediment before they enter the beel. Additionally, a need-based silt trap basin may be constructed at confluence point to reduce the velocity of incoming water, thereby enhancing silt deposition and preventing excessive sediment buildup within the beel.

[29] lakeexcavating.com

166. *Sub-activity 3.3.4 Construction of water retaining structures*. Water retaining structures play a crucial role in managing water resources and mitigating the impact of floods and droughts. Based on the (beel) site suitability and conditions, the project will support the construction of water retaining structures. Sluice gates help regulate water levels, ensuring sufficient water retention during dry periods to sustain fishing activities and controlled release during periods of excess rainfall, thereby preventing flooding. Gabion structures, on the other hand, control water flow and reduce erosion in hilly regions, contributing to the stability and sustainability of the beel ecosystem.

167. *Sub-activity 3.3.5 Installation of hume pipes.* Based on assessed need, the project will support the installation of hume pipes as required at selected sites. Hume pipes will be useful in beel restoration for regulating water flow, preventing erosion, and enhancing drainage connectivity. By regulating water flow between different sections of the beel and surrounding areas, hume pipes help maintain optimal water levels, which is crucial for supporting aquatic life and preventing issues such as flooding or drought. Hume pipes could also be useful in erosion control by directing water through designated channels.

168. Master plan of all 74 beels are depicted in the figures 3-5 to figure 3-78 while satellite view of beels showing key interventions are presented in figure 3-79 to figure 3-152.




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**Figure 3-5. Master Plan layout of Udmari Chara Beel**

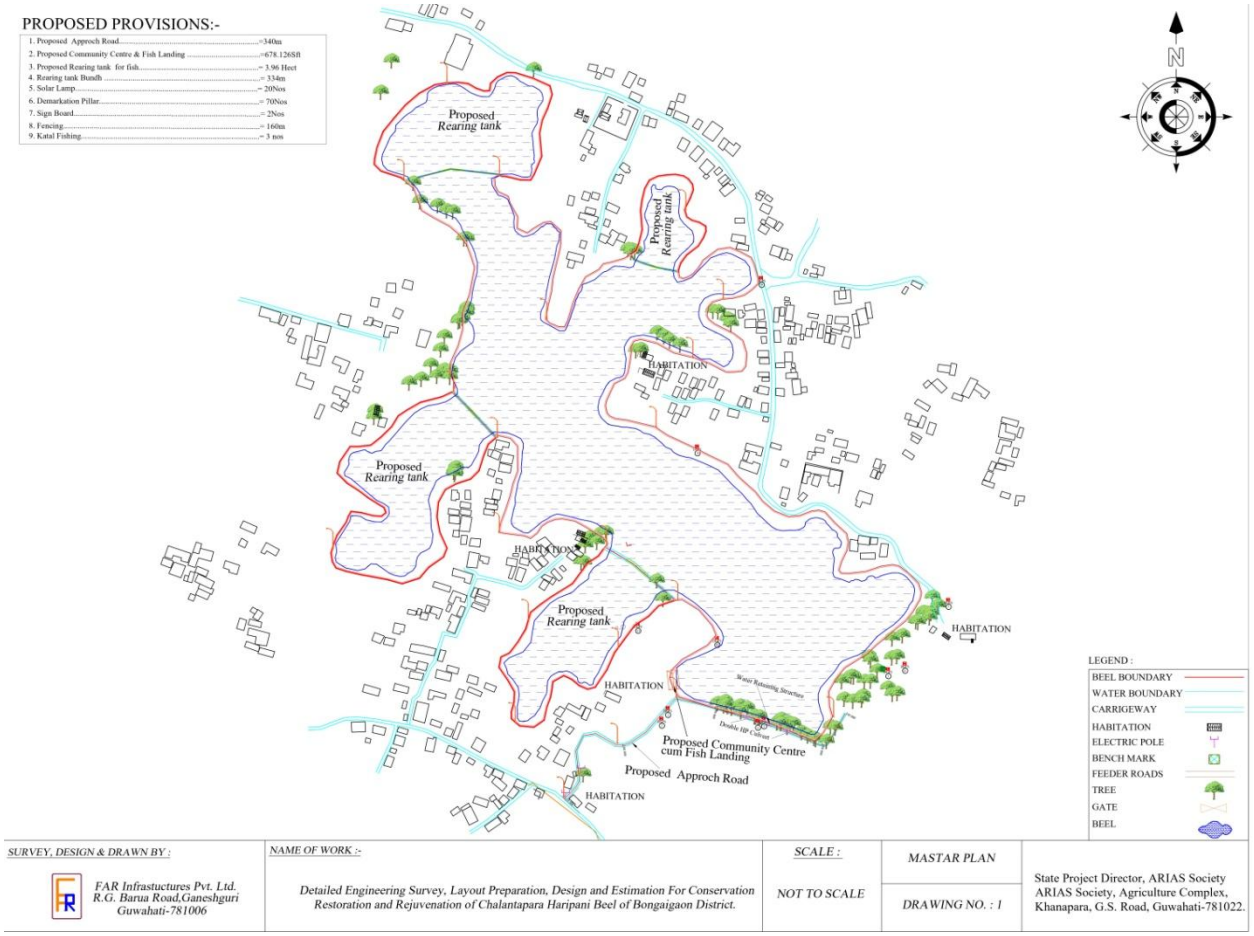



**Figure 3-6. Master Plan layout of Chalantapara Haripani Beel**

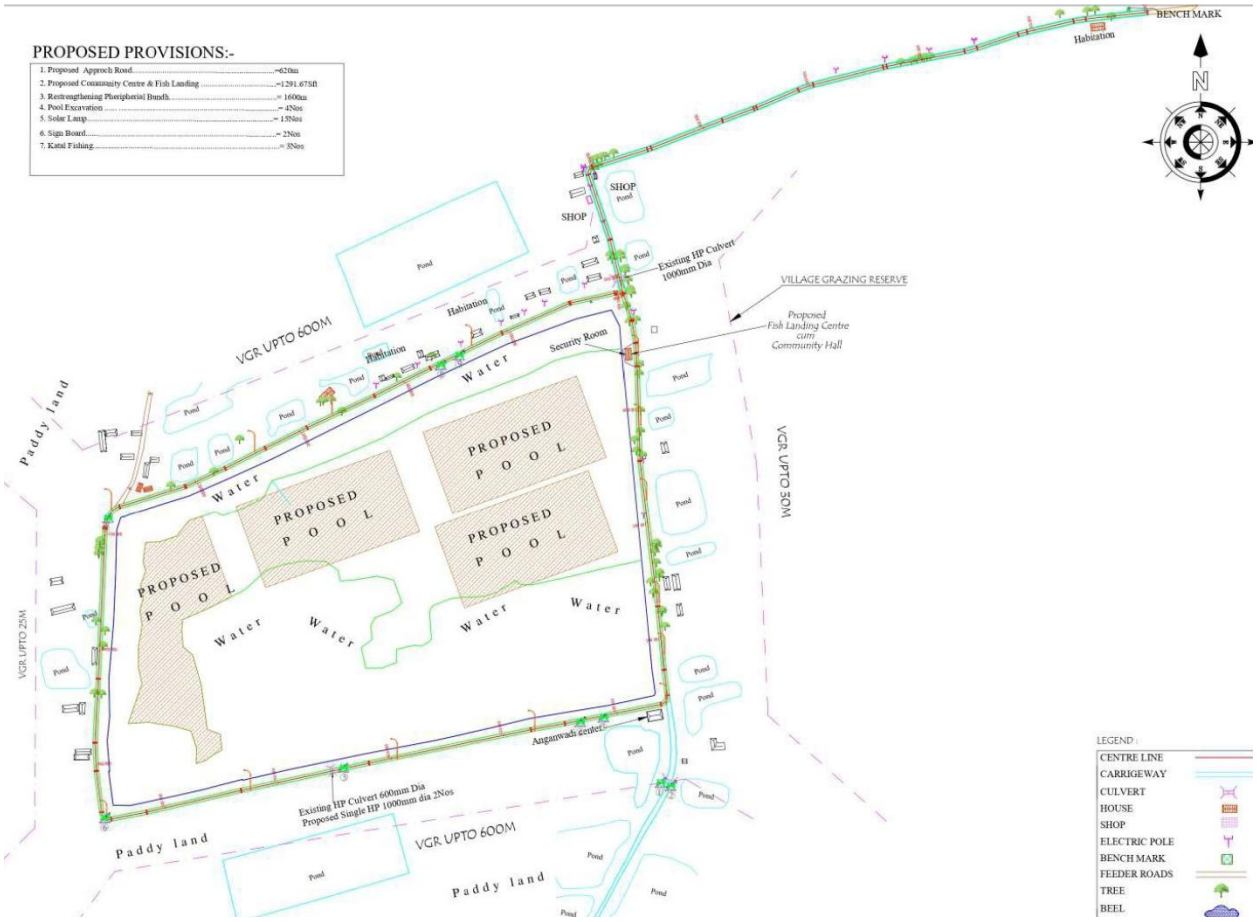



**Figure 3-7. Master Plan layout of Gandhi Beel**

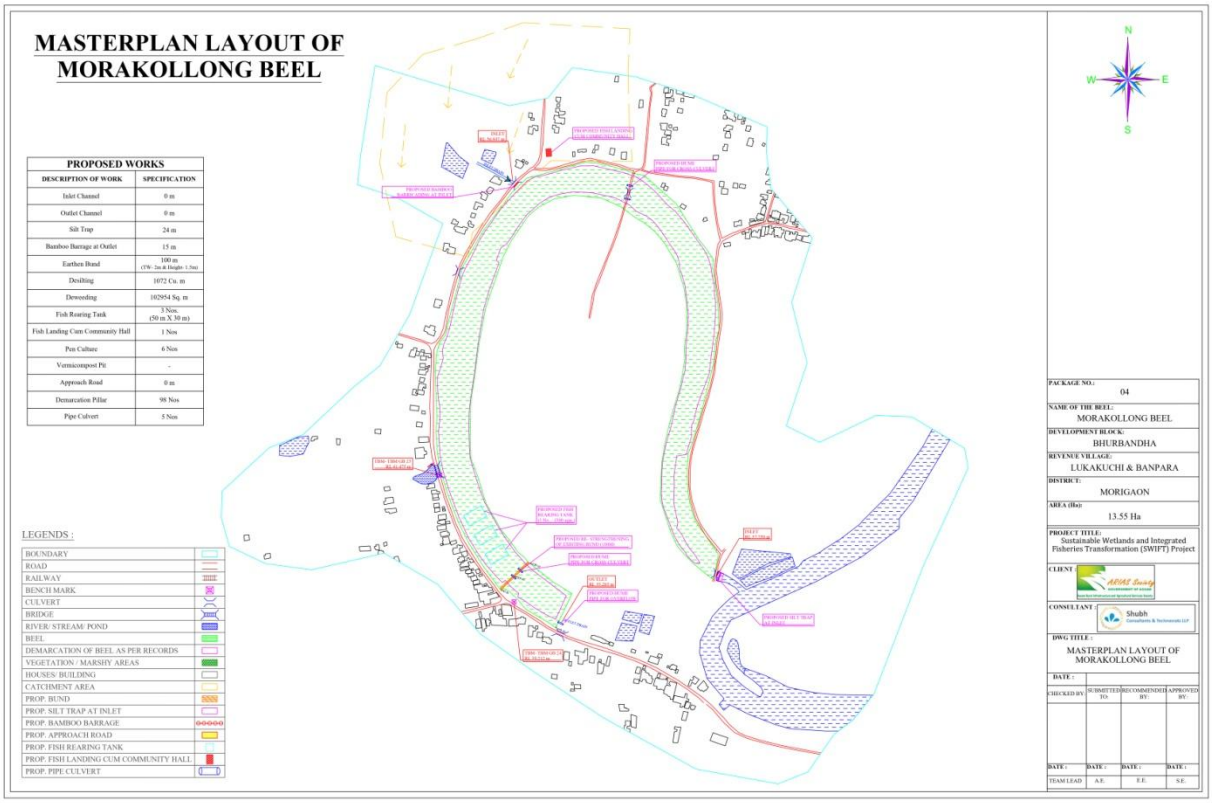



**Figure 3-8. Master Plan layout of Morakollong Beel**

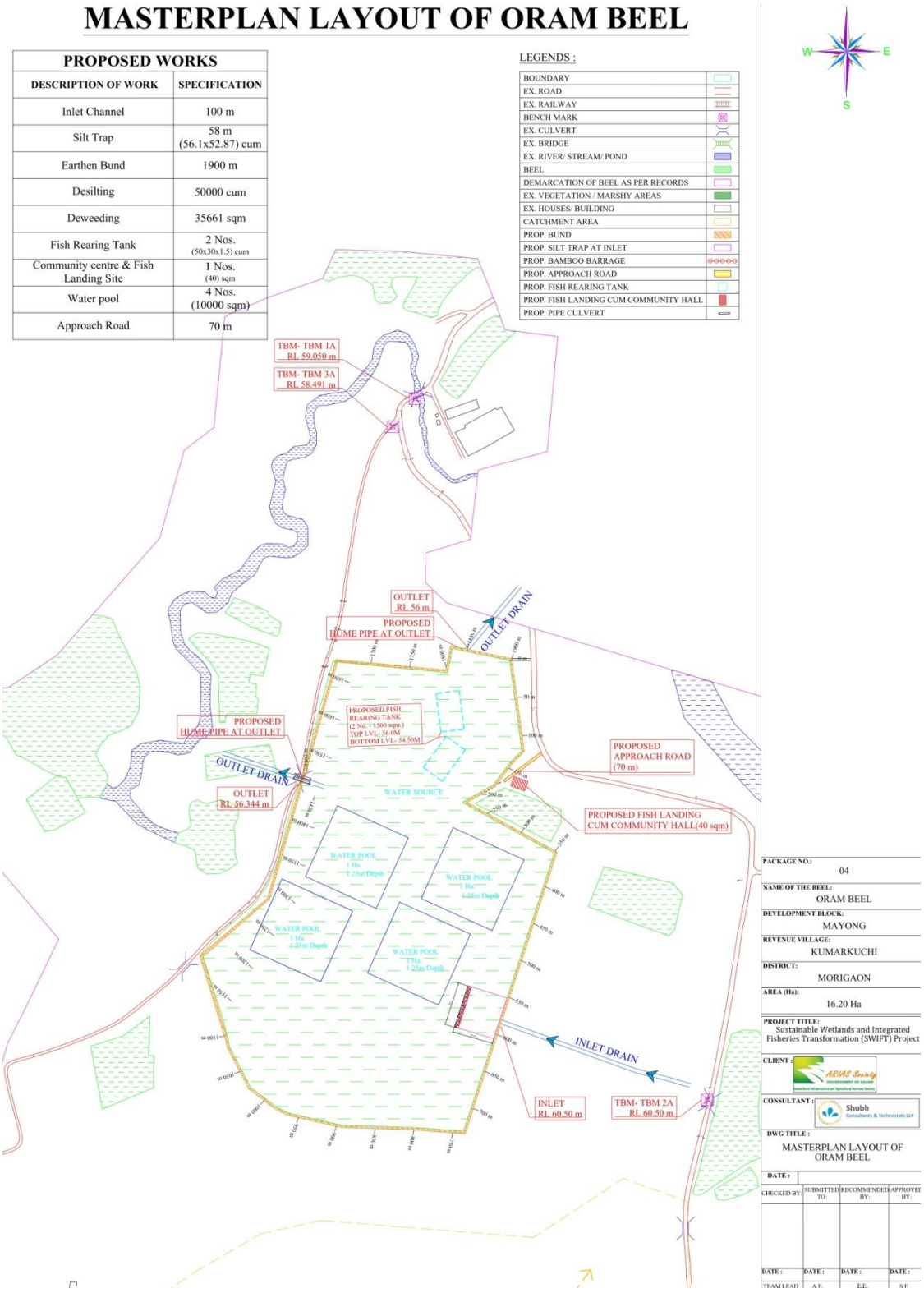



**Figure 3-9. Master Plan layout of Oram Beel**

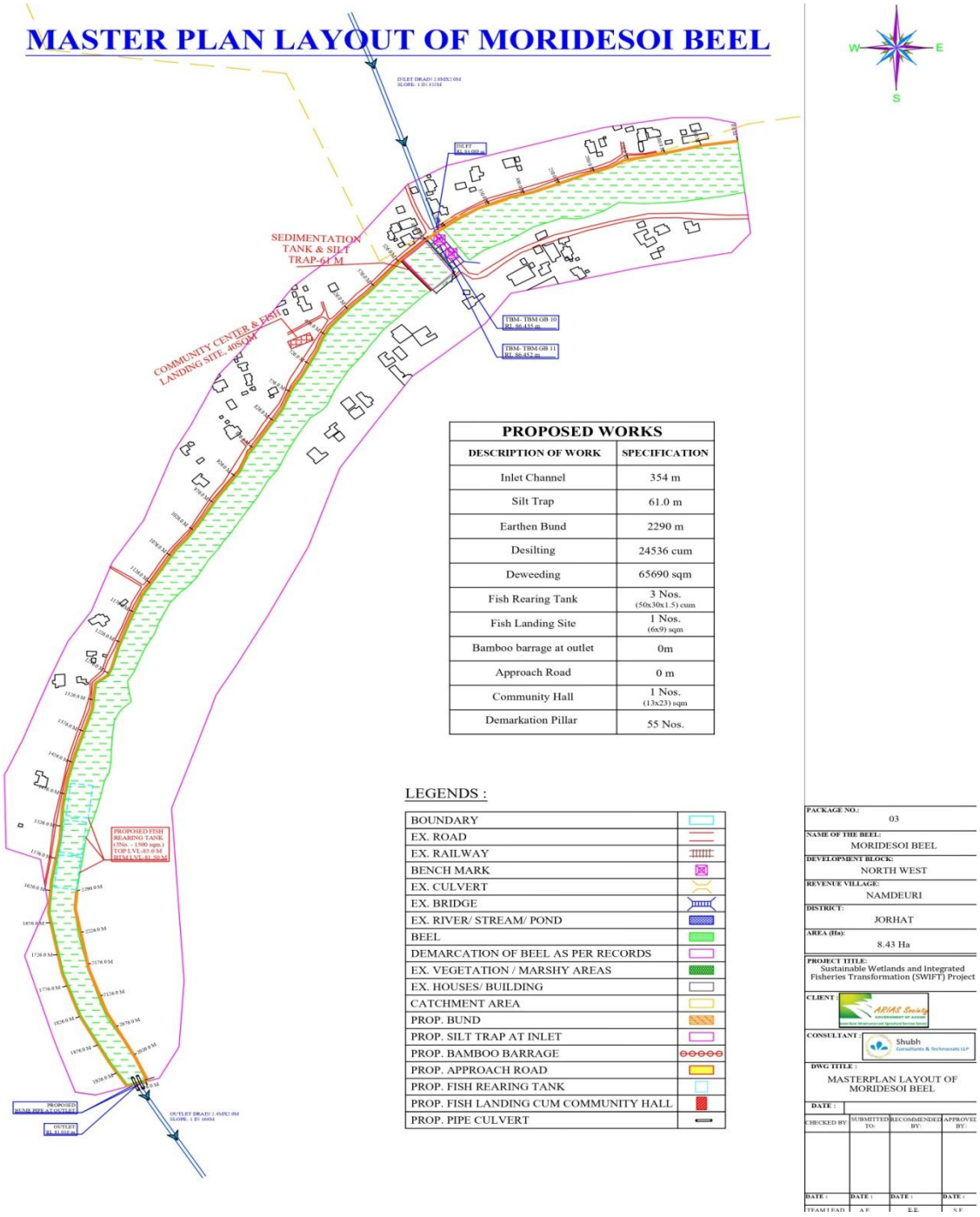



**Figure 3-10. Master Plan layout of Moridesoi Beel**

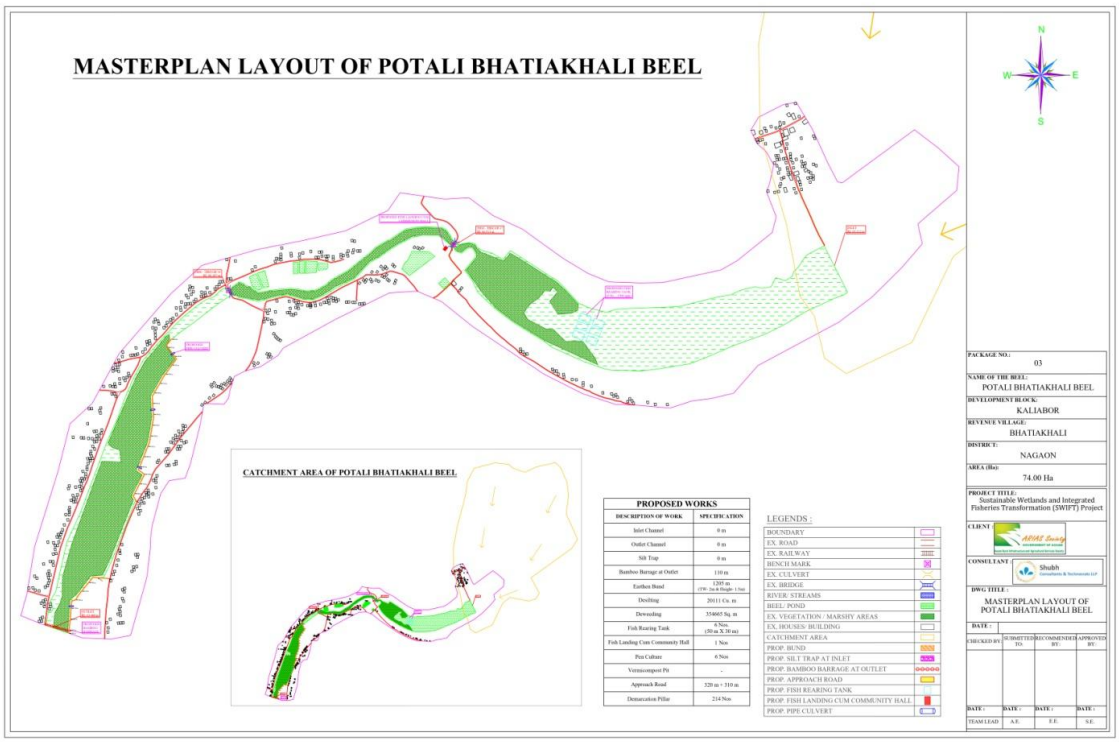



**Figure 3-11. Master Plan layout of Potali Bhatiakhali Beel**

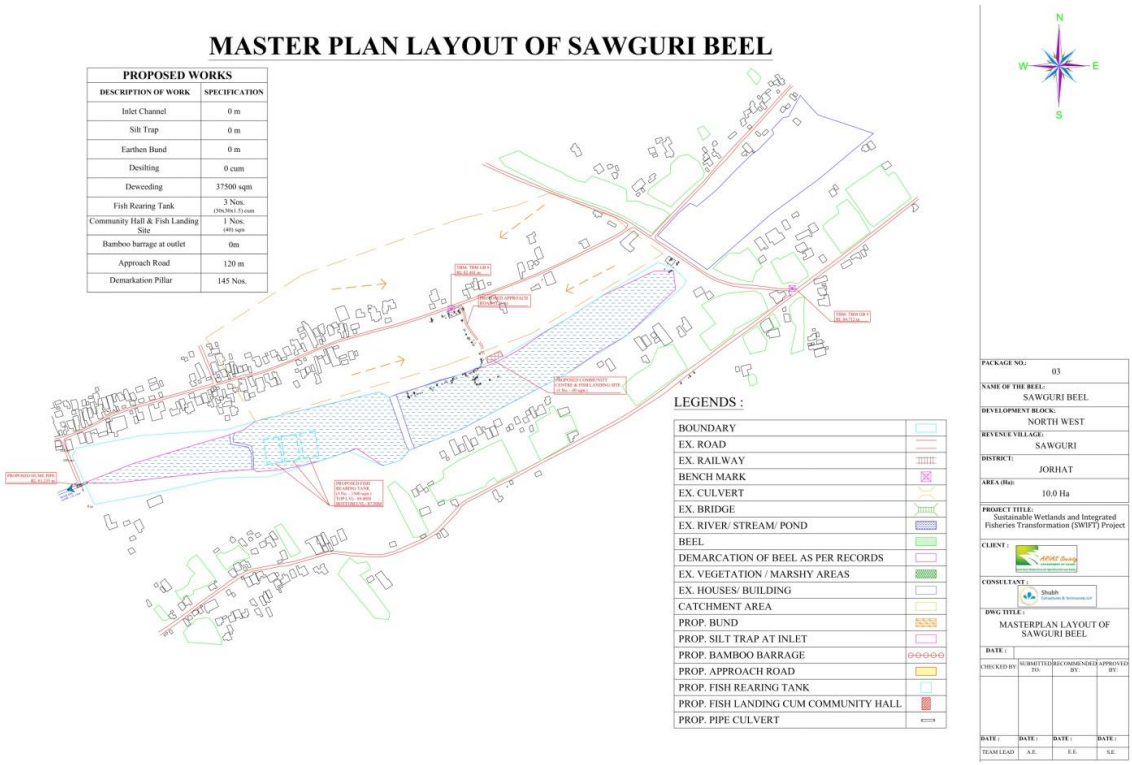



**Figure 3-12. Master Plan layout of Sawguri Beel**

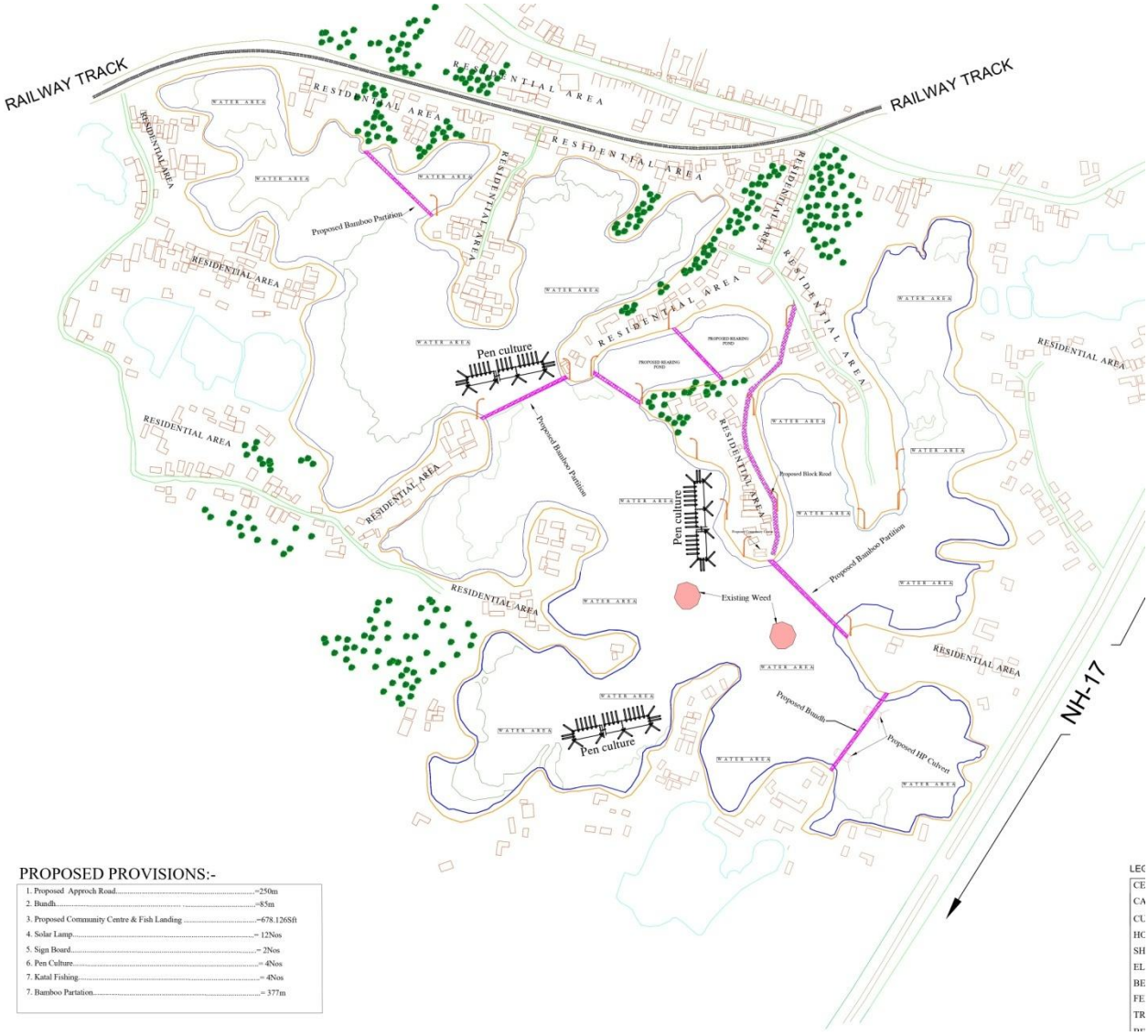



**Figure 3-13. Master Plan layout of Deepor Pitoni Beel**

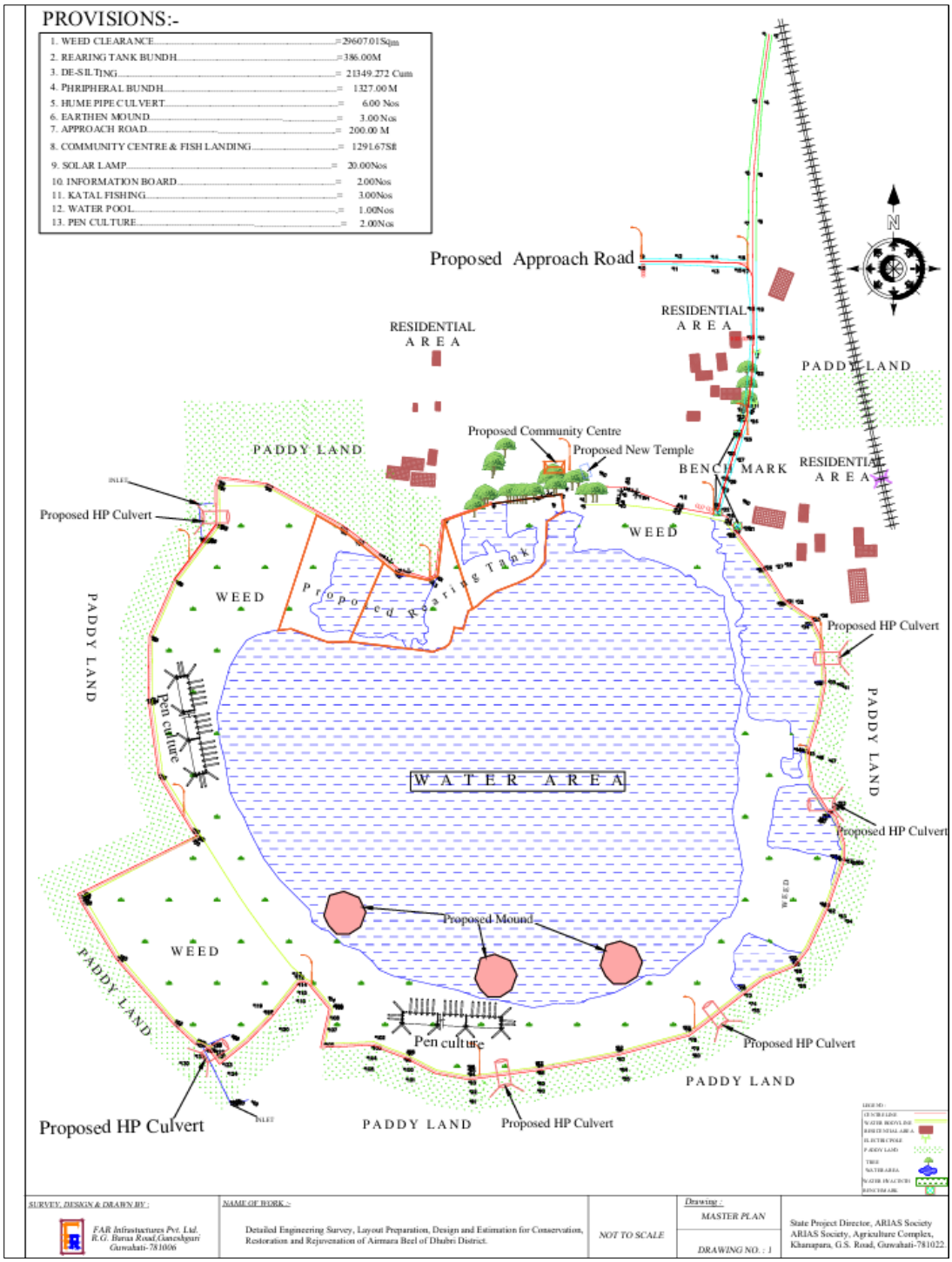



**Figure 3-14. Master Plan layout of Airmara Beel**

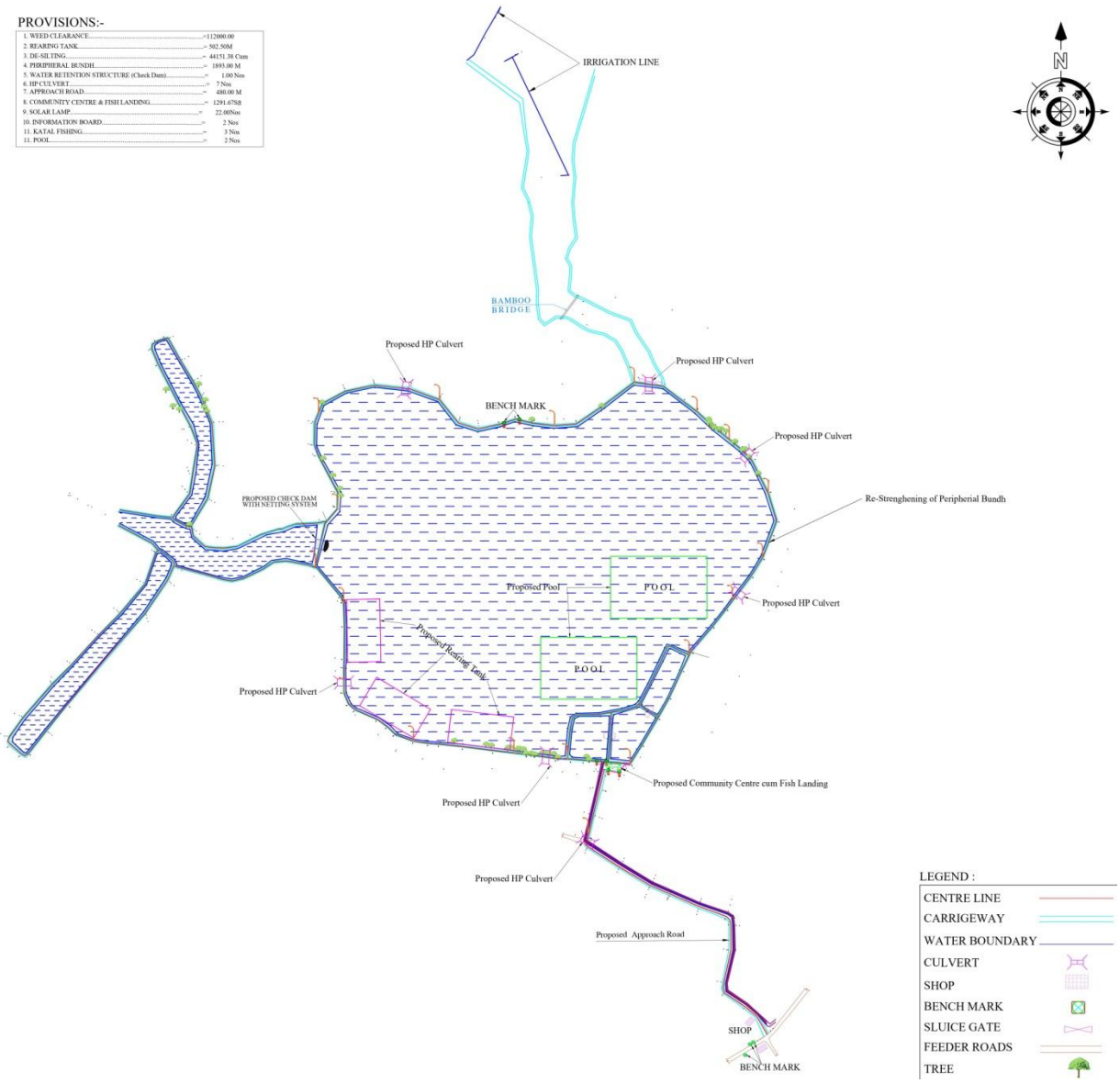



**Figure 3-15. Master Plan layout of Borjong Beel**

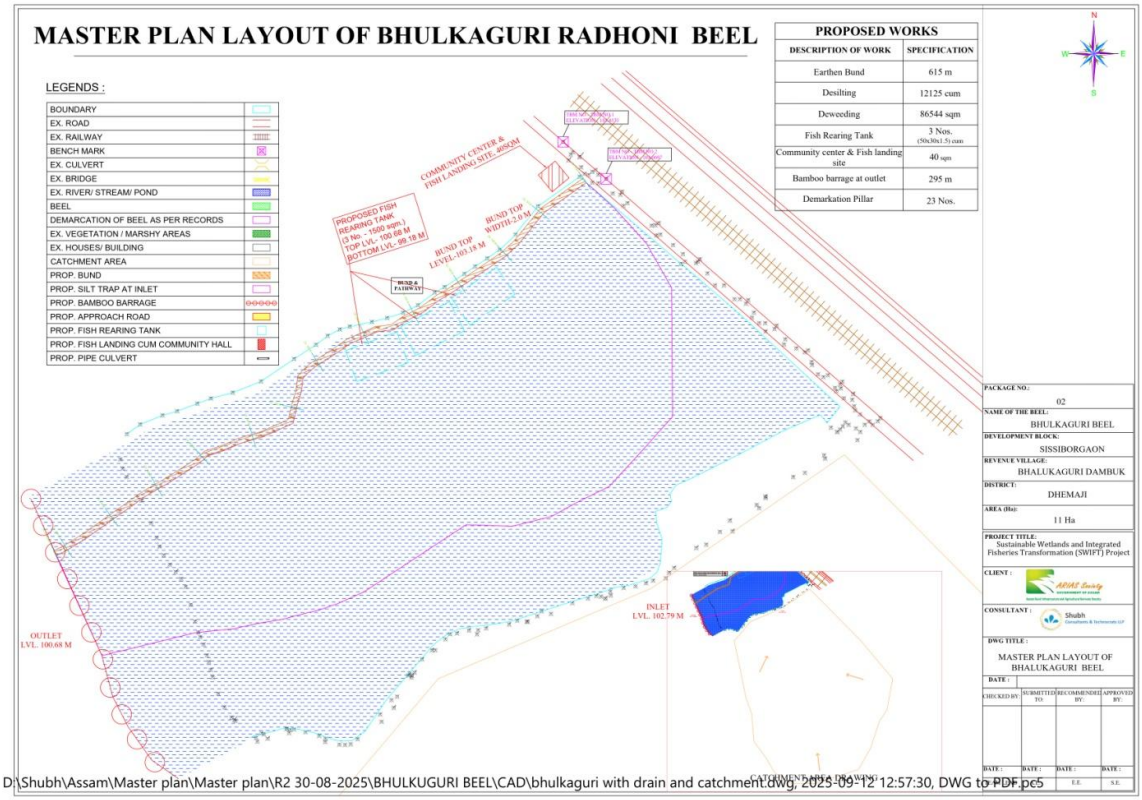



**Figure 3-16. Master Plan layout of Bhulkaguri Beel**

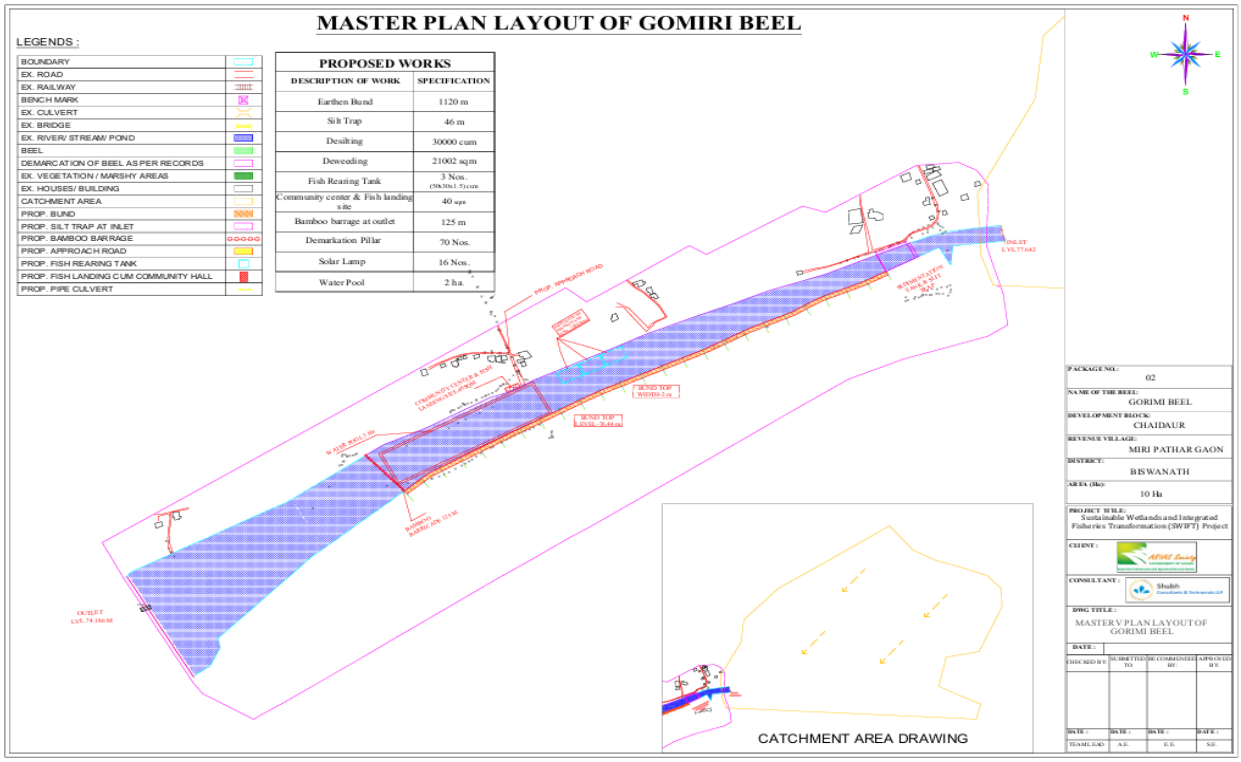



**Figure 3-17. Master Plan layout of Gomiri Beel**

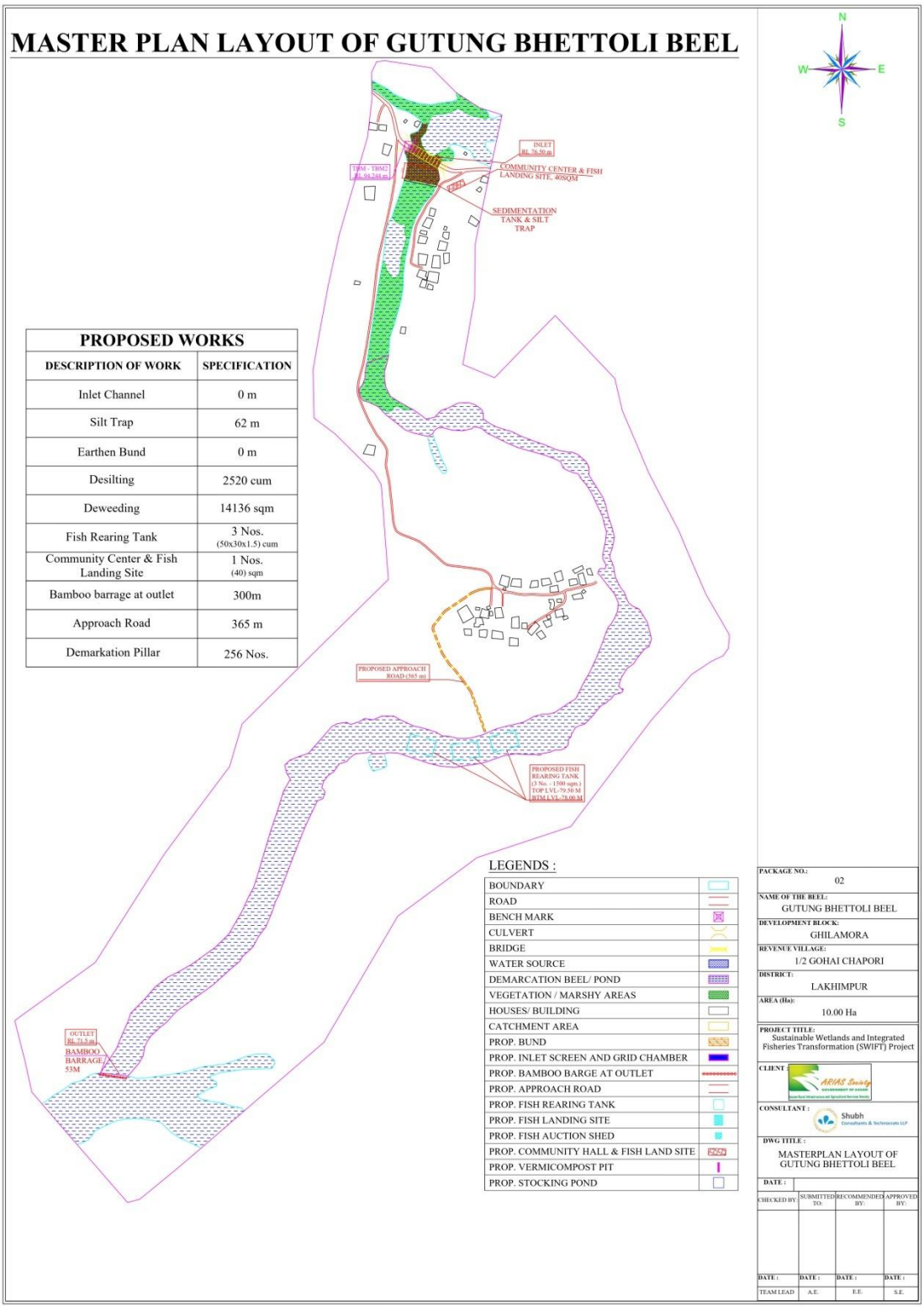



**Figure 3-18. Master Plan layout of Gutung Bhettoli Beel**

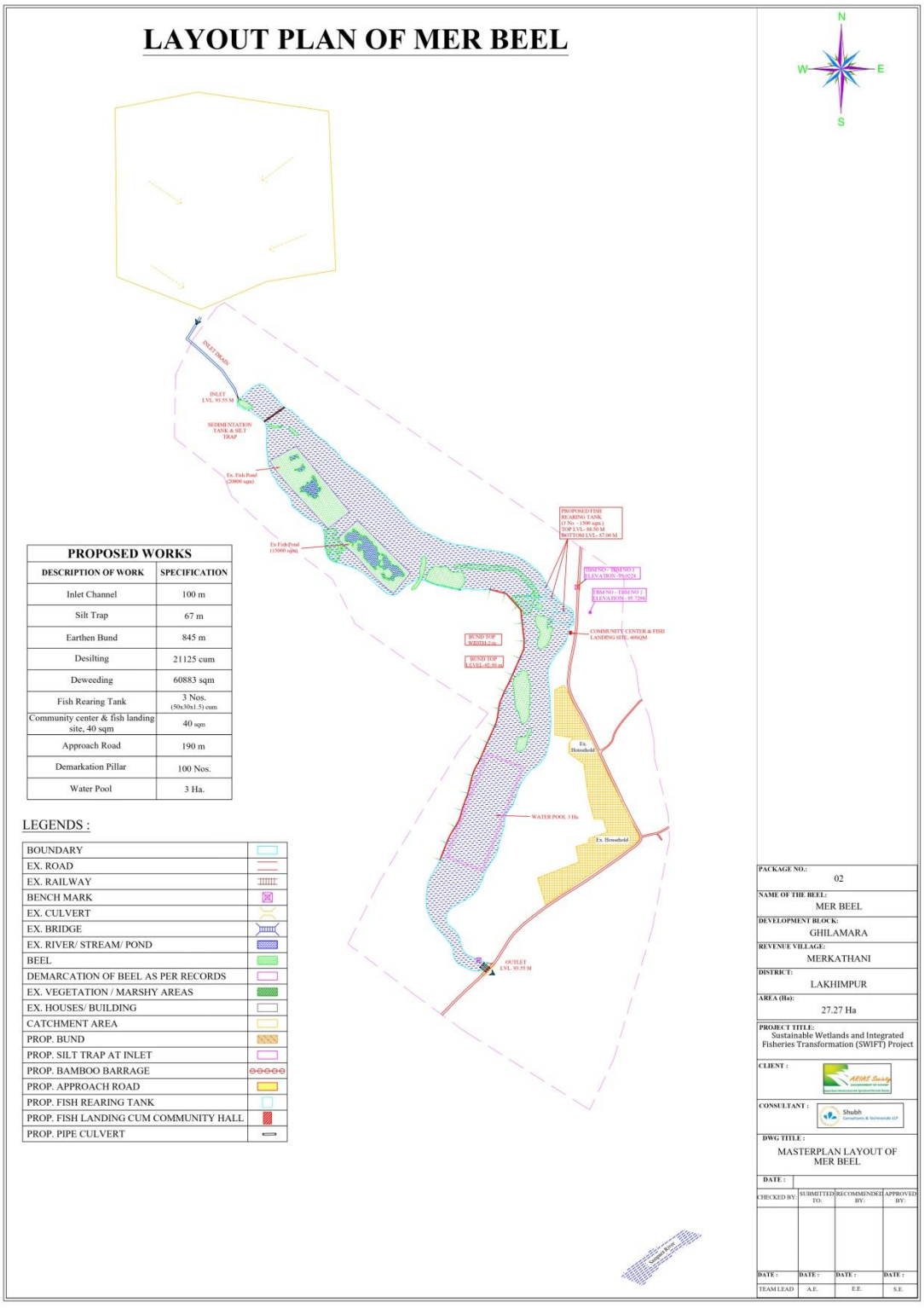



**Figure 3-19. Master Plan layout of Mer Beel**

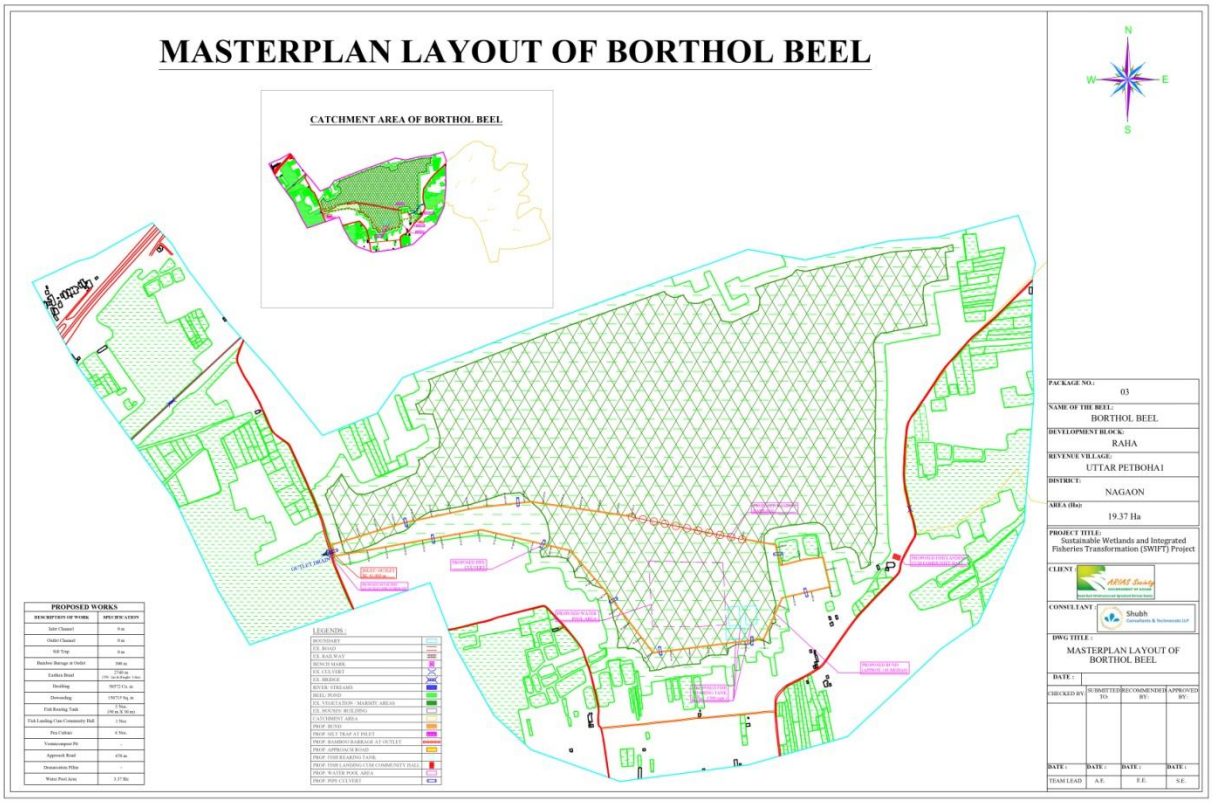



**Figure 3-20. Master Plan layout of Borthol Beel**

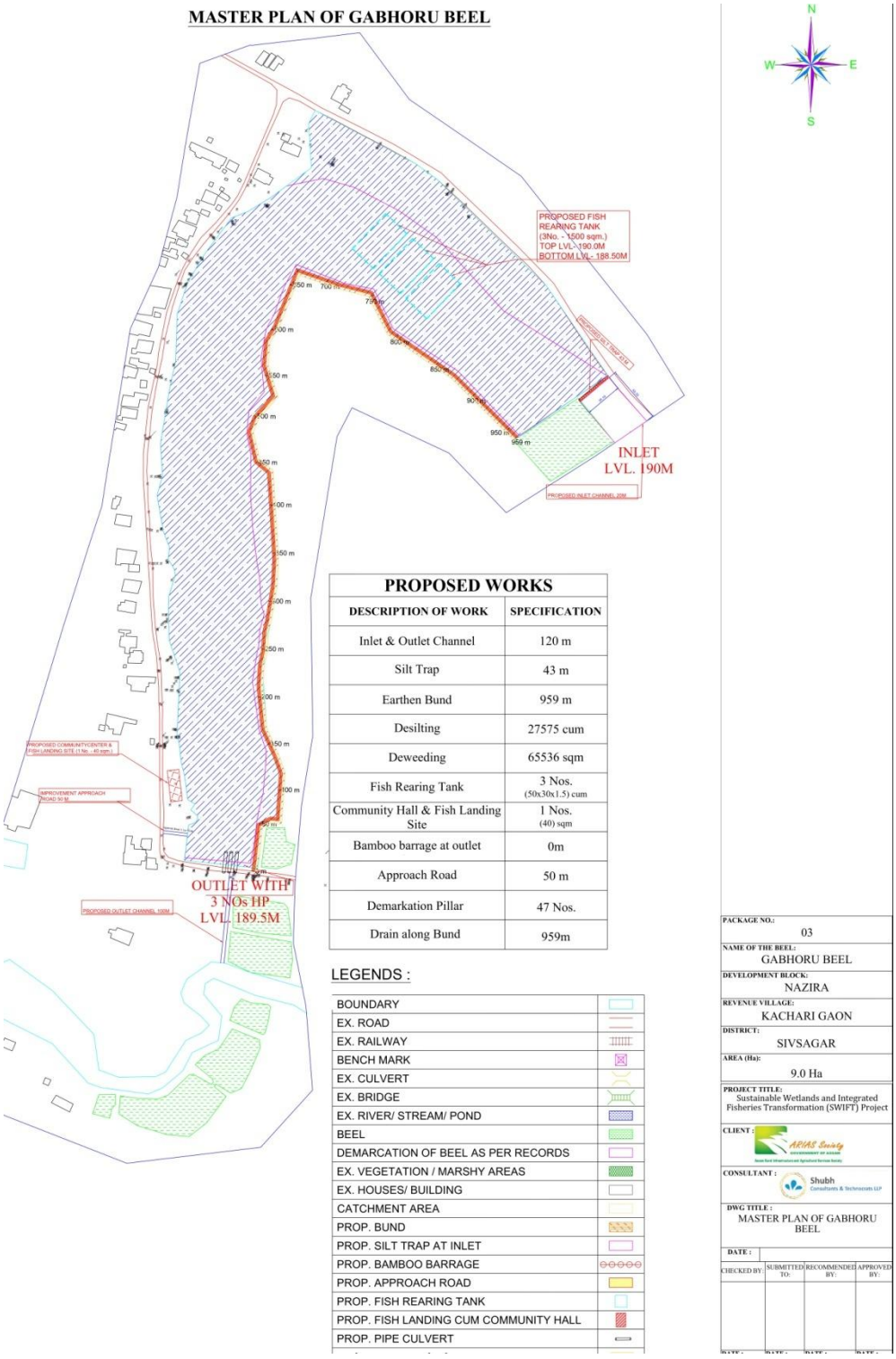



**Figure 3-21. Master Plan layout of Gabhoru Beel**

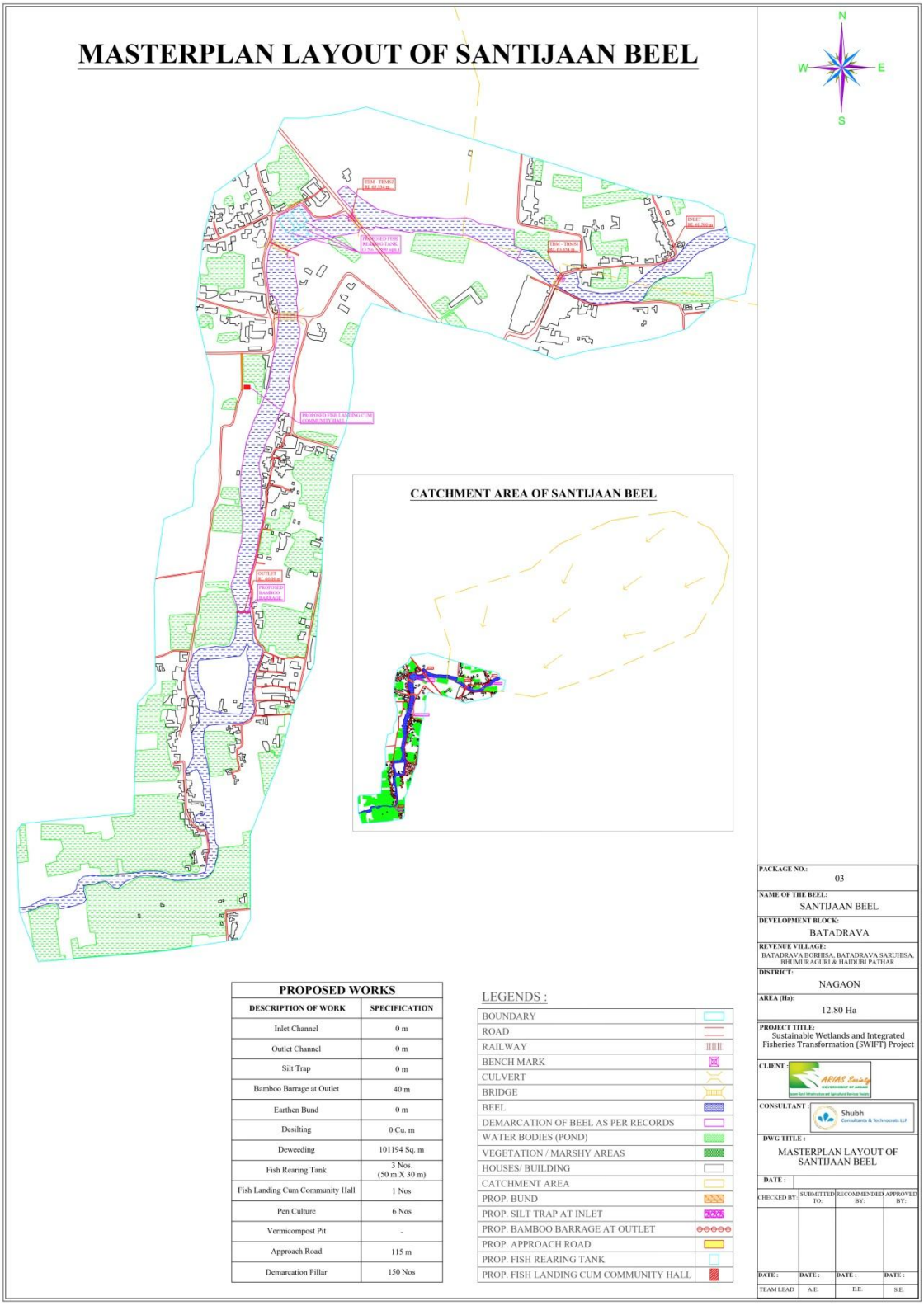



**Figure 3-22. Master Plan layout of Santijaan Beel**

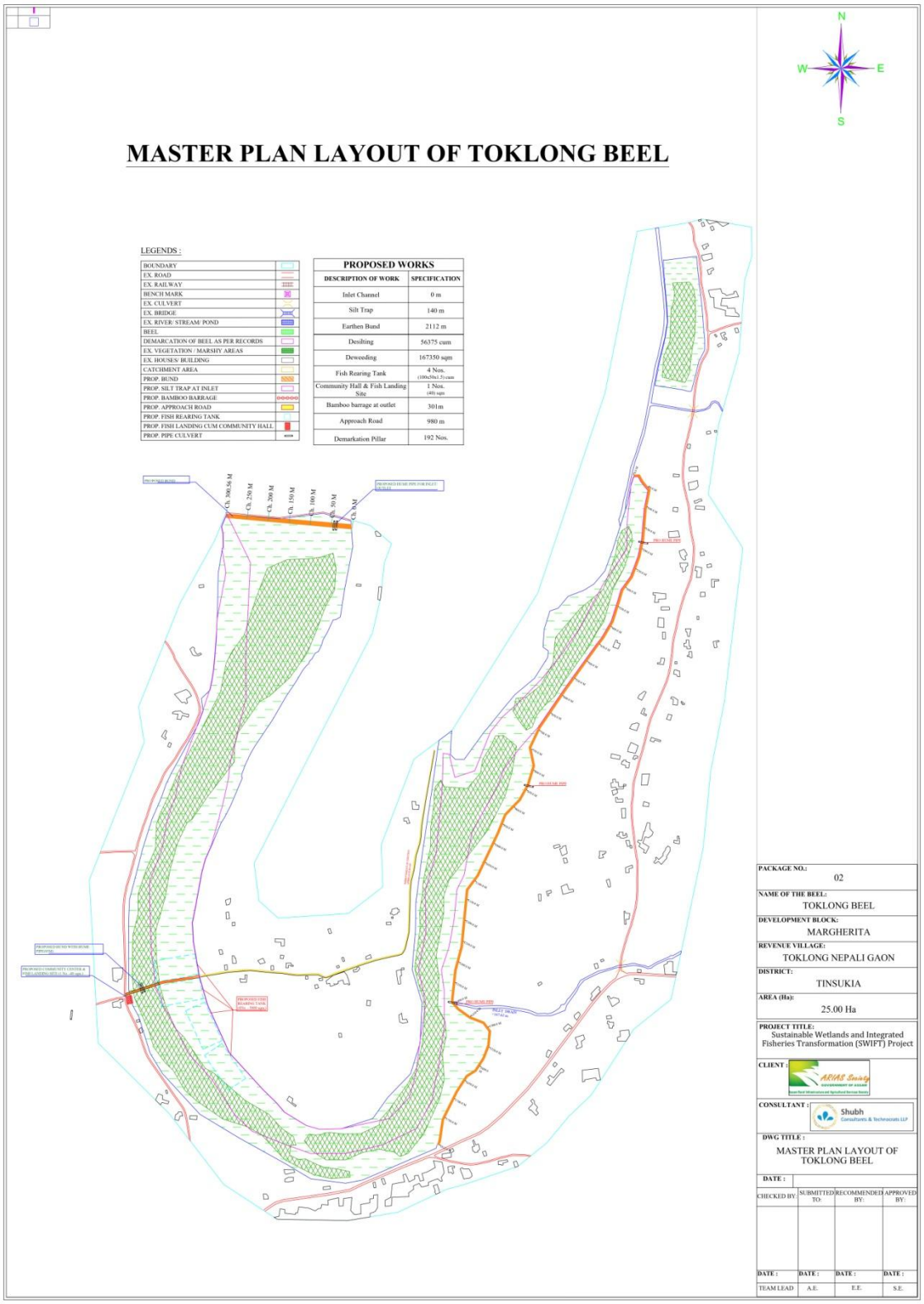



**Figure 3-23. Master Plan layout of Toklong Beel**

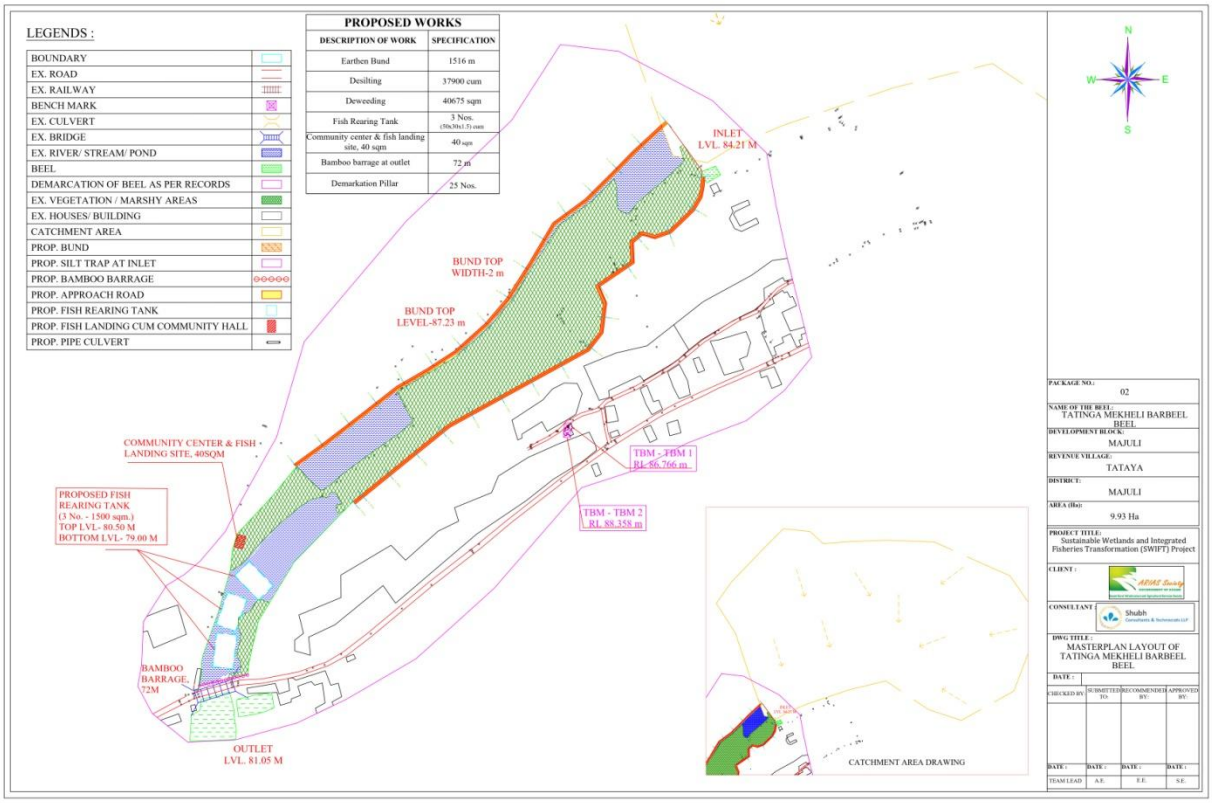



**Figure 3-24. Master Plan layout of Tatinga Mekheli Bor Beel**

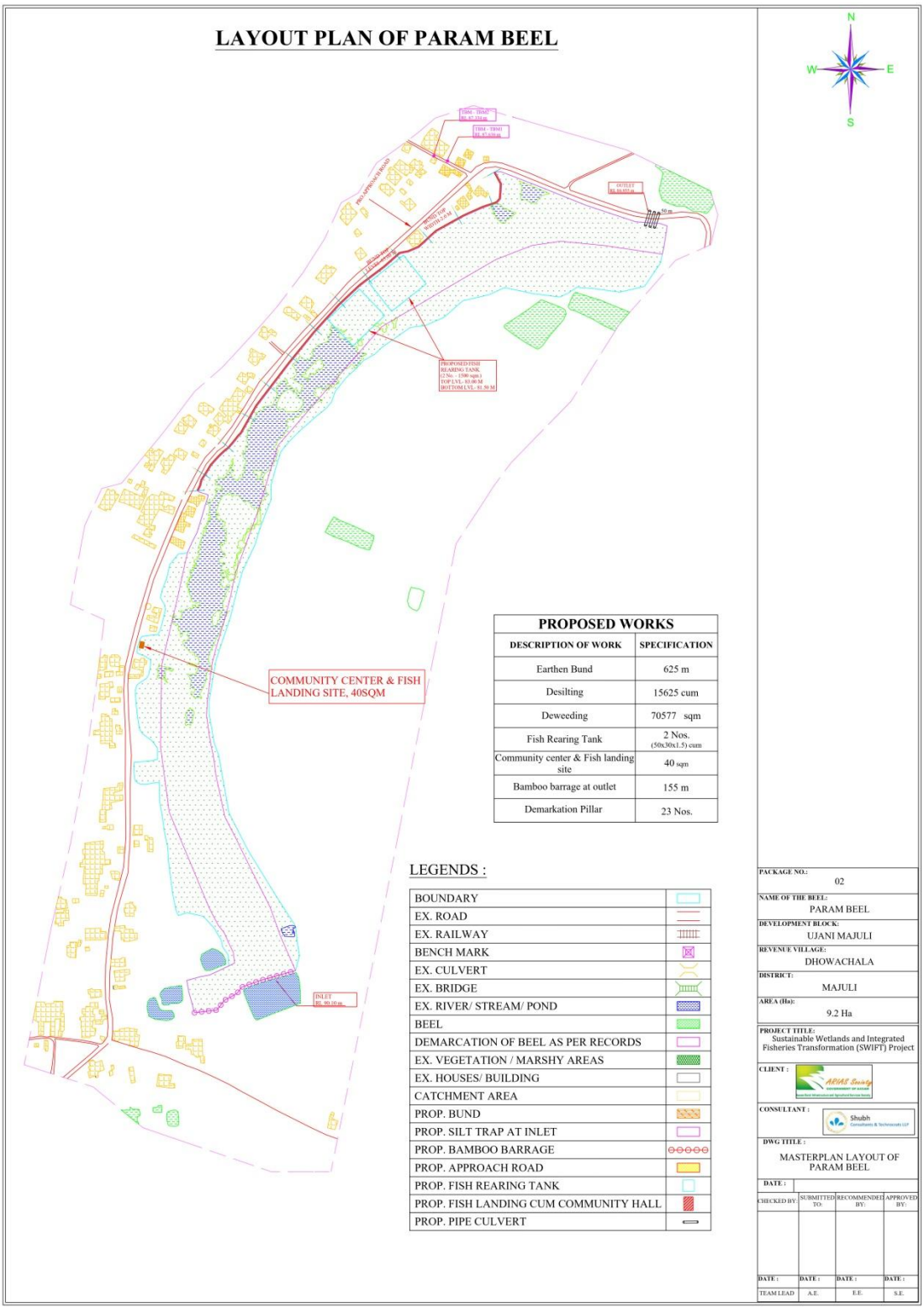



**Figure 3-25. Master Plan layout of Param Beel**

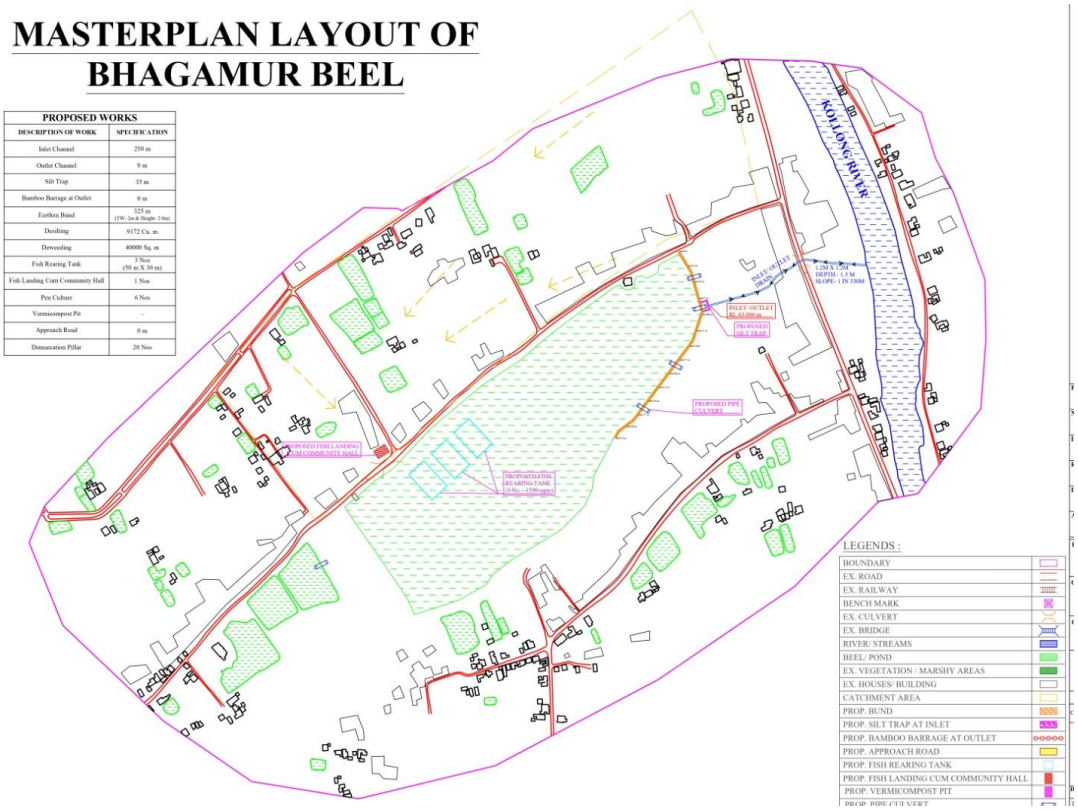



**Figure 3-26. Master Plan layout of Bhagamur Beel**

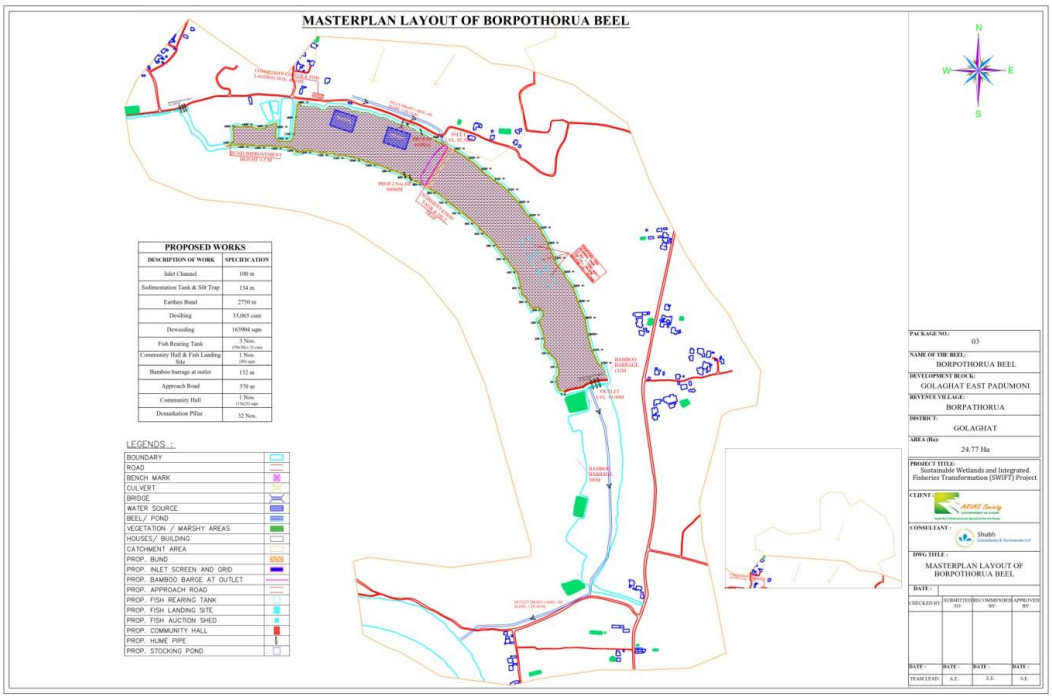



**Figure 3-27. Master Plan layout of Borpothorua Beel**

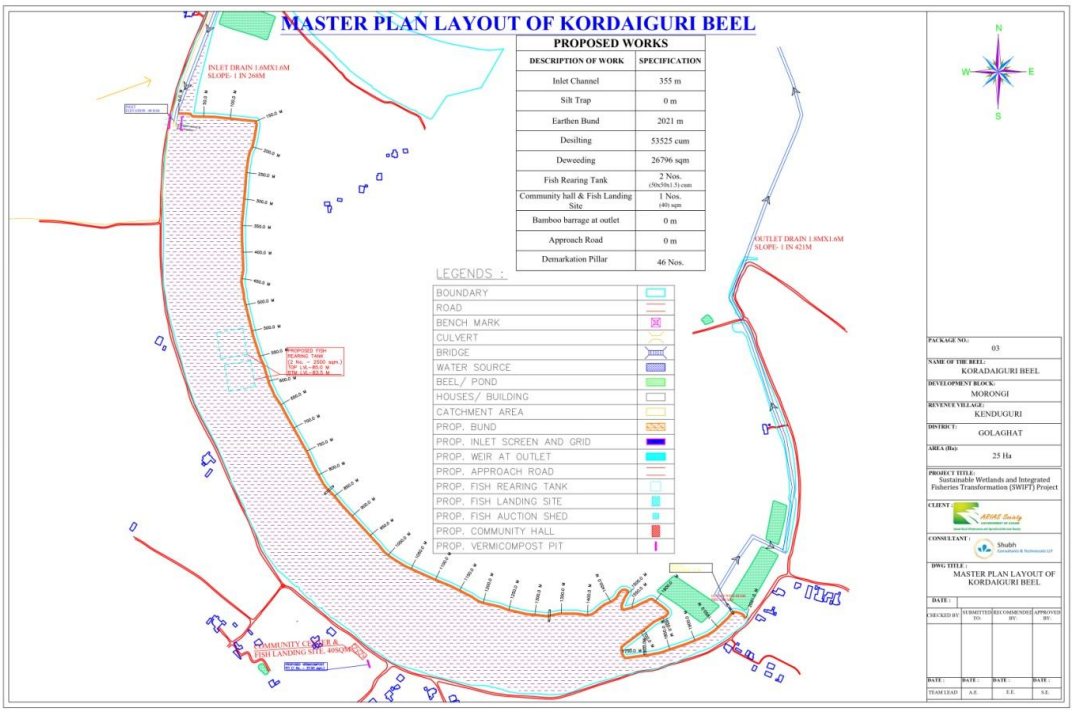



**Figure 3-28. Master Plan layout of Kordaiguri Beel**

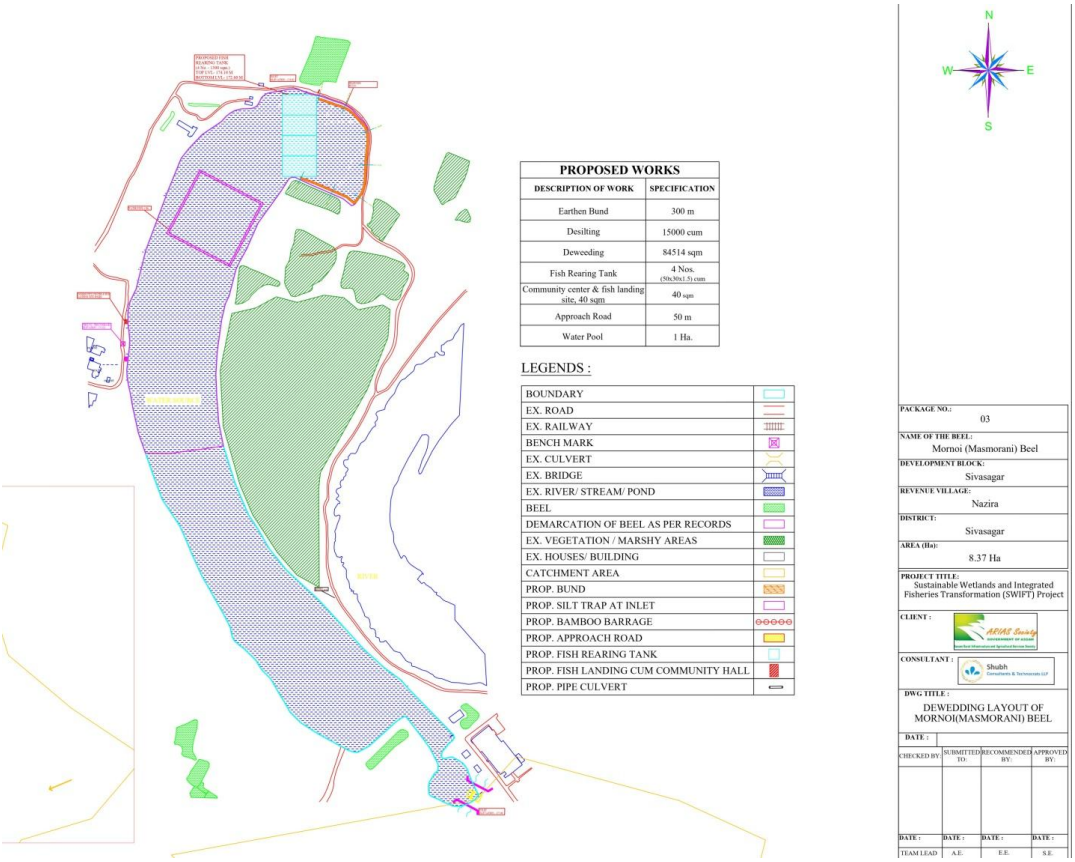



**Figure 3-29. Master Plan layout of Mornoi Masmornoi Beel**

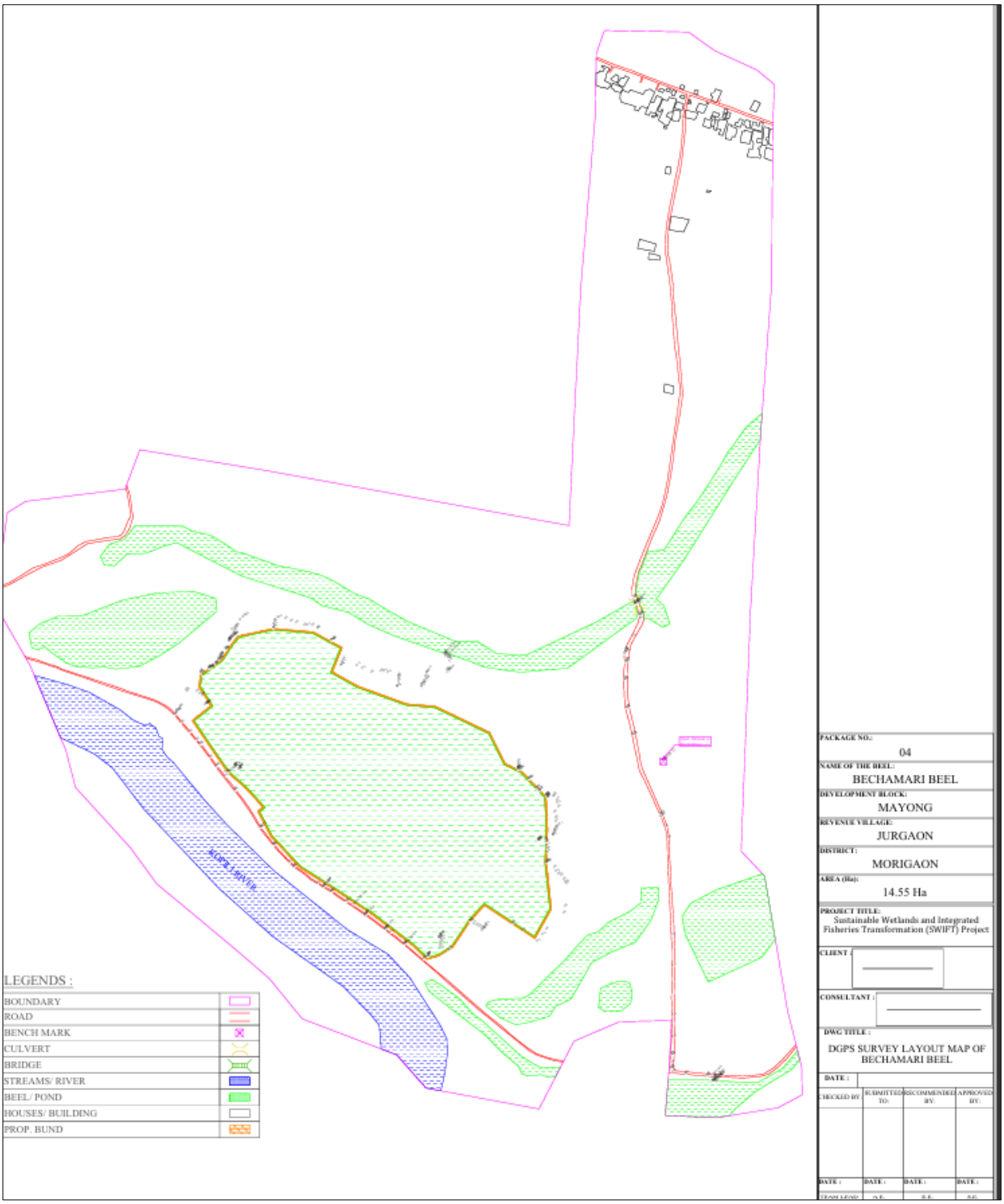



**Figure 3-30. Master Plan layout of Bechamari Beel**

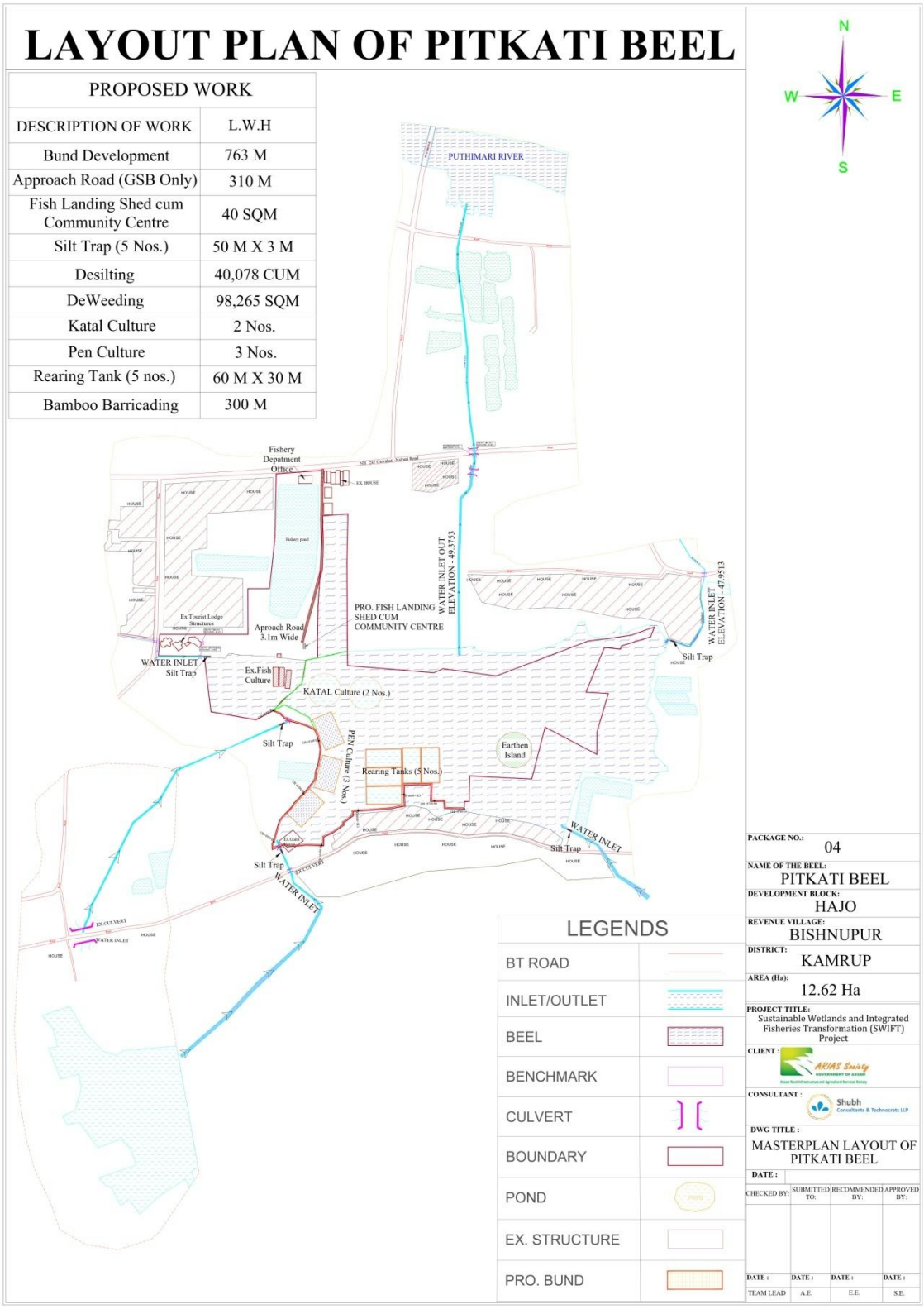



**Figure 3-31. Master Plan layout of Pitkati Beel**

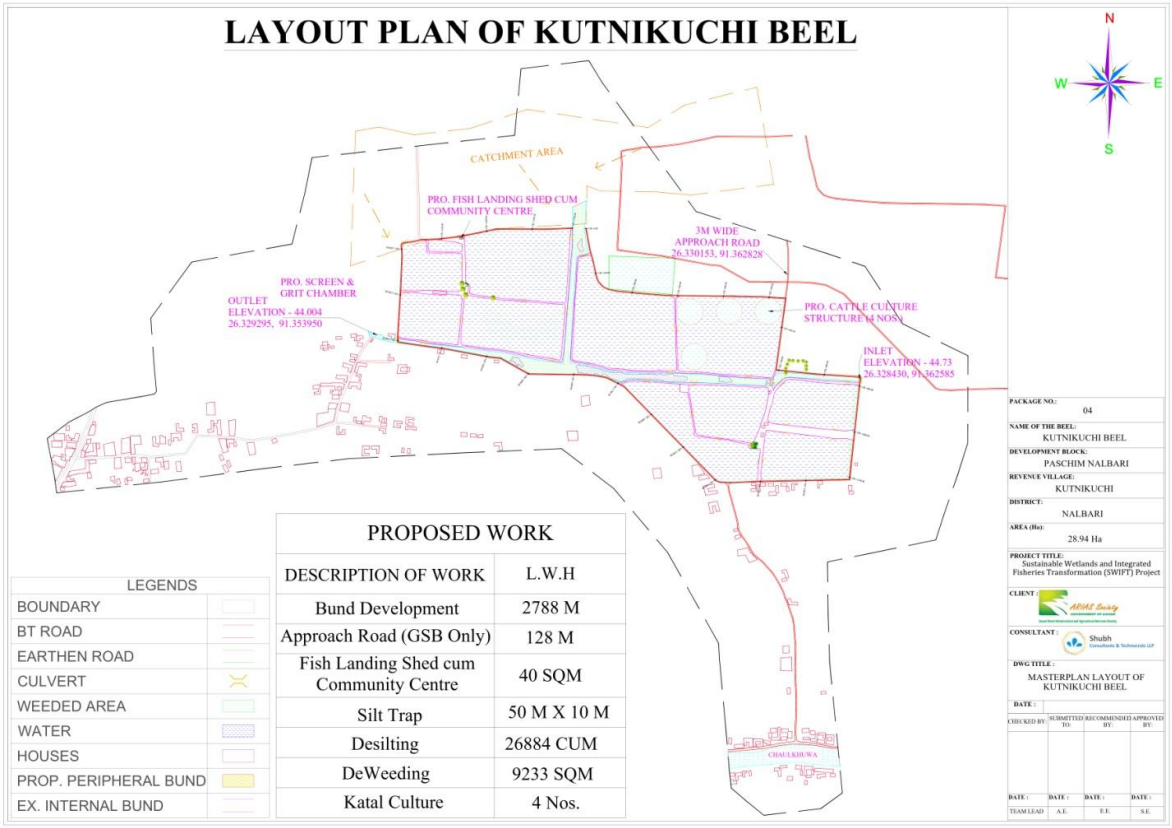



**Figure 3-32. Master Plan layout of Kutnikuchi Beel**

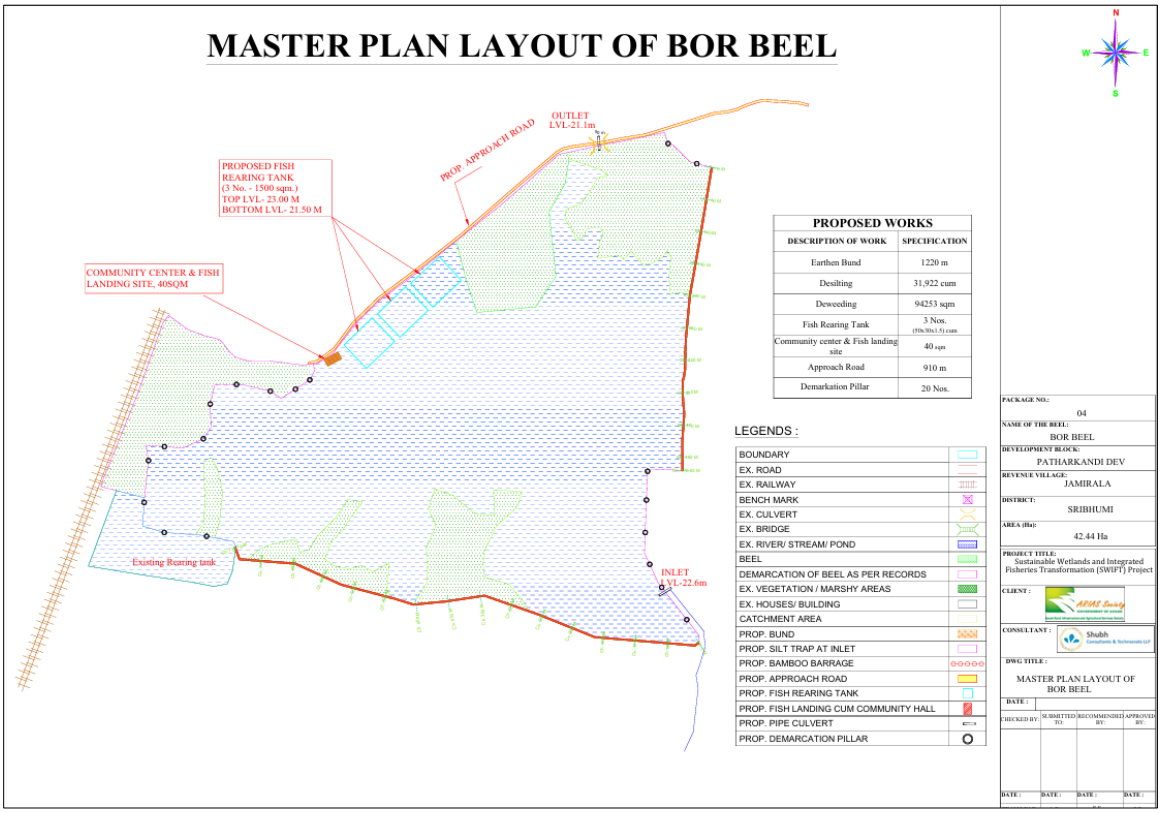



**Figure 3-33. Master Plan layout of Bor Beel**

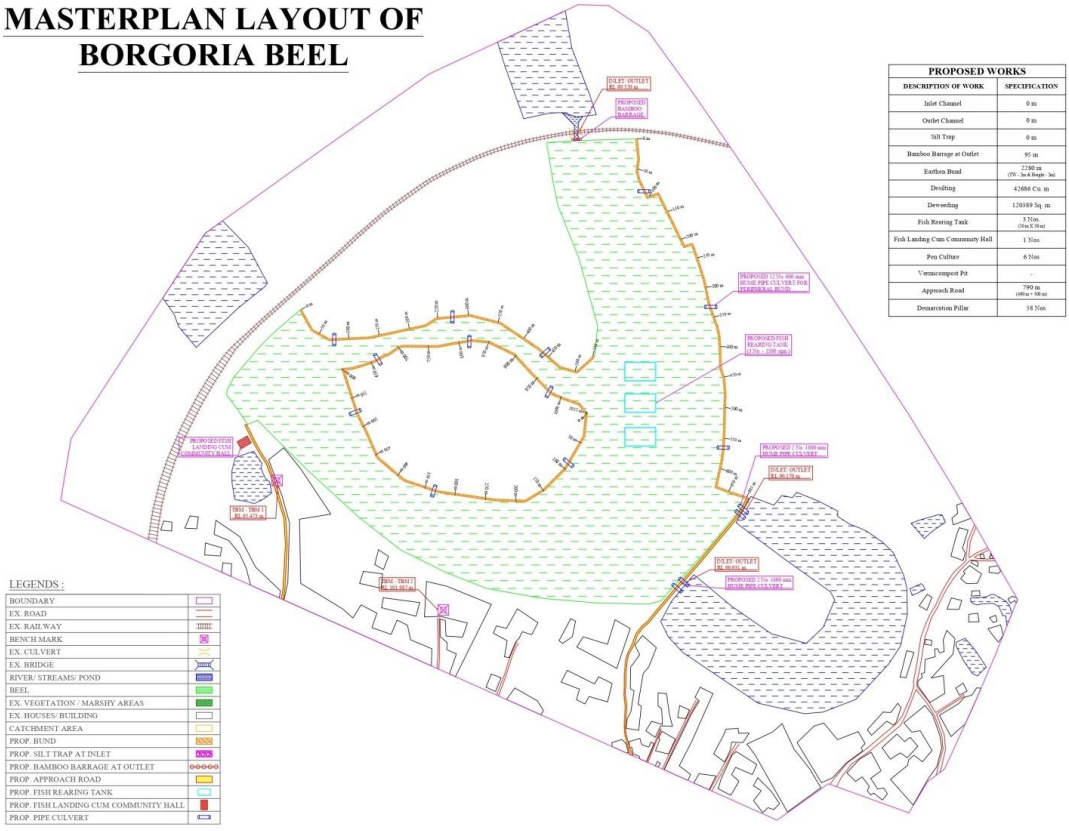



**Figure 3-34. Master Plan layout of Borgoria Beel**

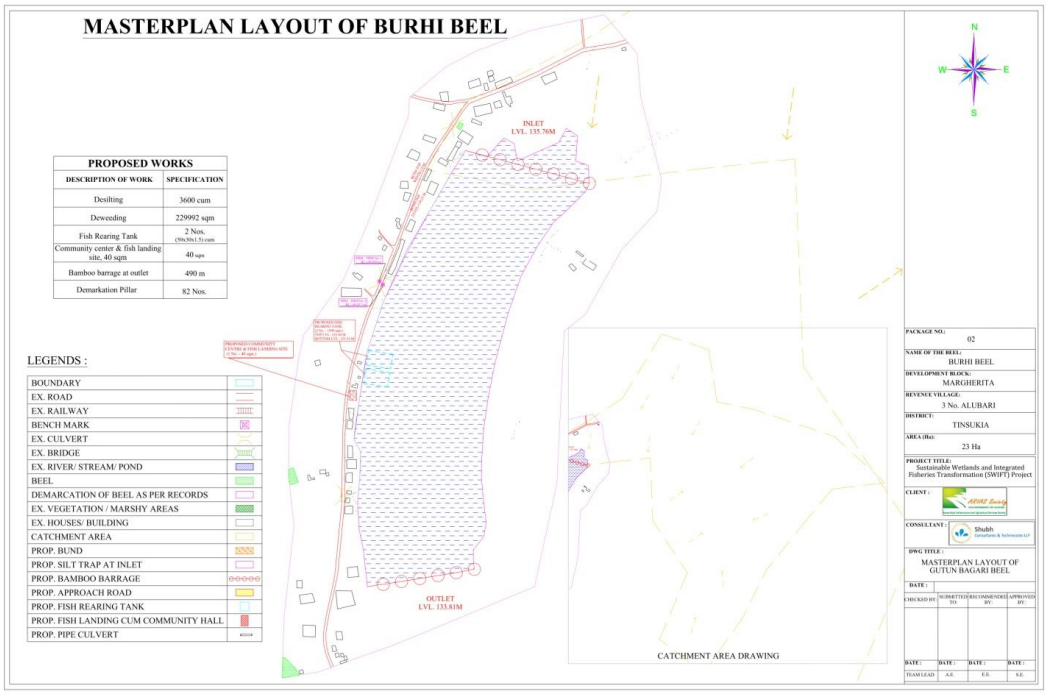



**Figure 3-35. Master Plan layout of Burhi Beel**

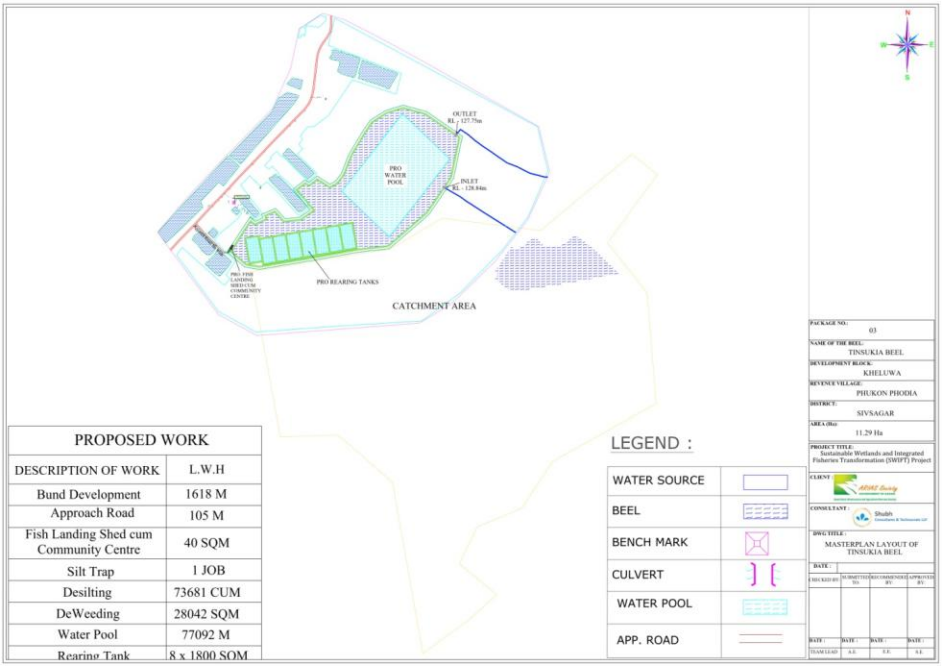



**Figure 3-36. Master Plan layout of Tinsukia Beel**

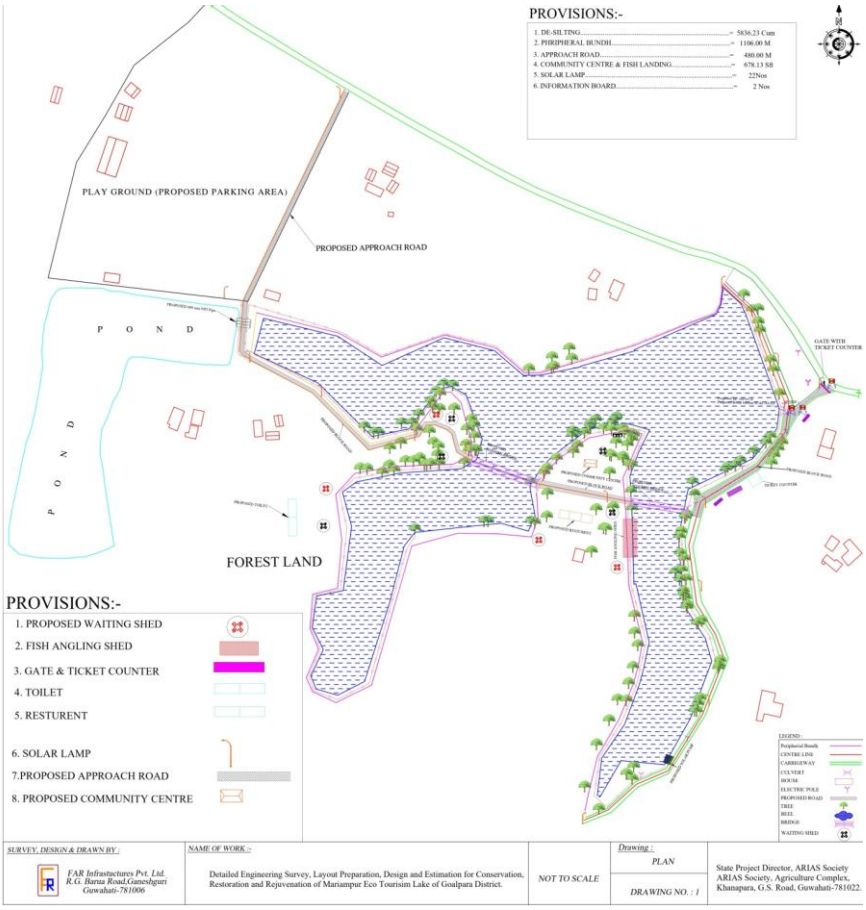



**Figure 3-37. Master Plan layout of Mariampur Beel**

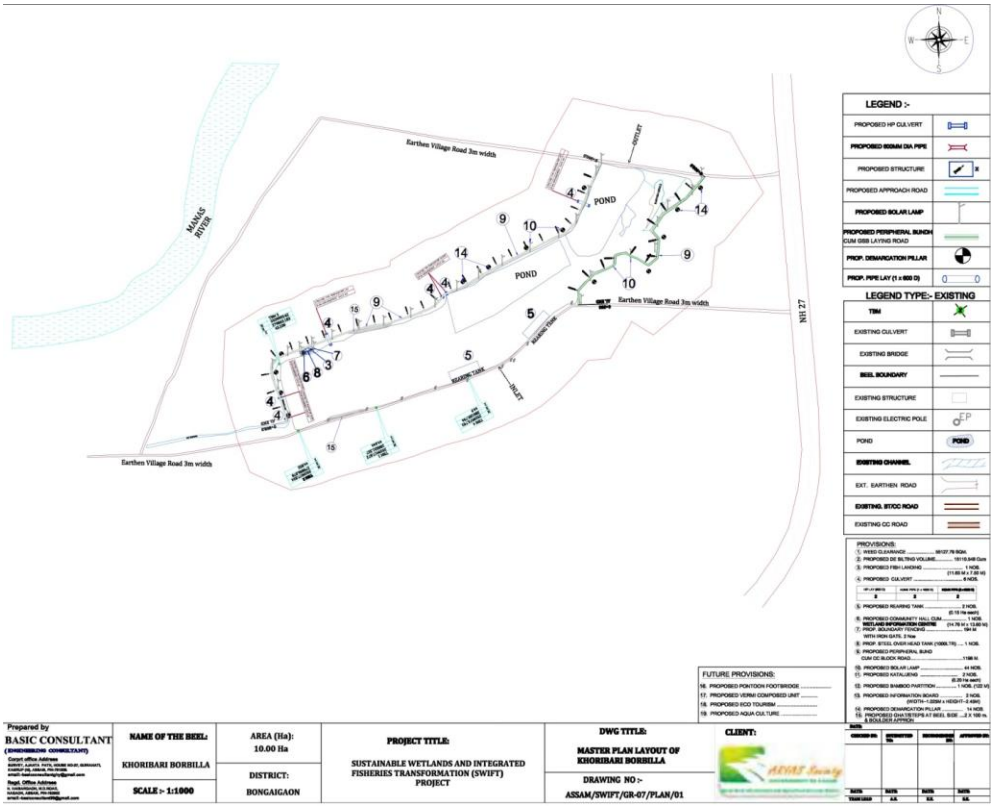



**Figure 3-38. Master Plan layout of Khoribari Borbilla Beel**

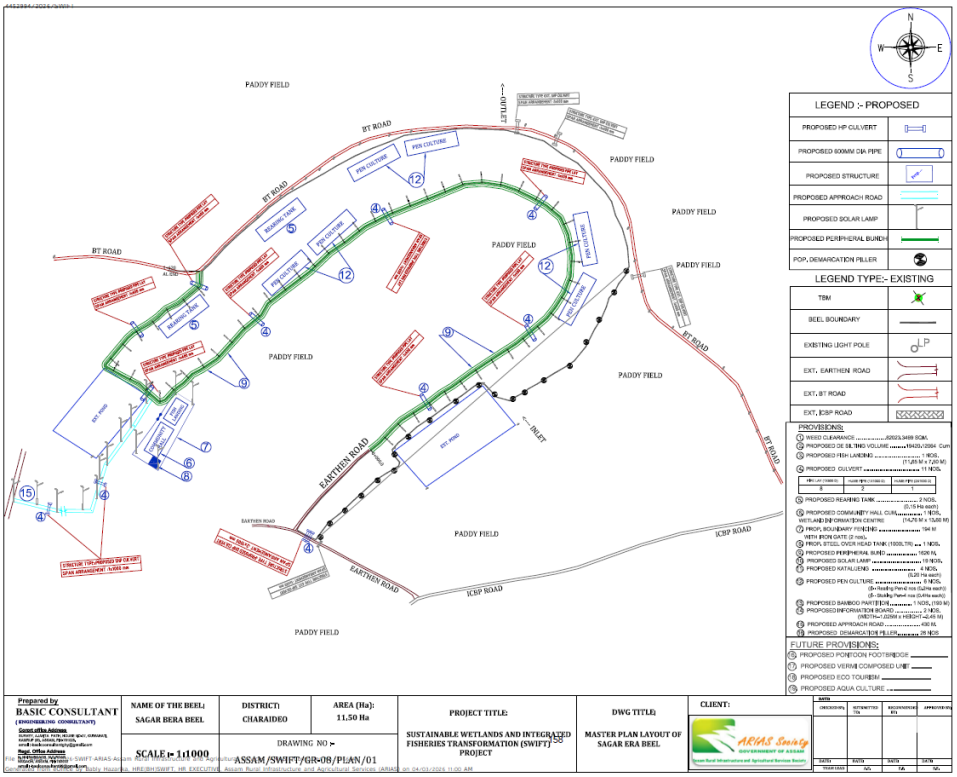



**Figure 3-39. Master Plan layout of Sagar Bera Beel**

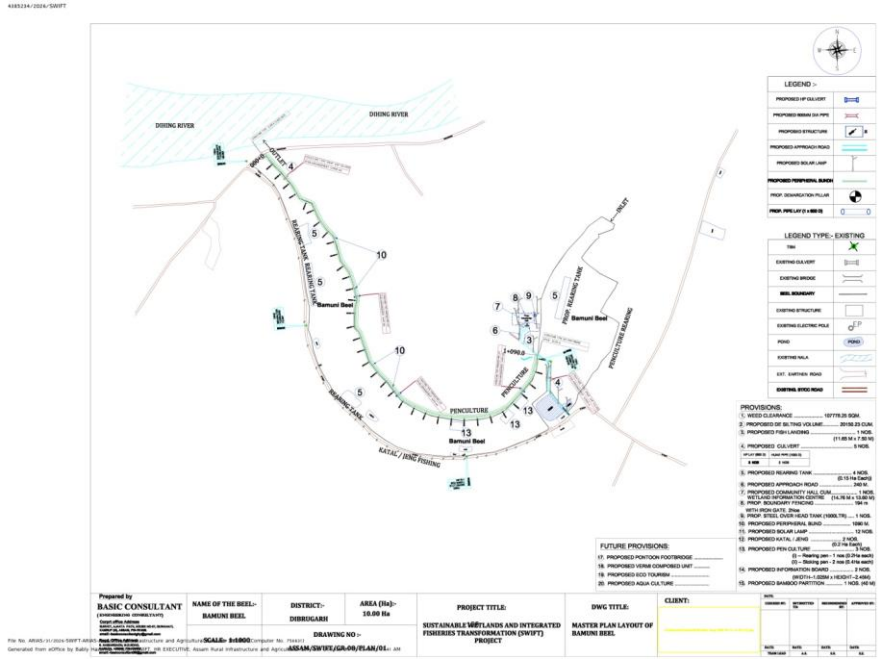



**Figure 3-40. Master Plan layout of Bamuni Beel**

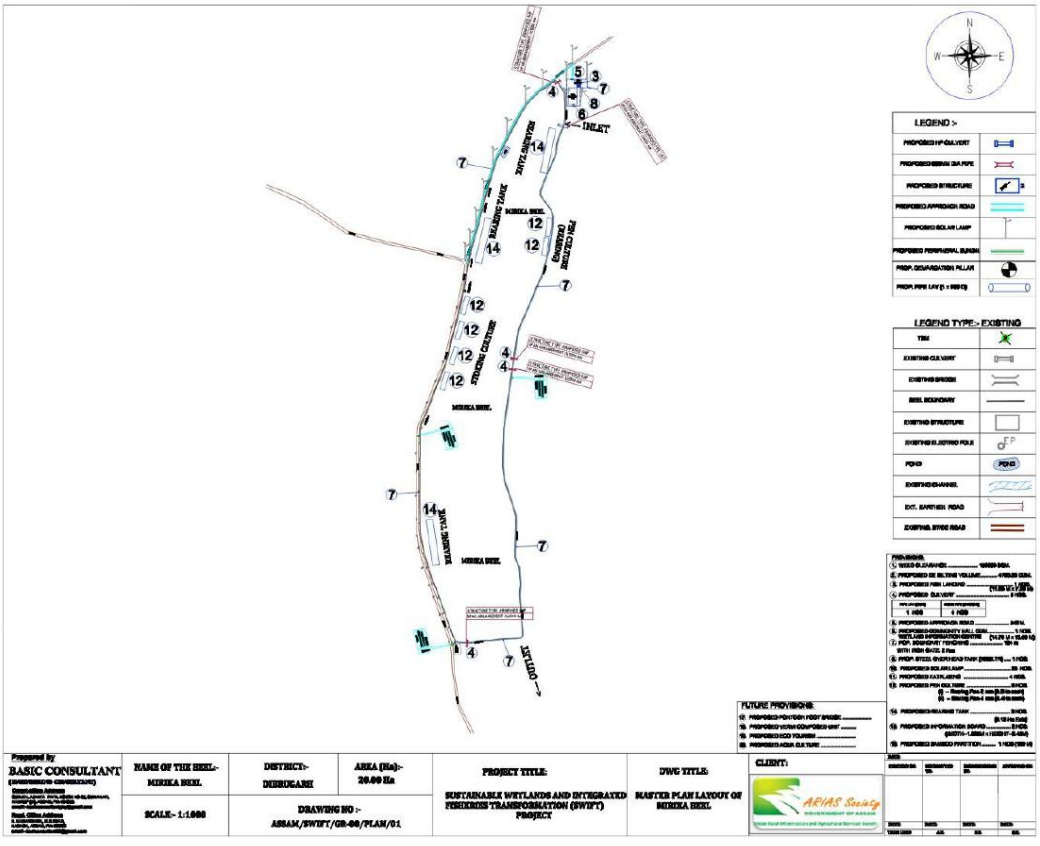



**Figure 3-41. Master Plan layout of Mirika Beel**

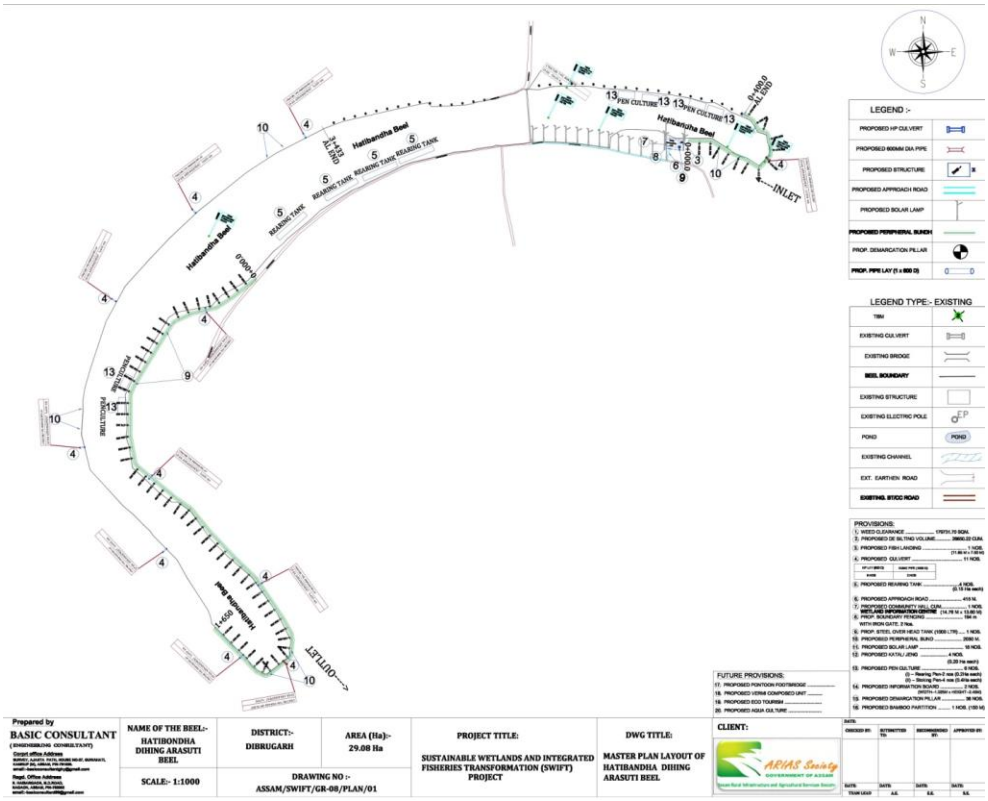



**Figure 3-42. Master Plan layout of 1 no. Hatibondha Dihing Arasuti Beel**

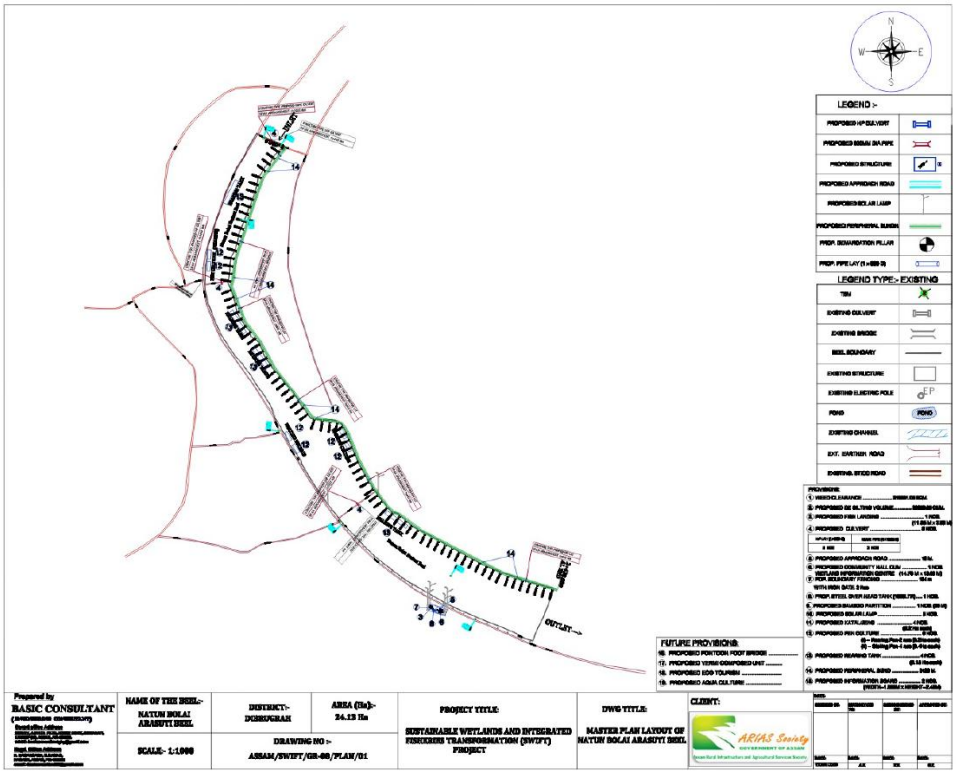



**Figure 3-43. Master Plan layout of Natun Bolai Beel**

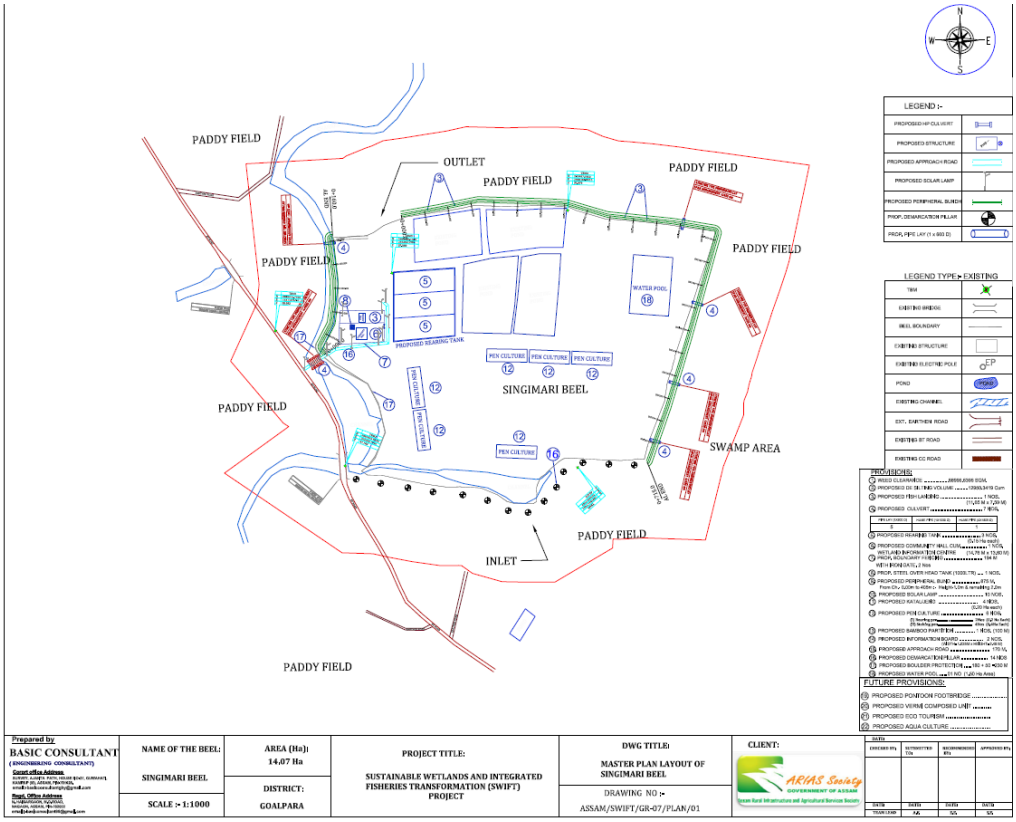



**Figure 3-44. Master Plan layout of Singimari Beel**

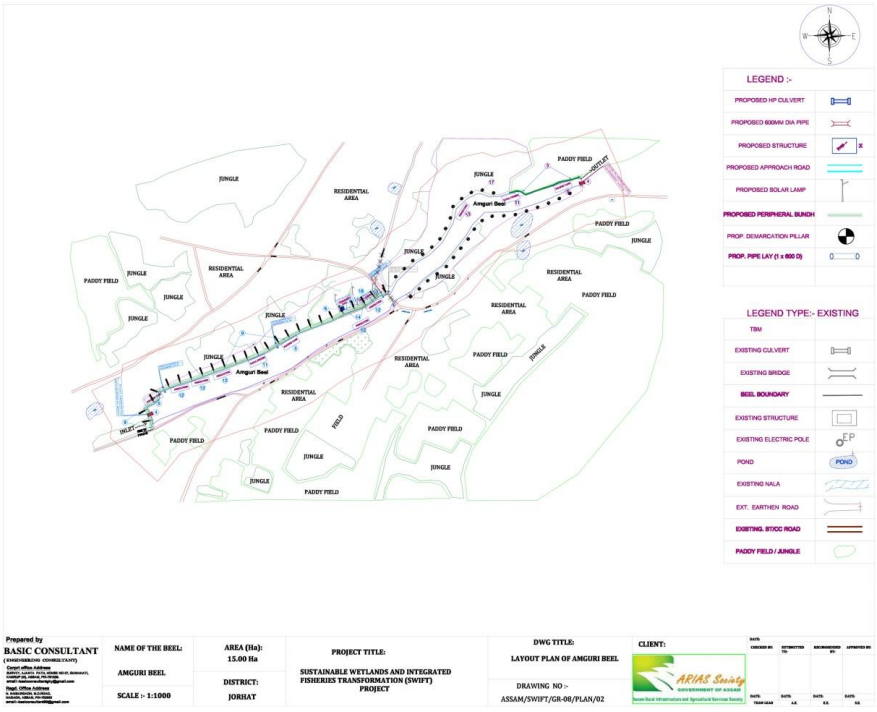



**Figure 3-45. Master Plan layout of Amguri Beel (Jorhat)**

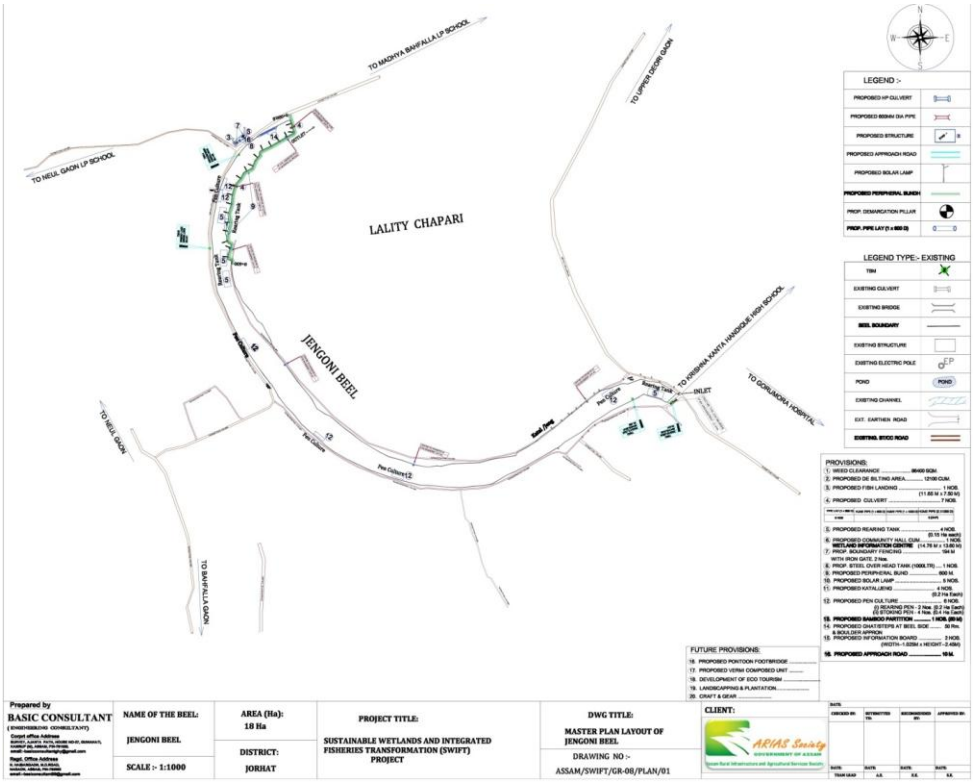



**Figure 3-46. Master Plan layout of Jengoni Beel**

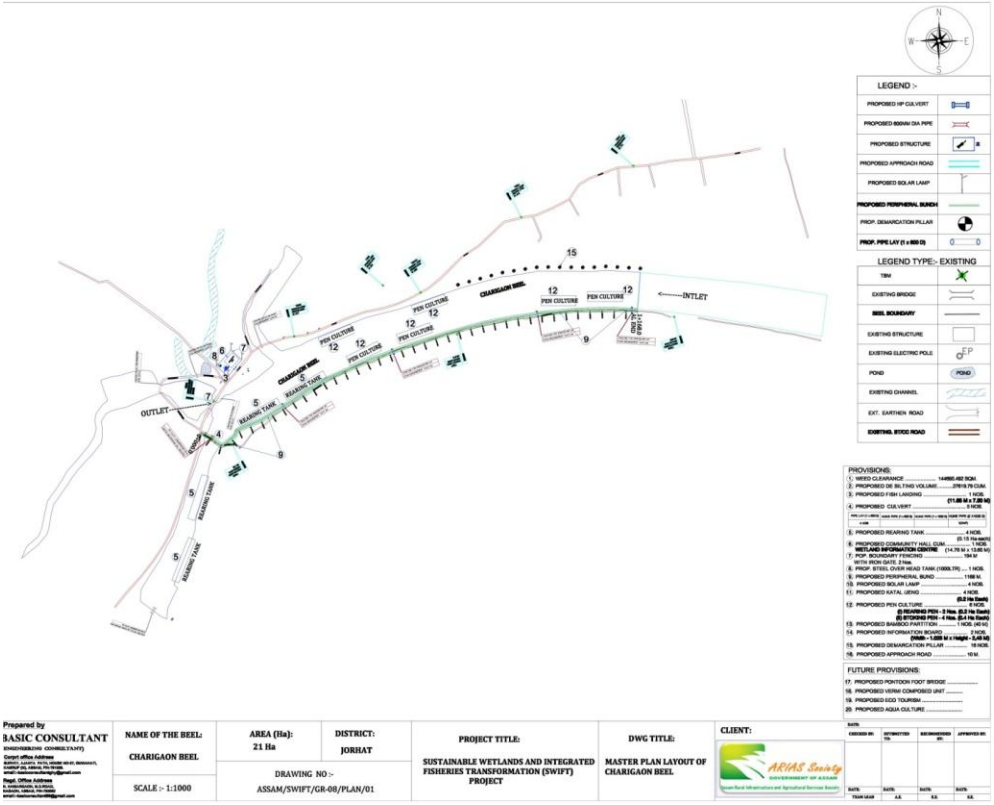



**Figure 3-47. Master Plan layout of Charigaon Beel**

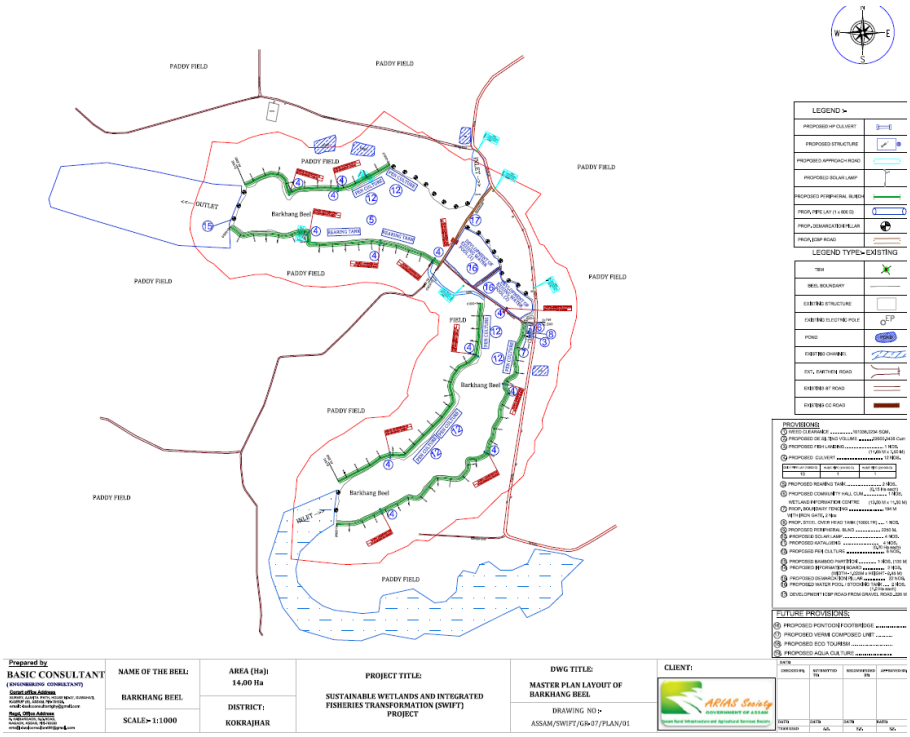



**Figure 3-48. Master Plan layout of Barkhang Beel**

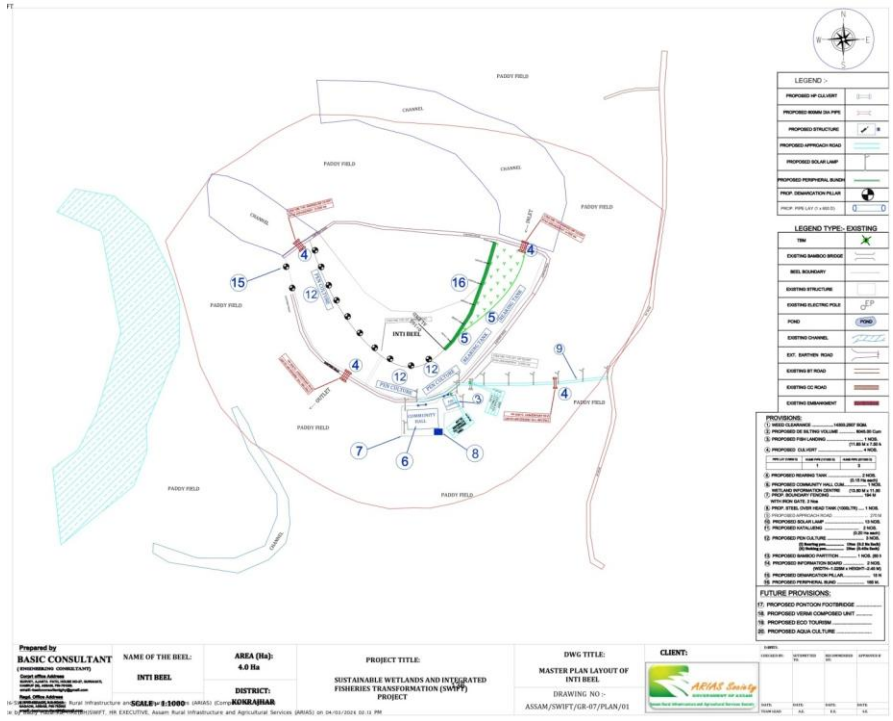



**Figure 3-49. Master Plan layout of Inti Beel**

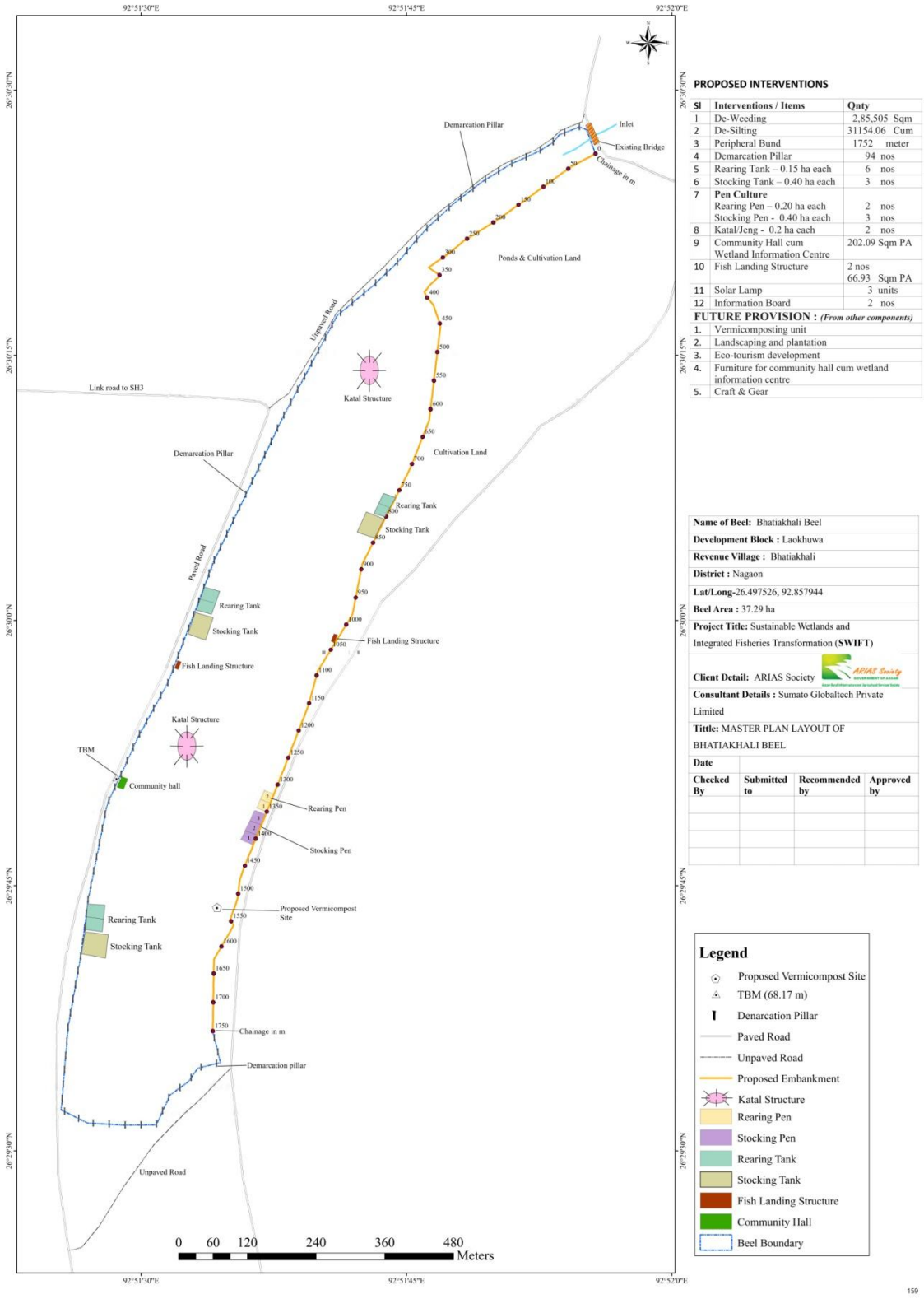



**Figure 3-50. Master Plan layout of Bhatiakhali Beel**

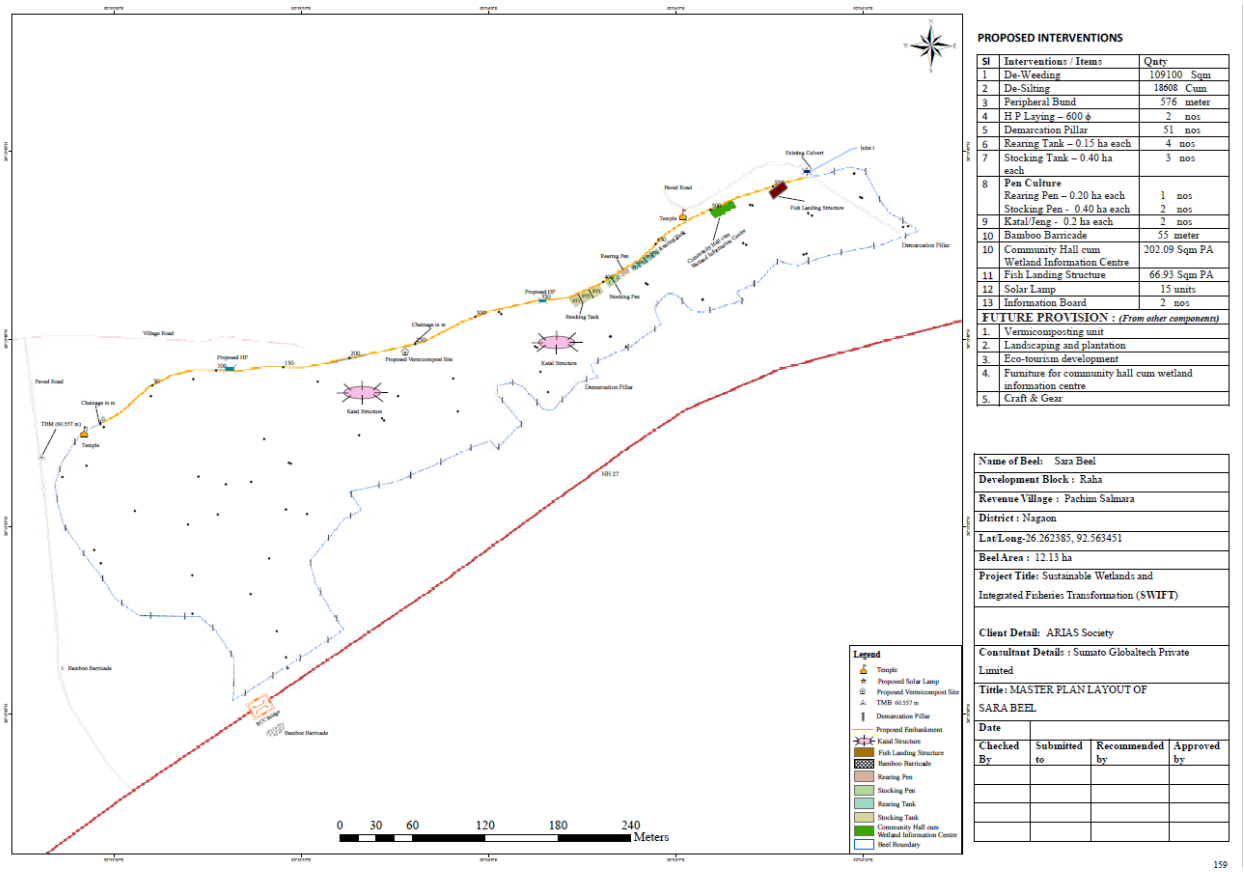



**Figure 3-51. Master Plan layout of Sara Beel**

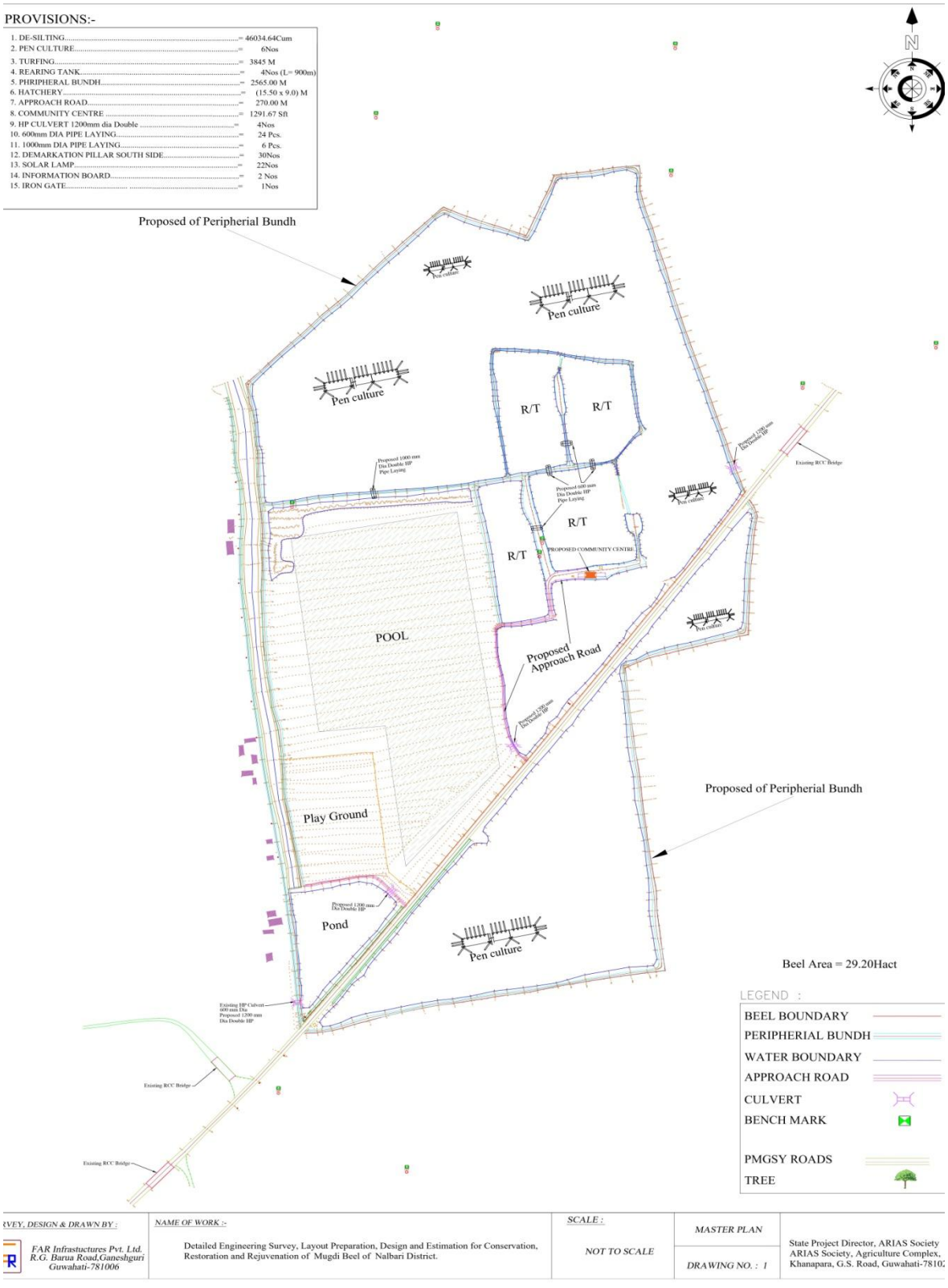



**Figure 3-52. Master Plan layout of Mugdi Beel**

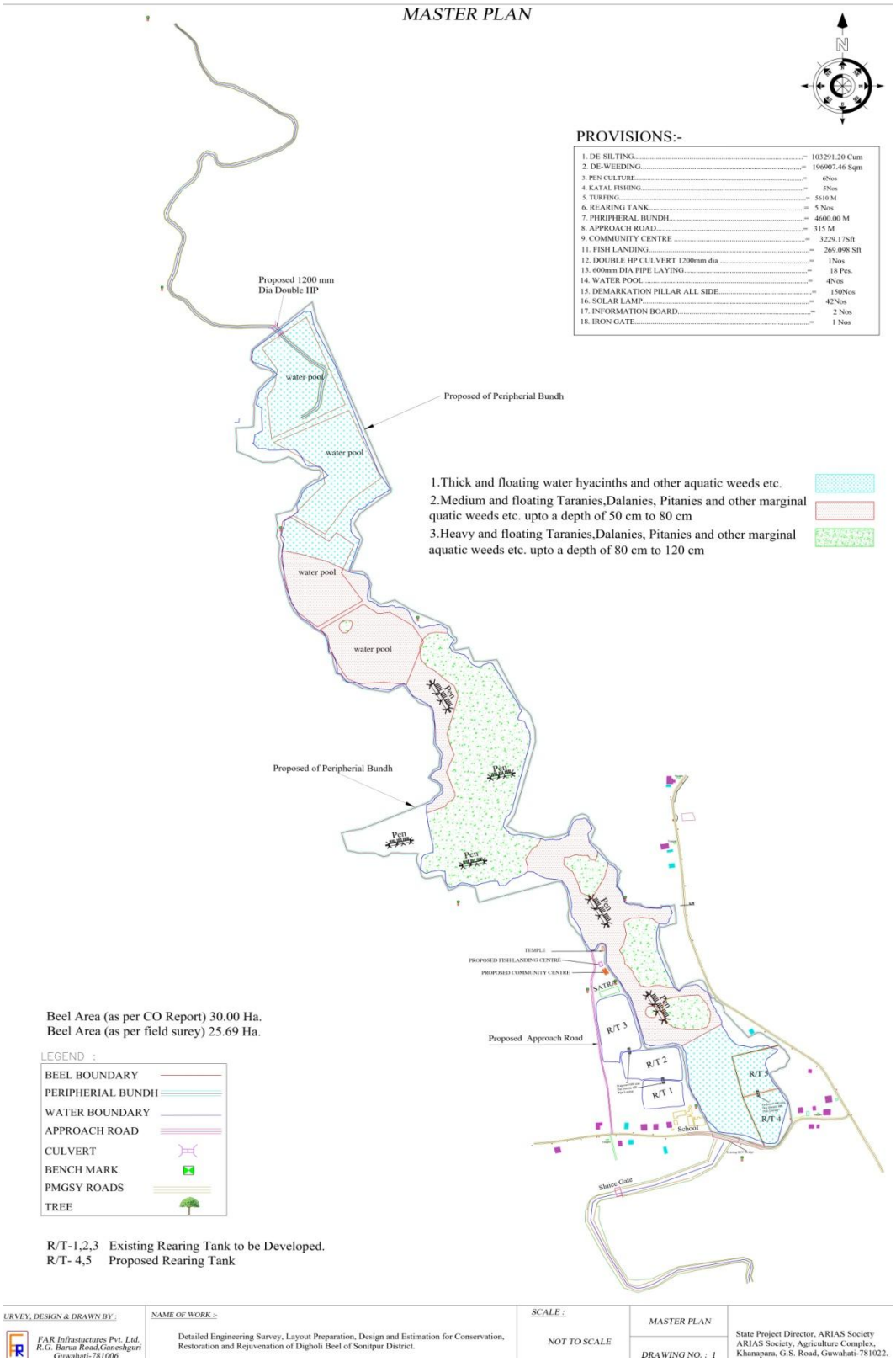



**Figure 3-53. Master Plan layout of Digholi Beel**

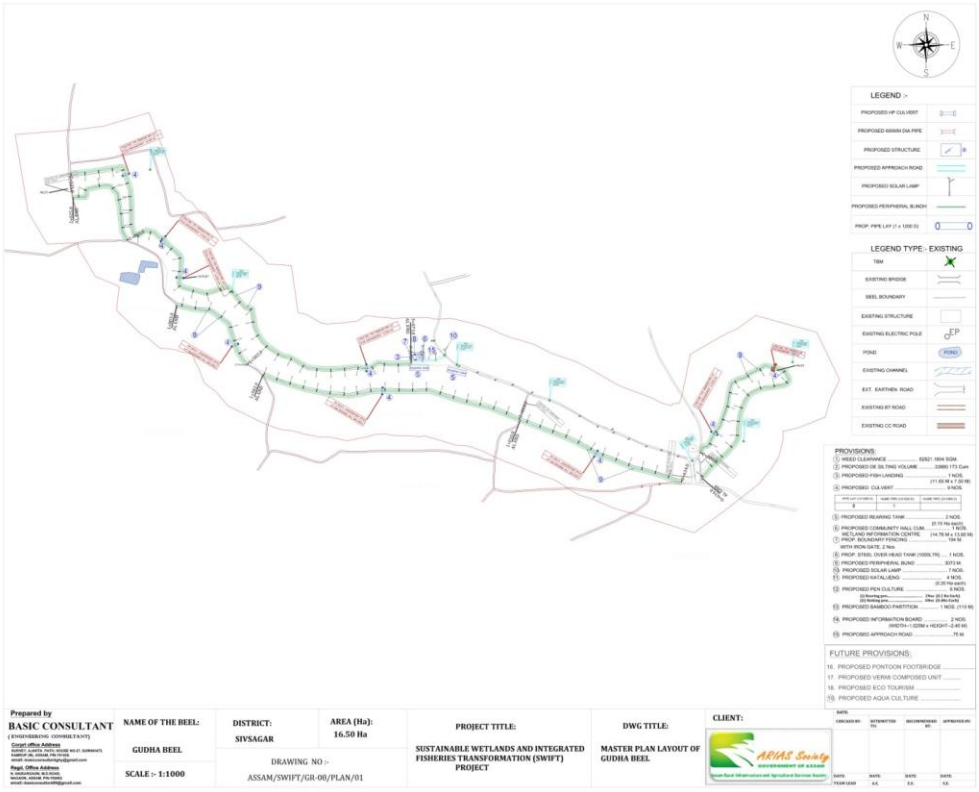



**Figure 3-54. Master Plan layout of Gudha Beel**

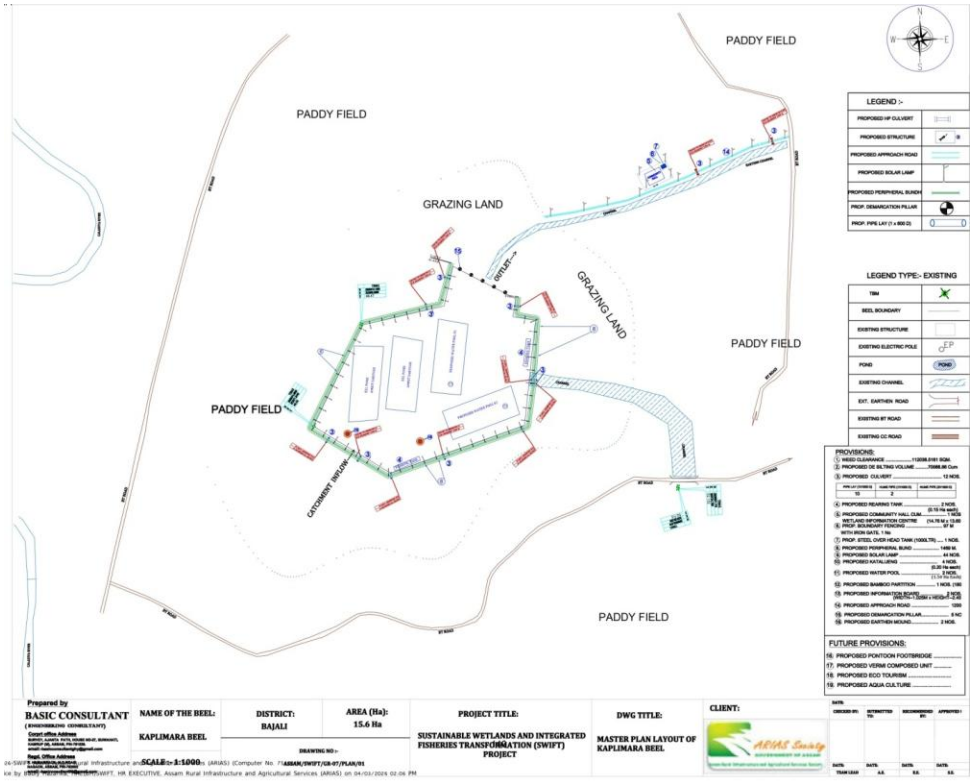



**Figure 3-55. Master Plan layout of Kaplimara Beel**

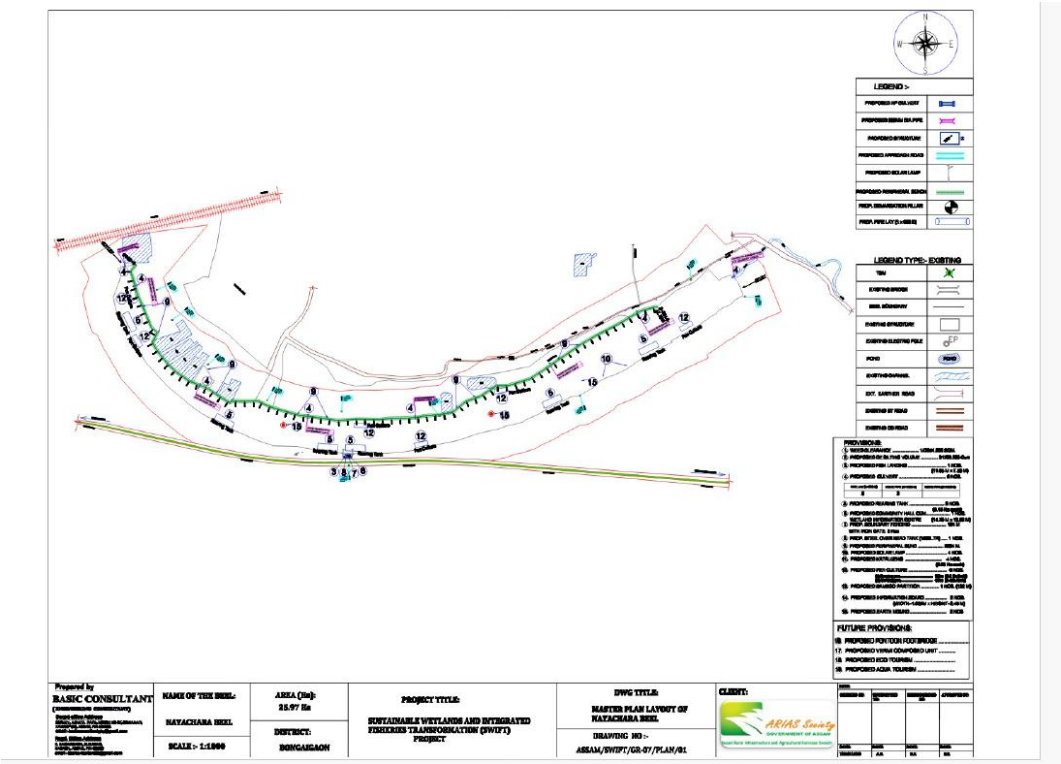



**Figure 3-56. Master Plan layout of Nayachara Beel**

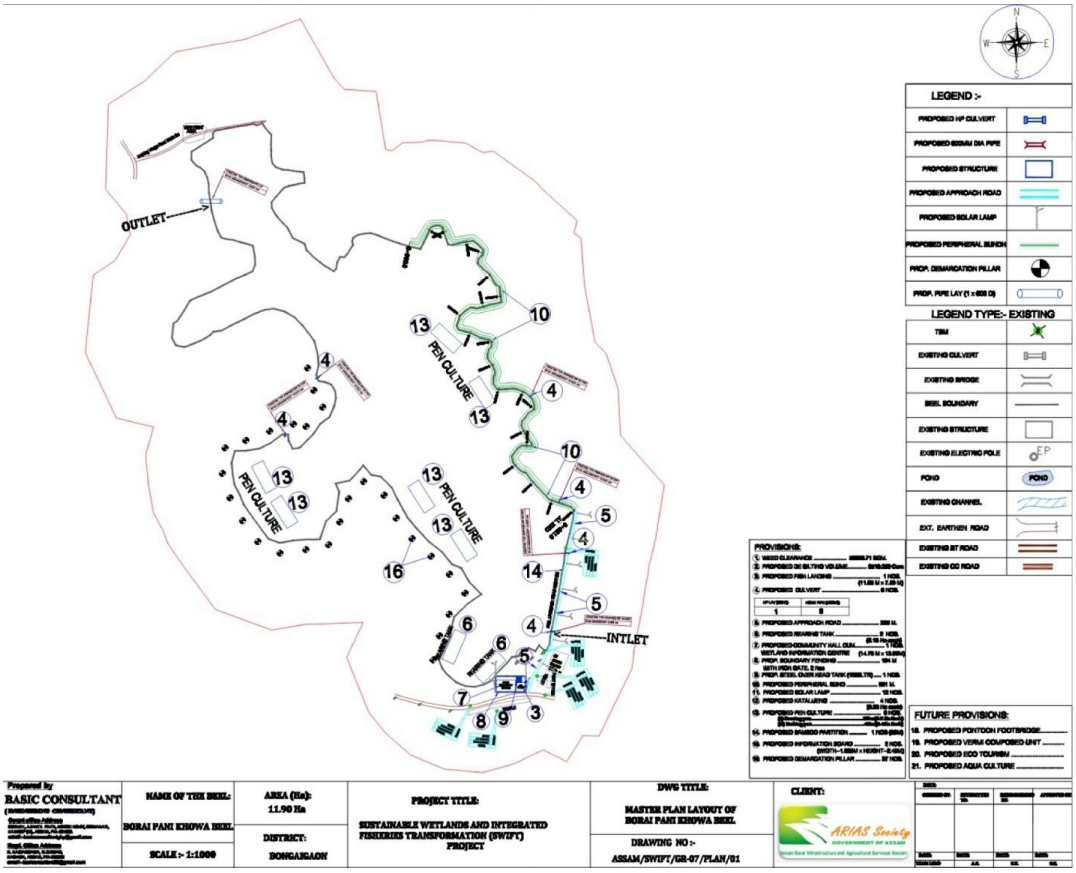



**Figure 3-57. Master Plan layout of Borai Pani Khowa Beel**

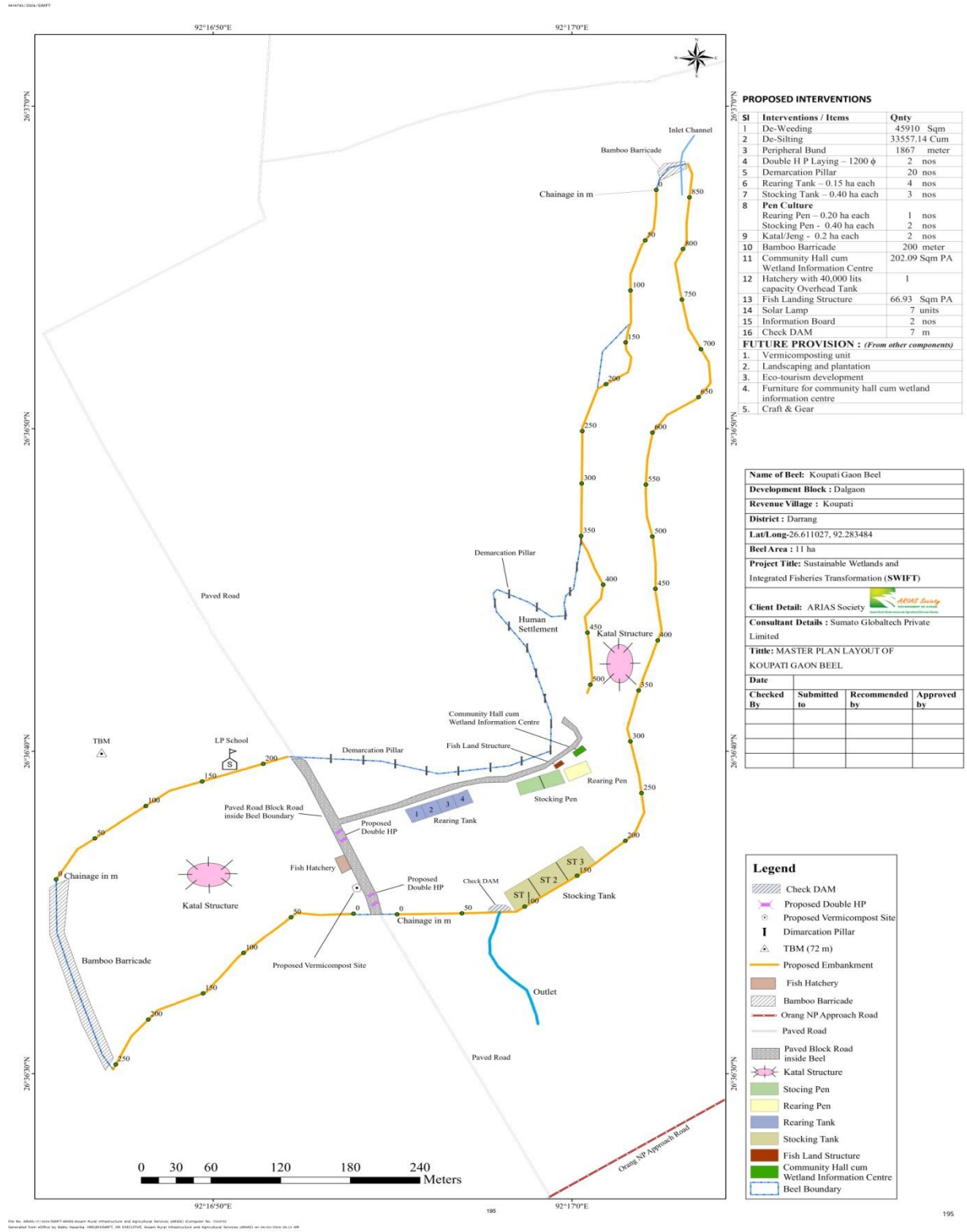



**Figure 3-58. Master Plan layout of Koupati Beel**

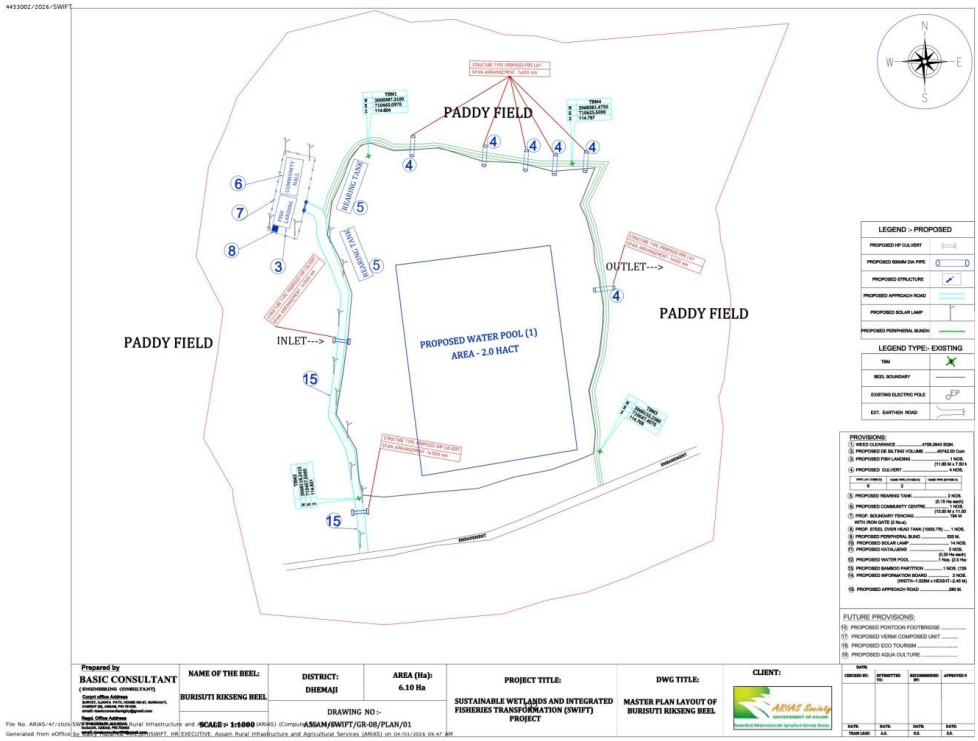



**Figure 3-59. Master Plan layout of Burisuti Rikseng Beel**

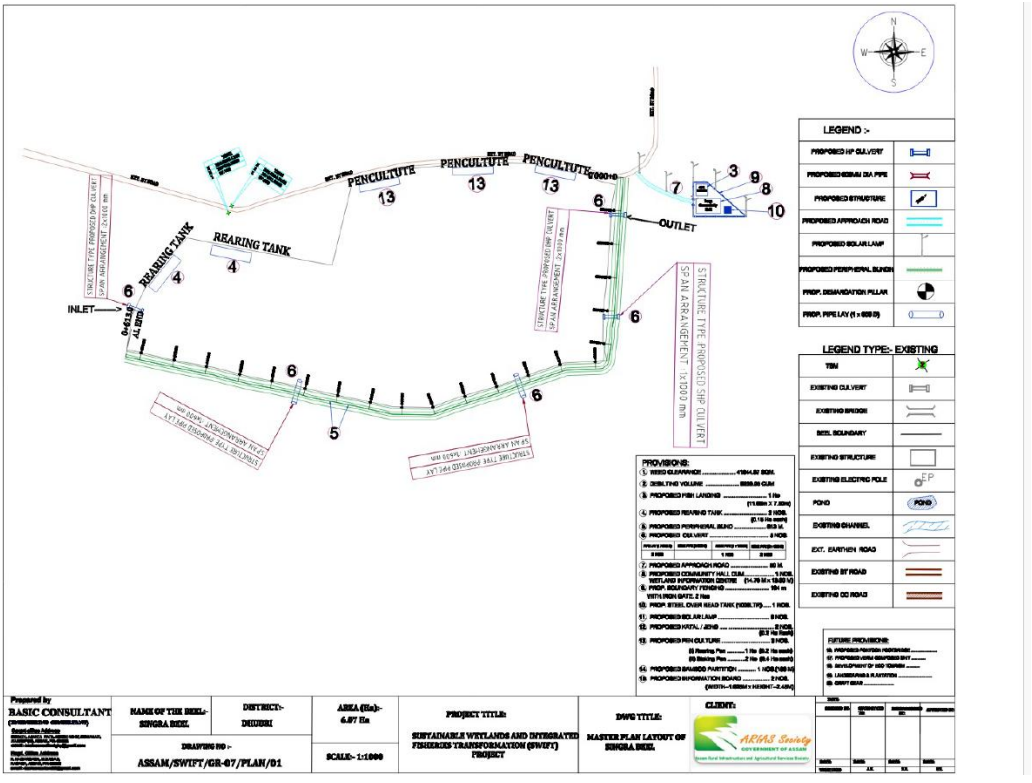



**Figure 3-60 . Master Plan layout of Singra Beel**

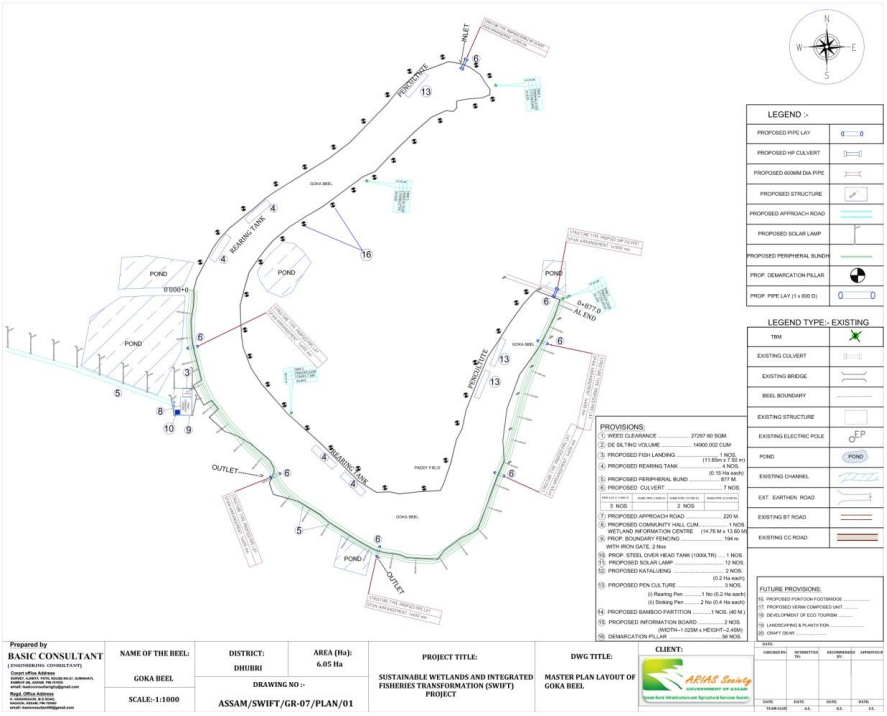



**Figure 3-61. Master Plan layout of Goka Beel**

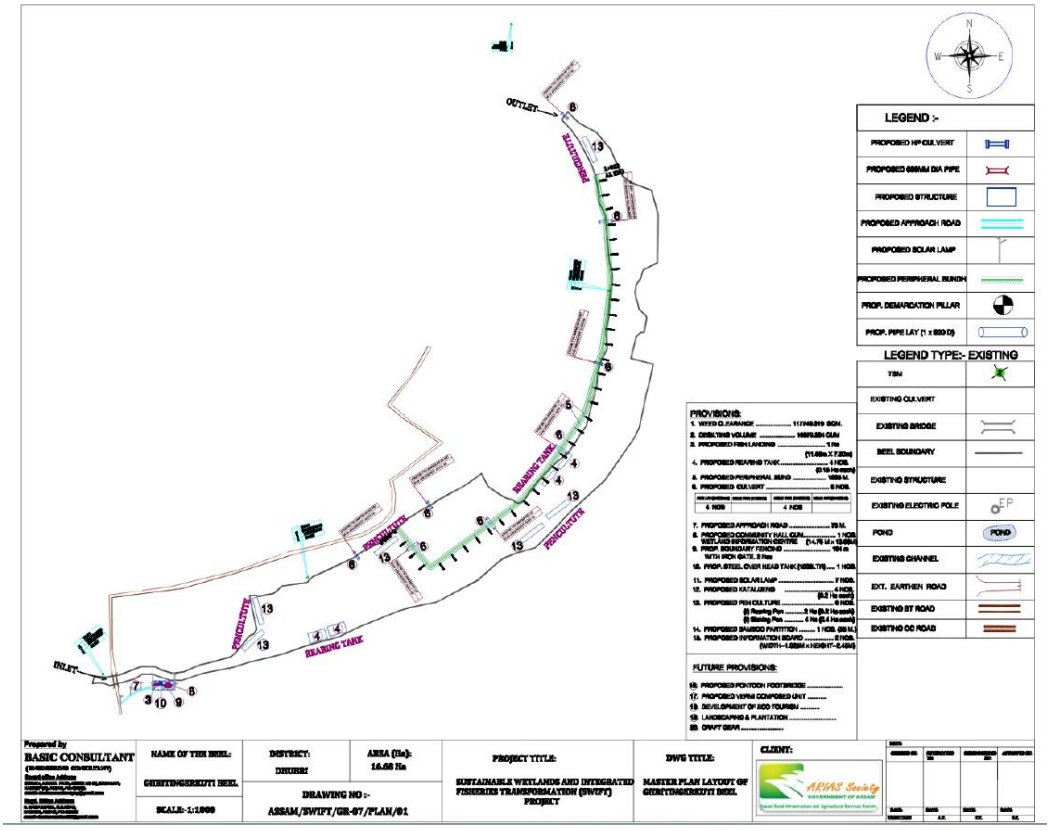



**Figure 3-62. Master Plan layout of Ghritingerkuti Beel**

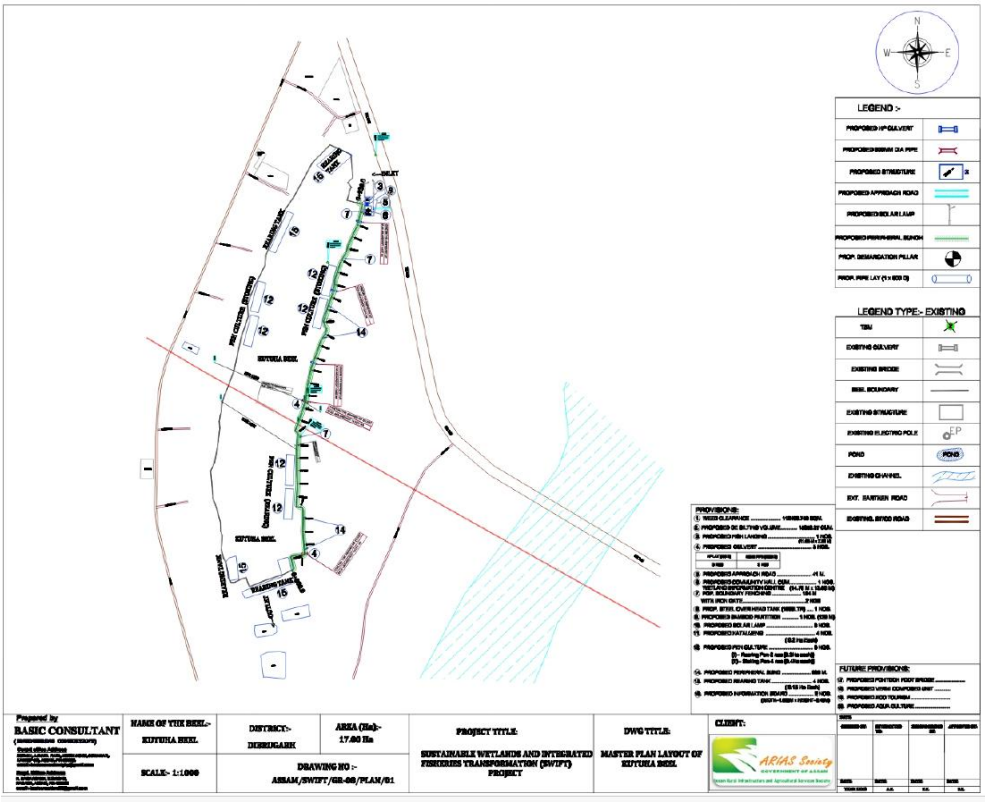



**Figure 3-63. Master Plan layout of Kutuha Beel**

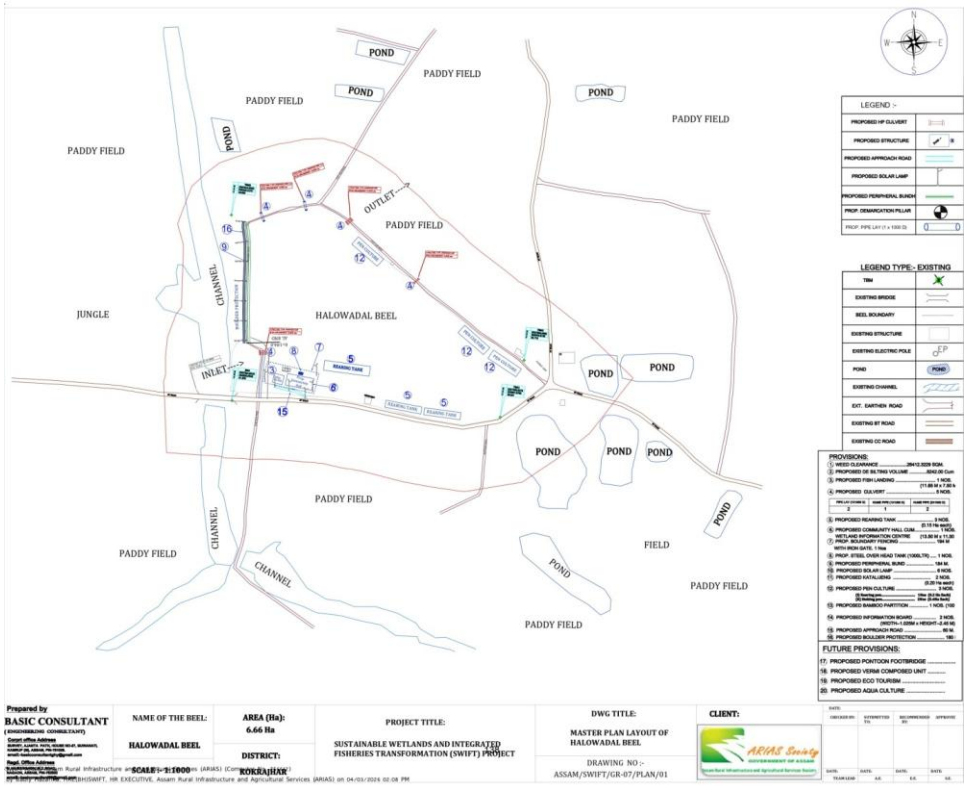



**Figure 3-64. Master Plan layout of Halowadal Beel**

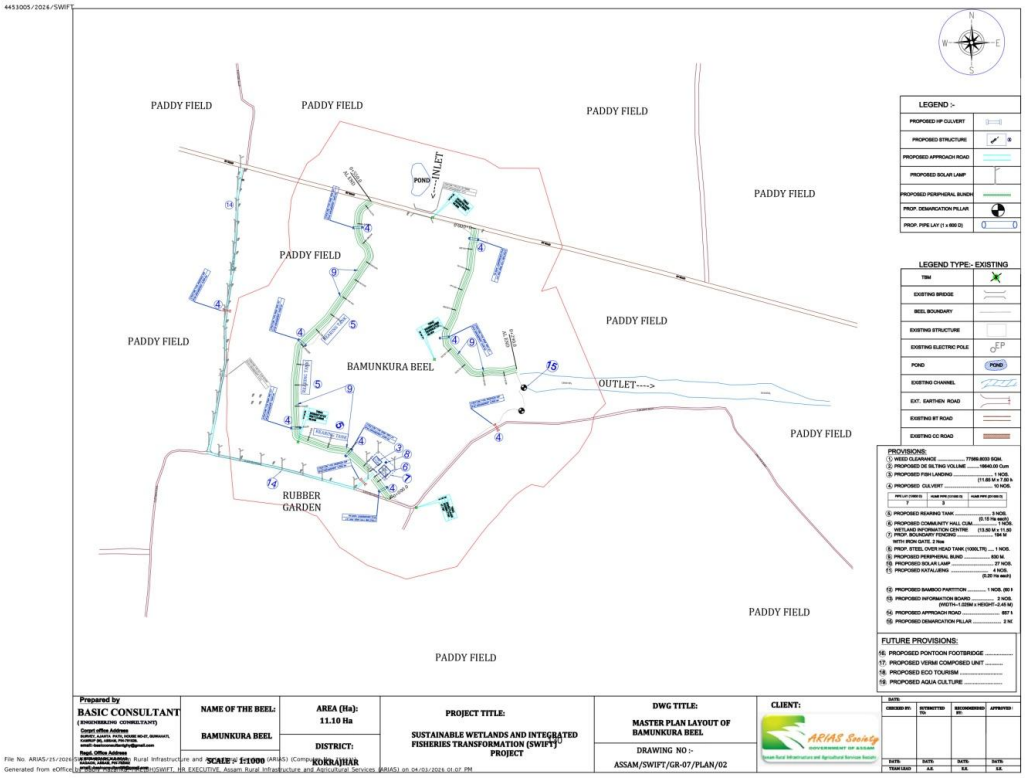



**Figure 3-65. Master Plan layout of Bamunkura Beel**

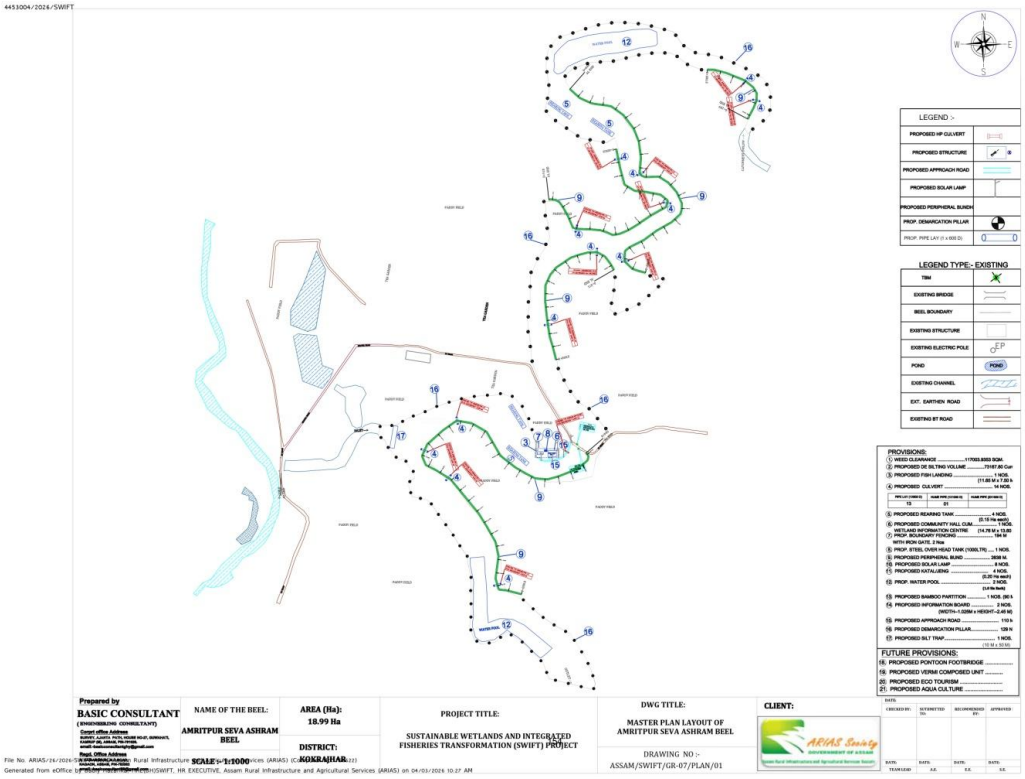



**Figure 3-66. Master Plan layout of Amritpur Brahma Sewashram Beel**

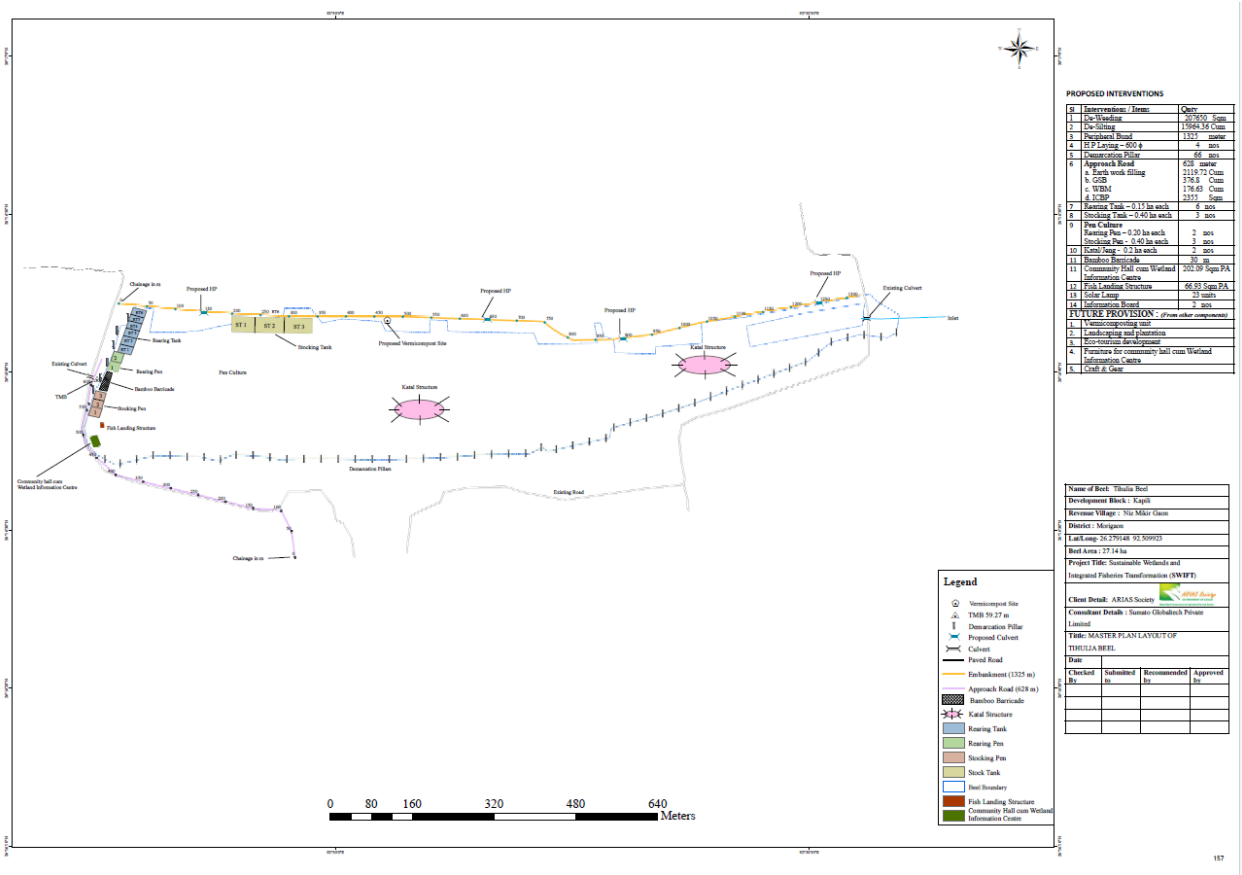



**Figure 3-67. Master Plan layout of Tihulia Beel**

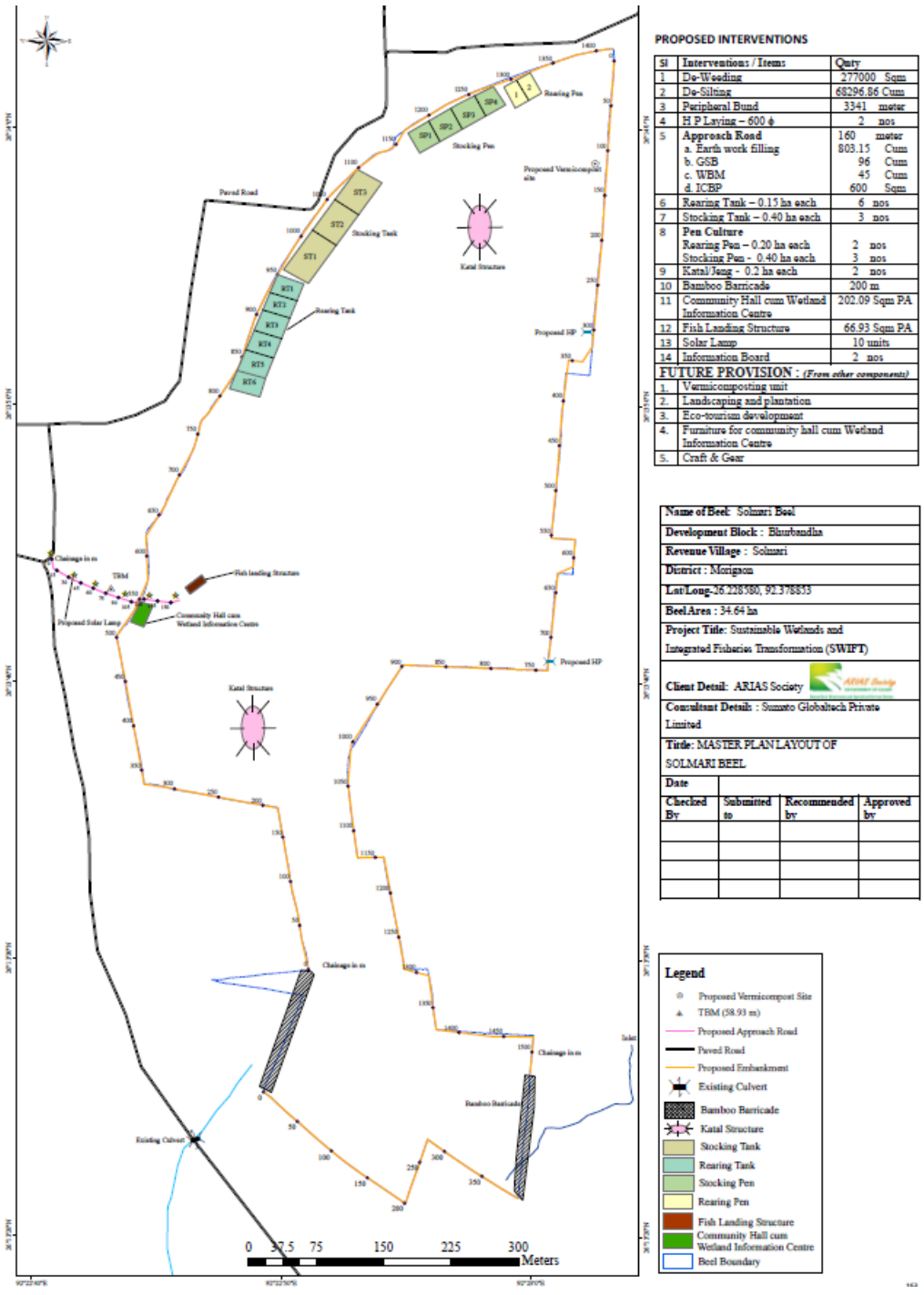



**Figure 3-68. Master Plan layout of Solmari Beel**

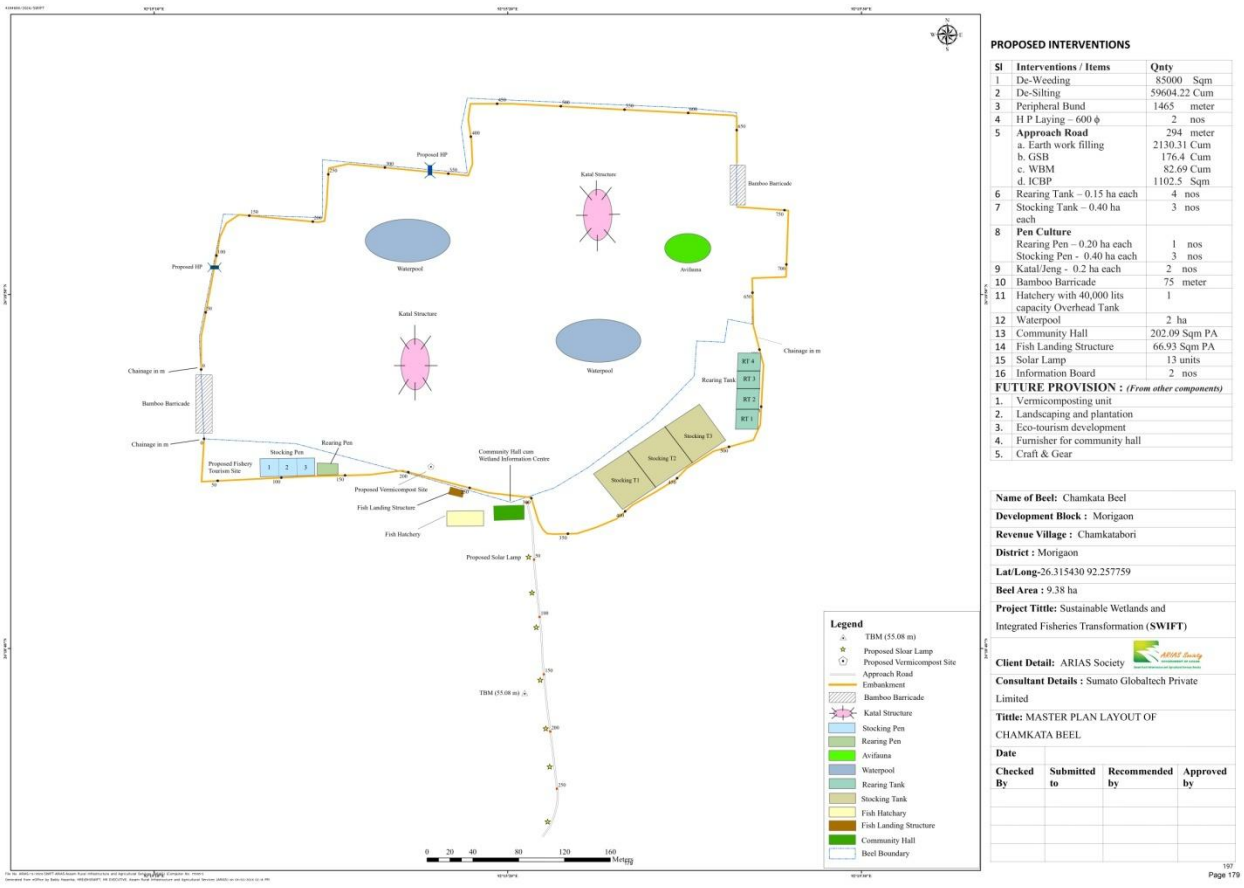



**Figure 3-69. Master Plan layout of Chamkata Beel**

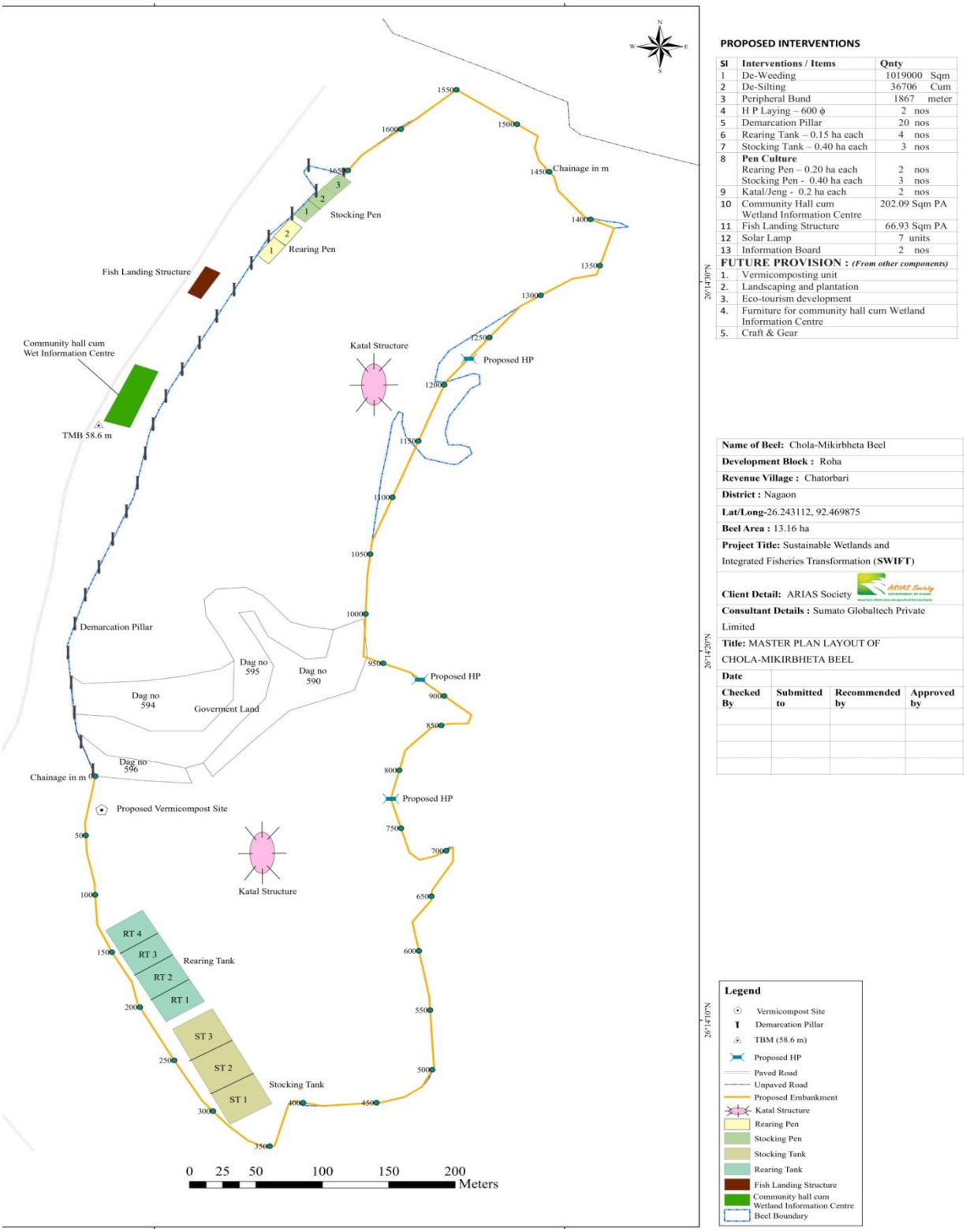



**Figure 3-70. Master Plan layout of Chola Mikirbheta Beel**

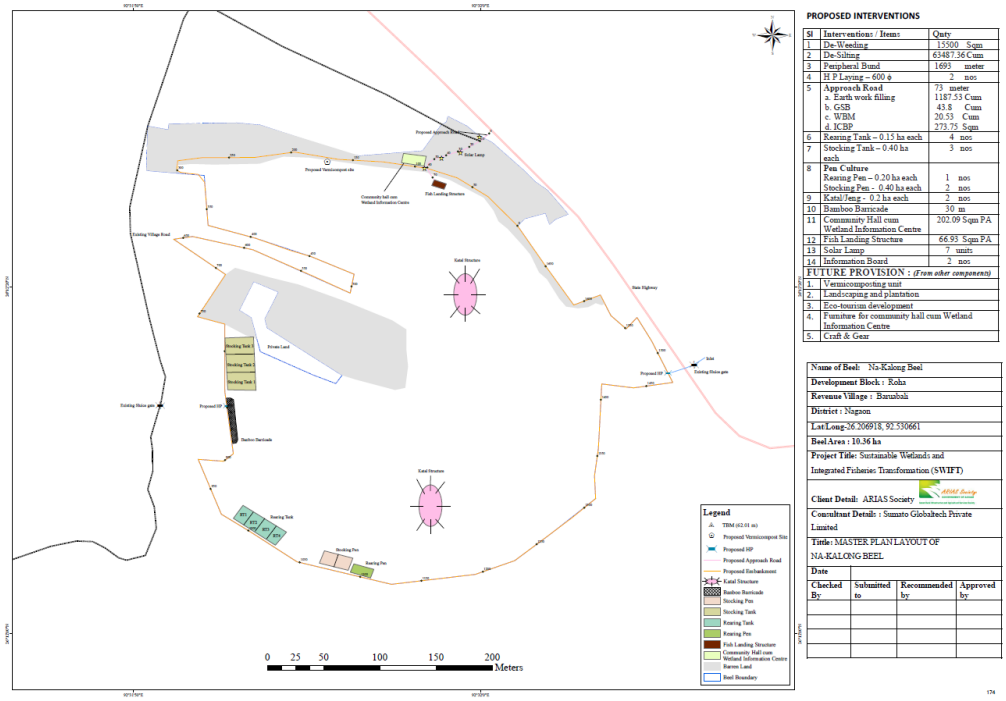



**Figure 3-71. Master Plan layout of Na Kollong Beel**

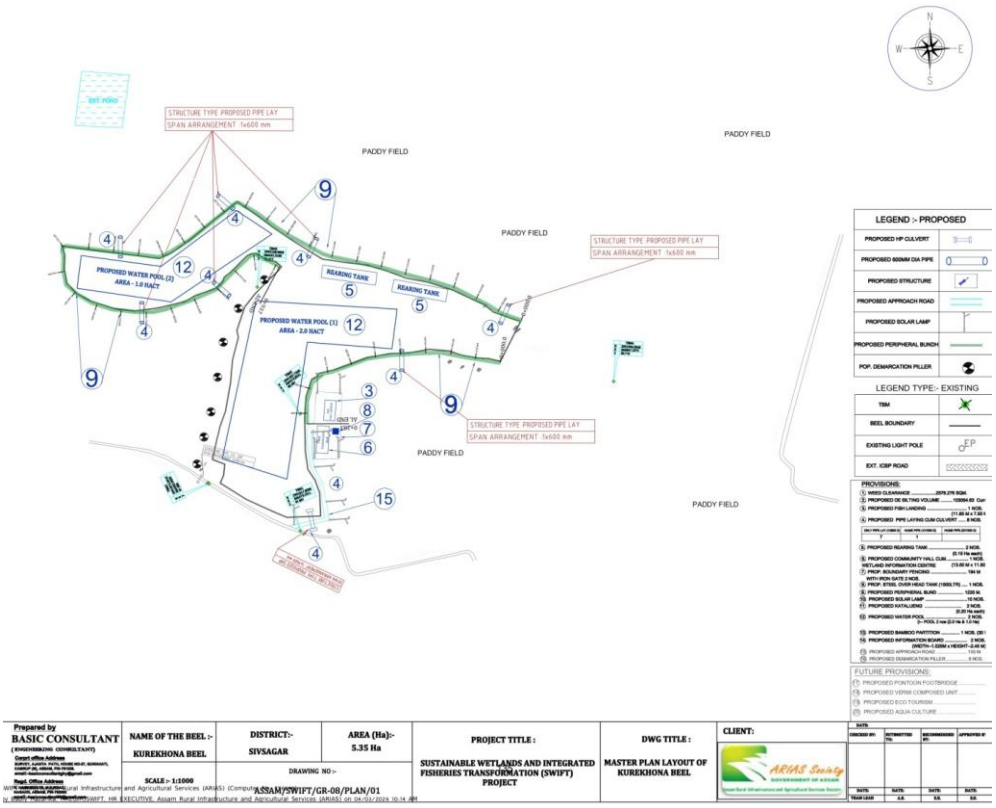



**Figure 3-72. Master Plan layout of Kurekhona Beel**

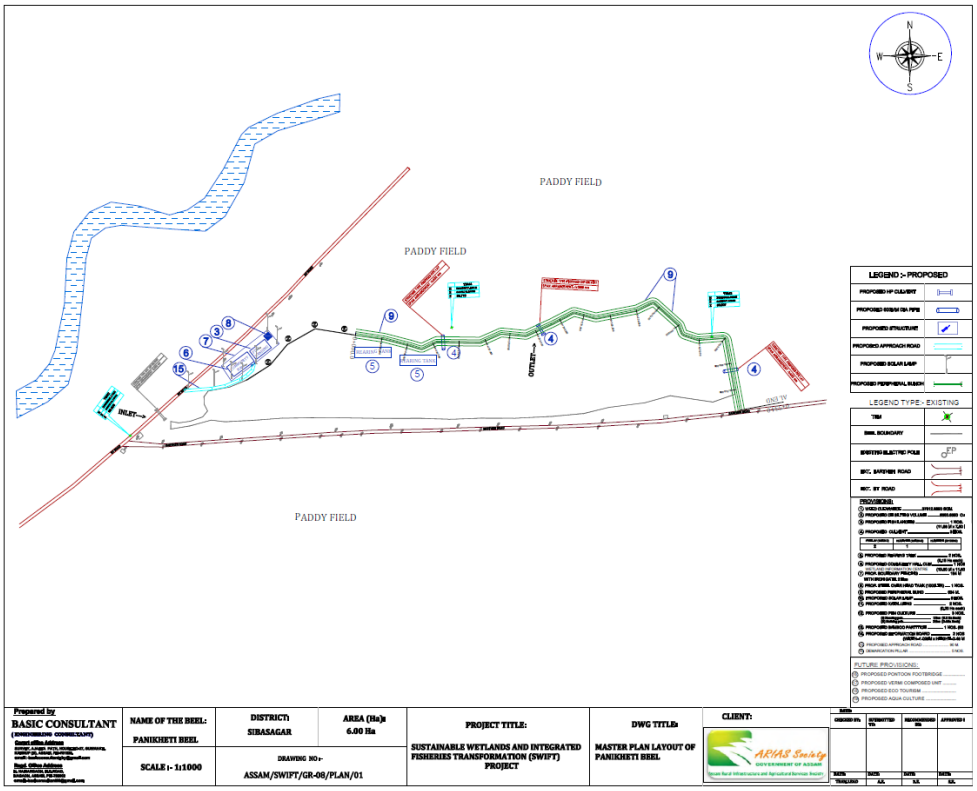



**Figure 3-73. Master Plan layout of Panikheti Beel**

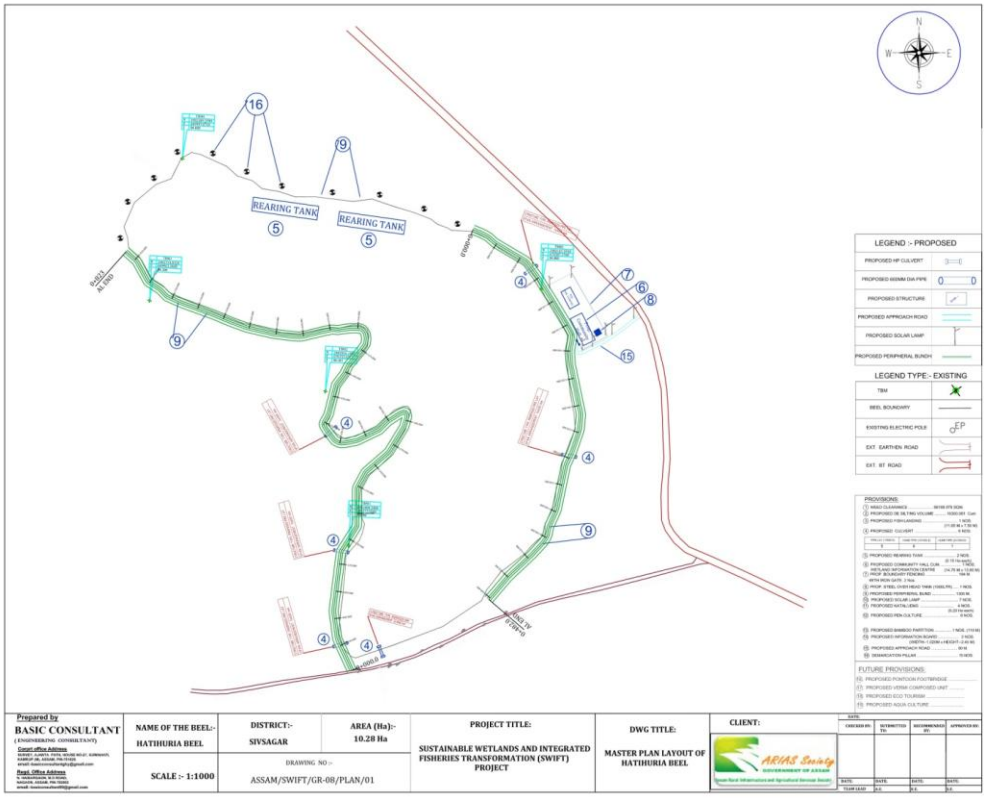



**Figure 3-74. Master Plan layout of Hatithuria Beel**

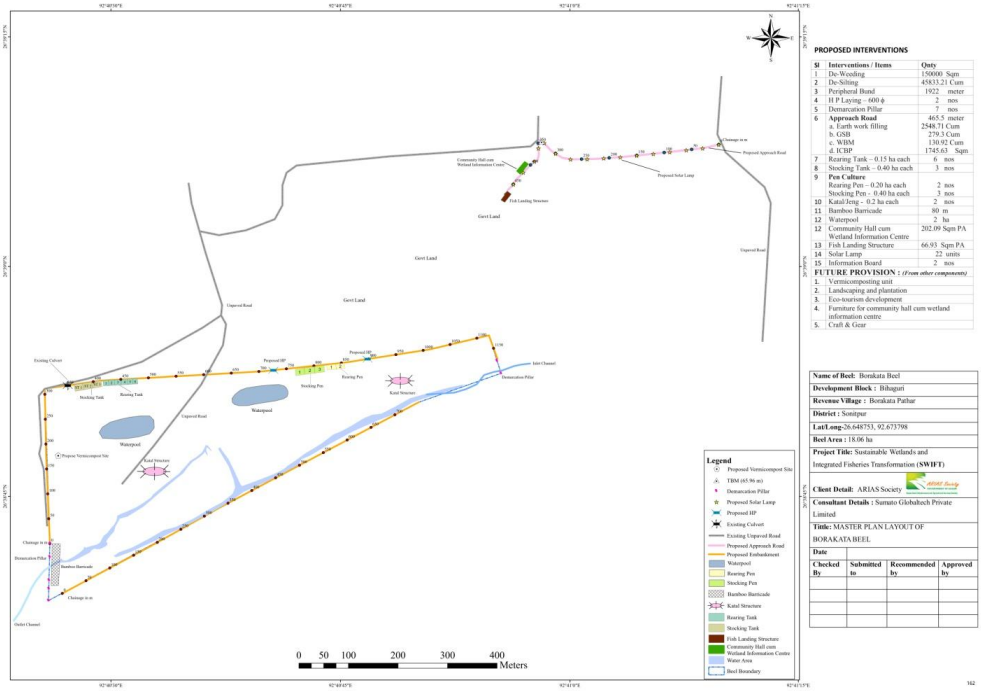



**Figure 3-75. Master Plan layout of Borakata Beel**

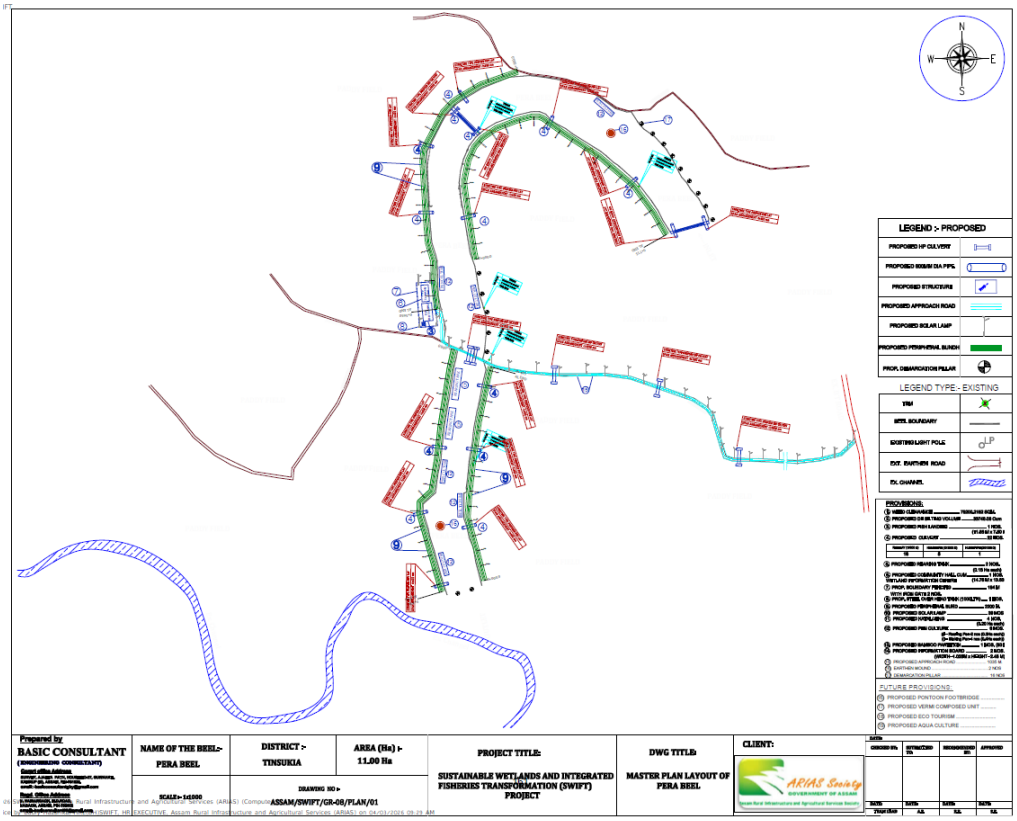



**Figure 3-76. Master Plan layout of Pera Beel**

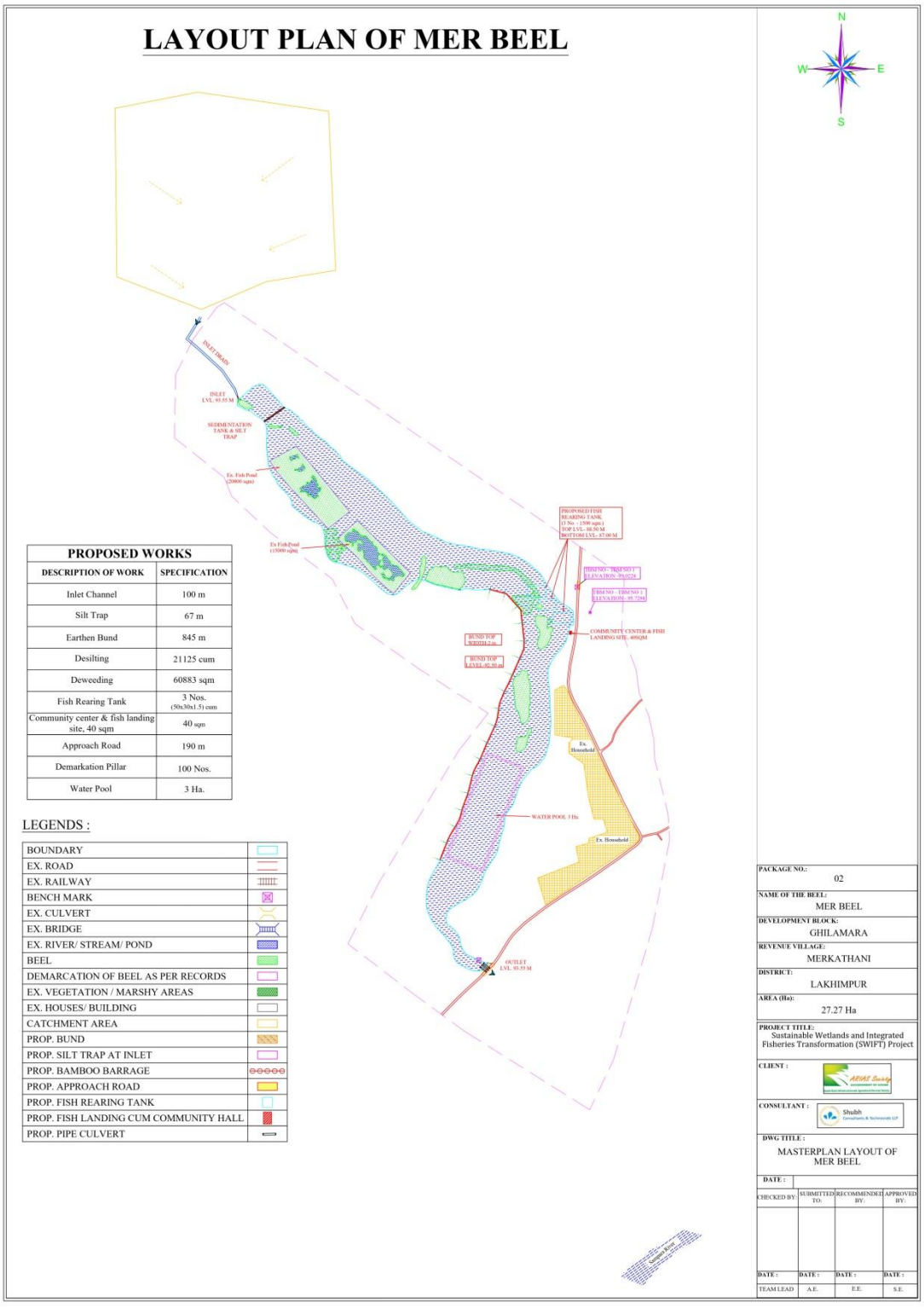



**Figure 3-77. Master Plan layout of Mer Beel**

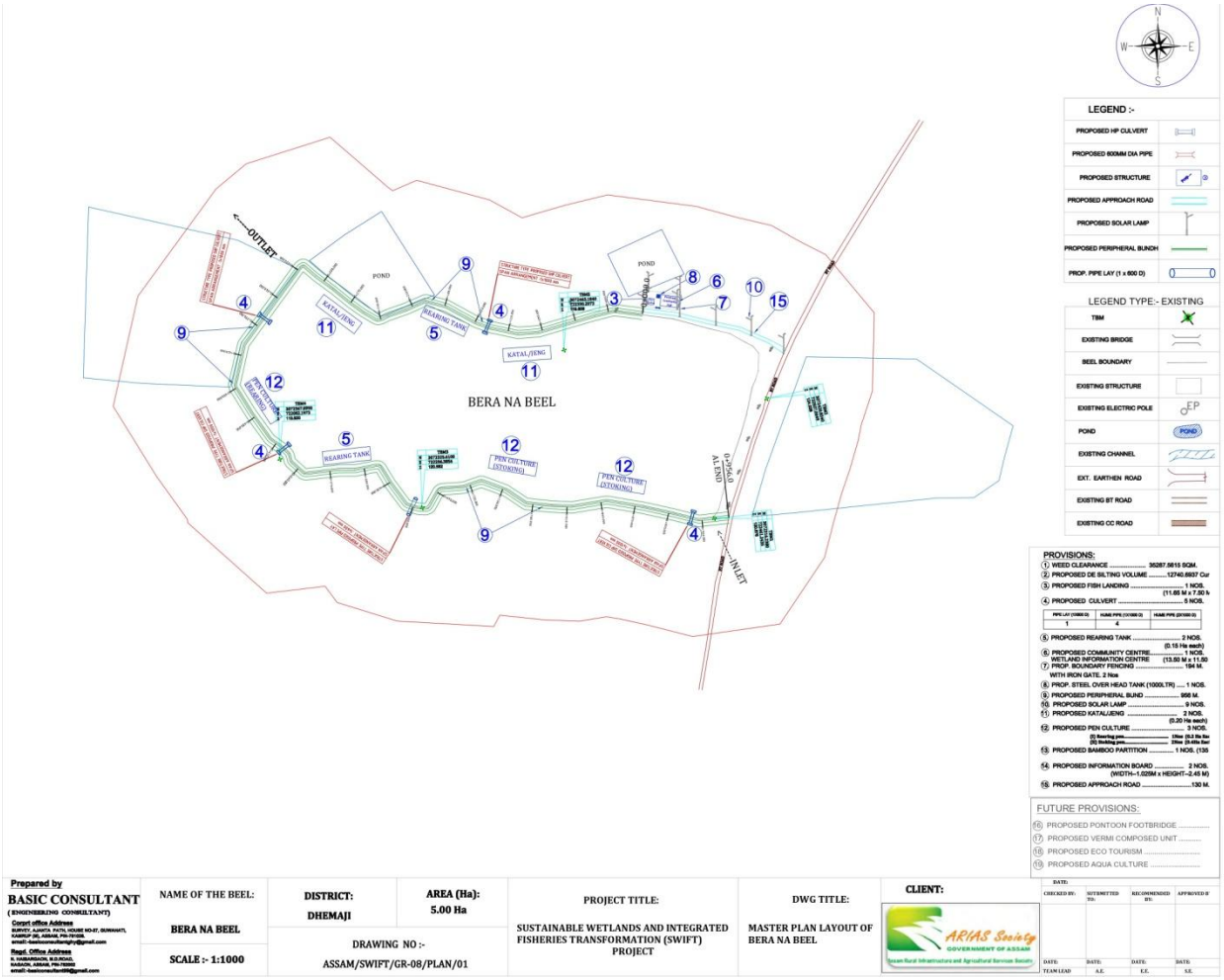



**Figure 3-78. Master Plan layout of Bera Na Beel**




**Figure 3-79. Satellite View of Udmari Beel Showing Key Interventions**




**Figure 3-80. Satellite View of Chalantapara Haripani Beel Showing Key Interventions**

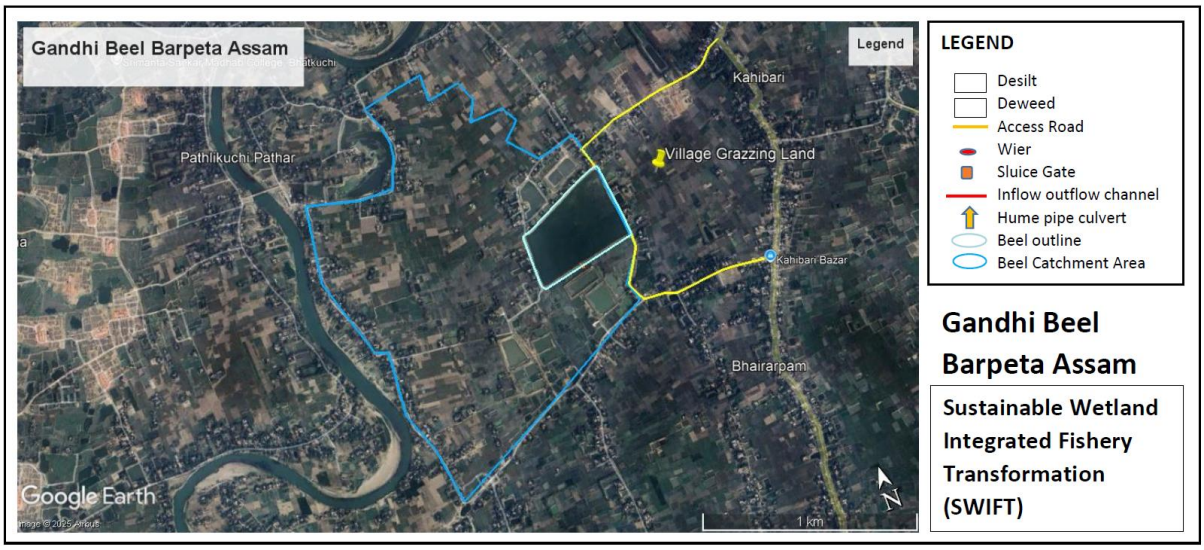



**Figure 3-81. Satellite View of Gandhi Beel Showing Key Interventions**

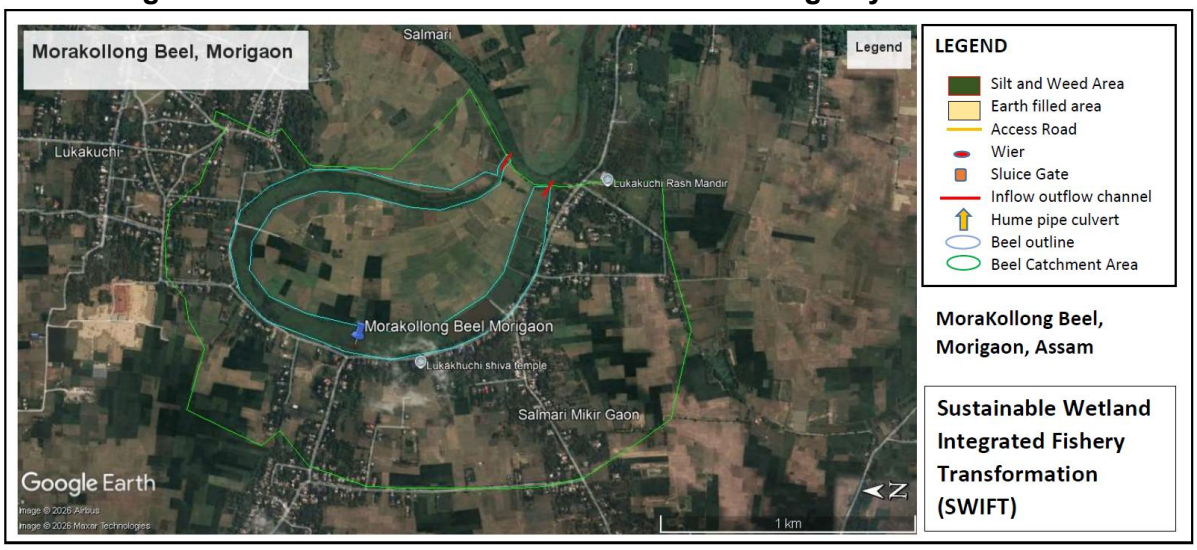



**Figure 3-82. Satellite View of Morakollong Beel Showing Key Interventions**




**Figure 3-83. Satellite View of Oram Beel Showing Key Interventions**




**Figure 3-84. Satellite View of Moridesoi Beel Showing Key Interventions**

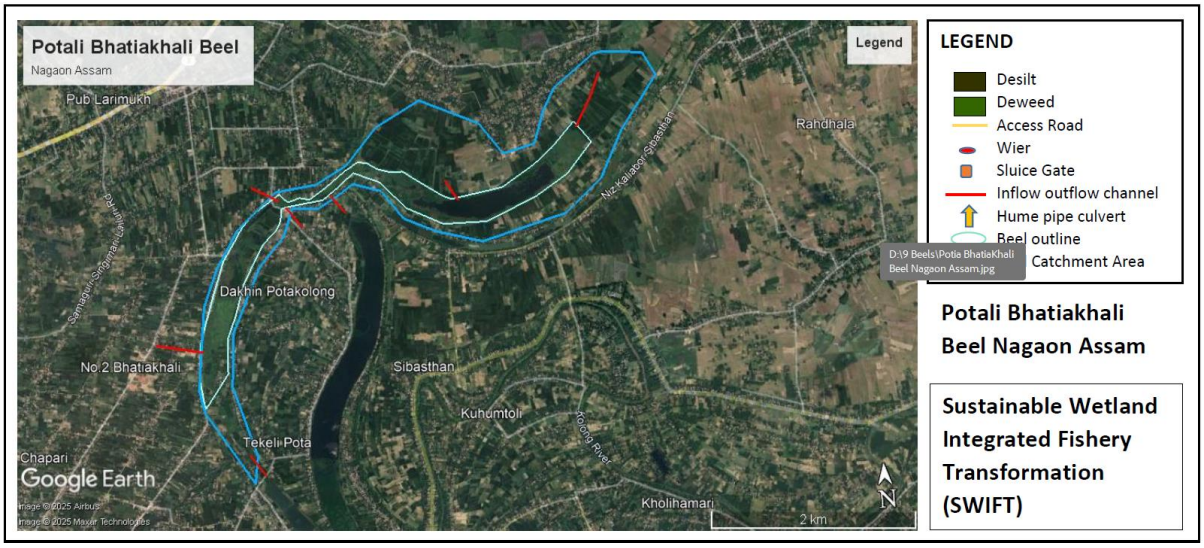



**Figure 3-85. Satellite View of Potali Bhatiakhali Beel Showing Key Interventions**

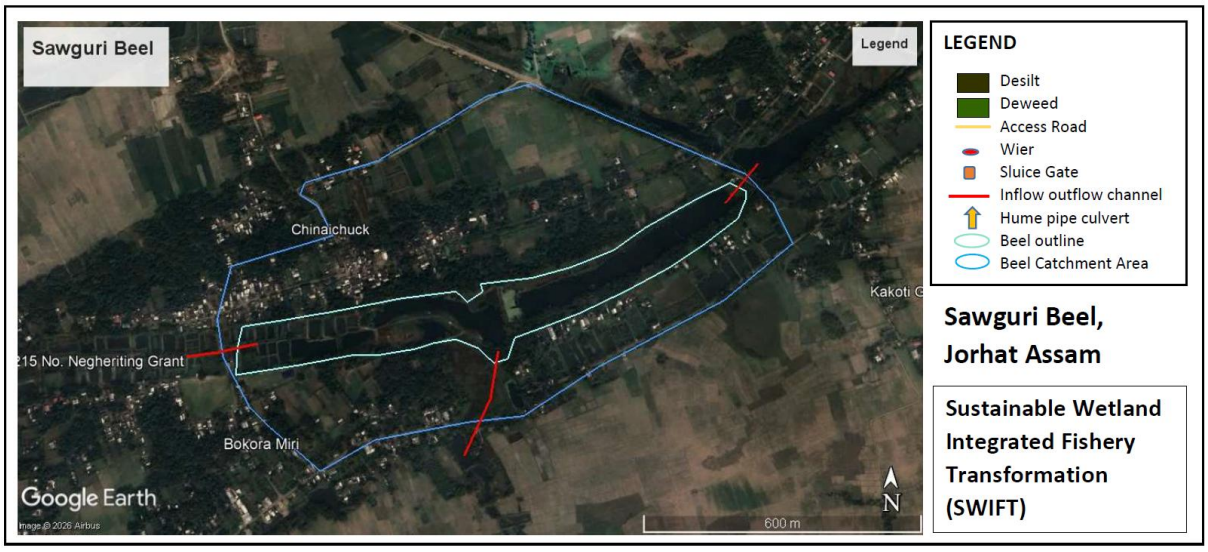



**Figure 3-86. Satellite View of Sawguri Beel Showing Key Interventions**

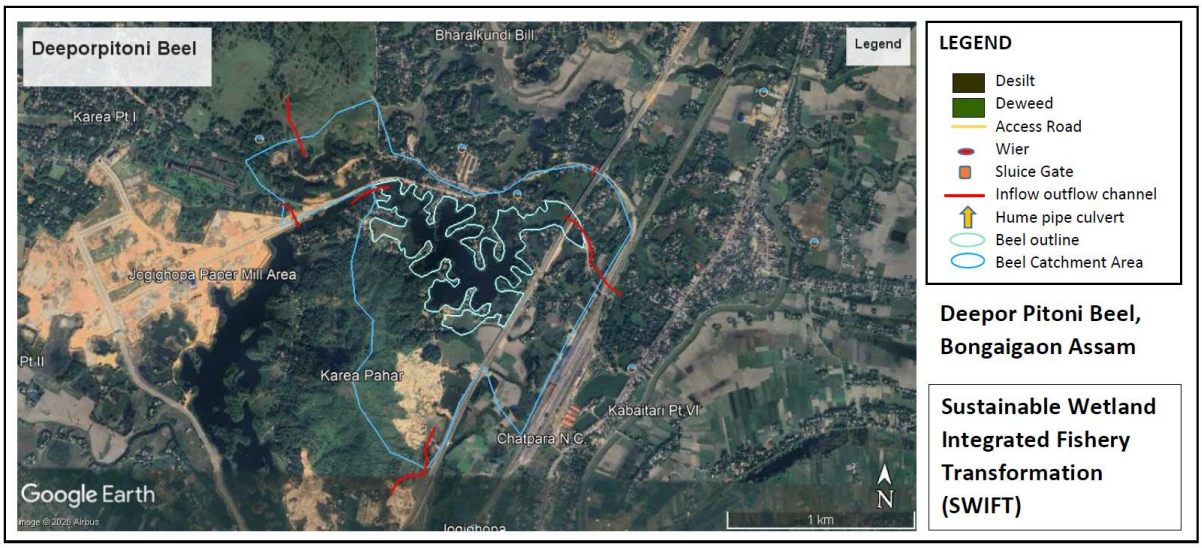



**Figure 3-87. Satellite View of Deepor Pitoni Beel Showing Key Interventions**




**Figure 3-88. Satellite View of Airmara Beel Showing Key Interventions**




**Figure 3-89. Satellite View of Borjong Beel Showing Key Interventions**




**Figure 3-90. Satellite View of Bhulkaguri Beel Showing Key Interventions**

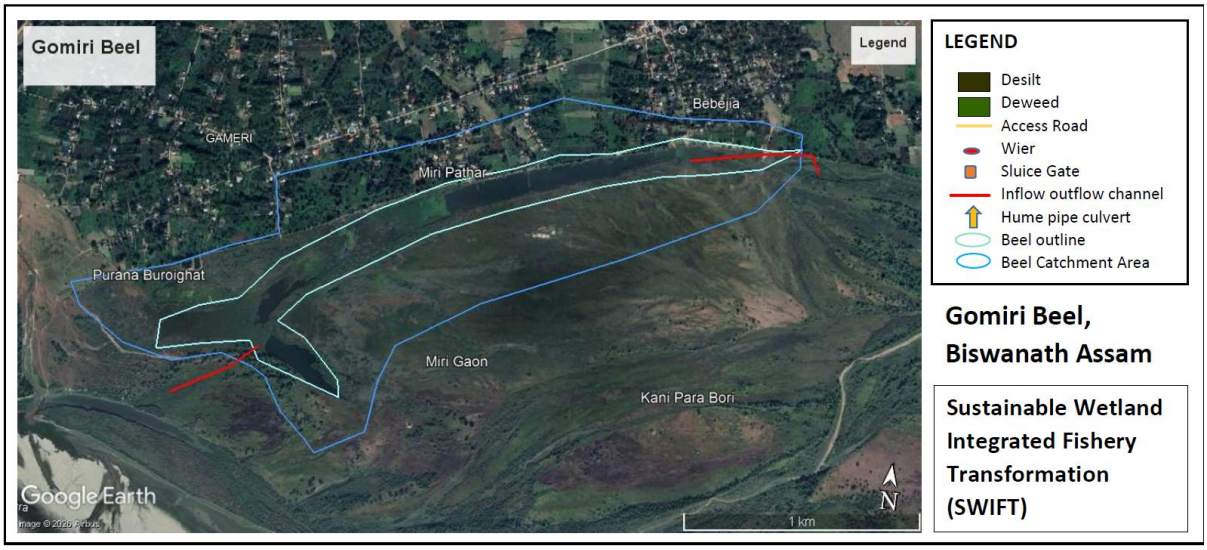



**Figure 3-91. Satellite View of Gamiri Beel Showing Key Interventions**

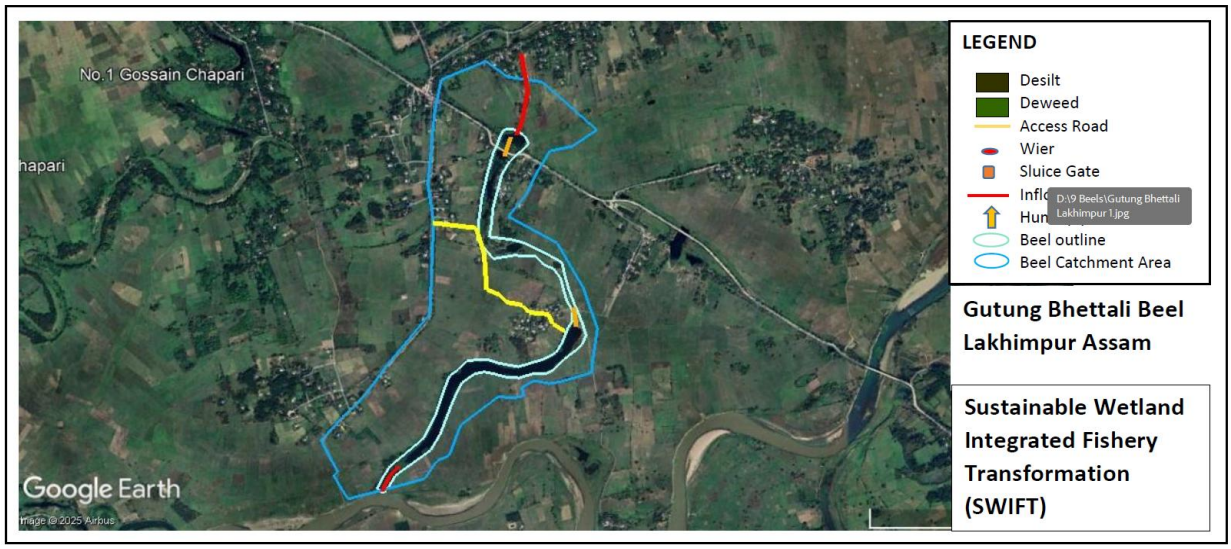



**Figure 3-92. Satellite View of Gutung Bhettali Beel Showing Key Interventions**

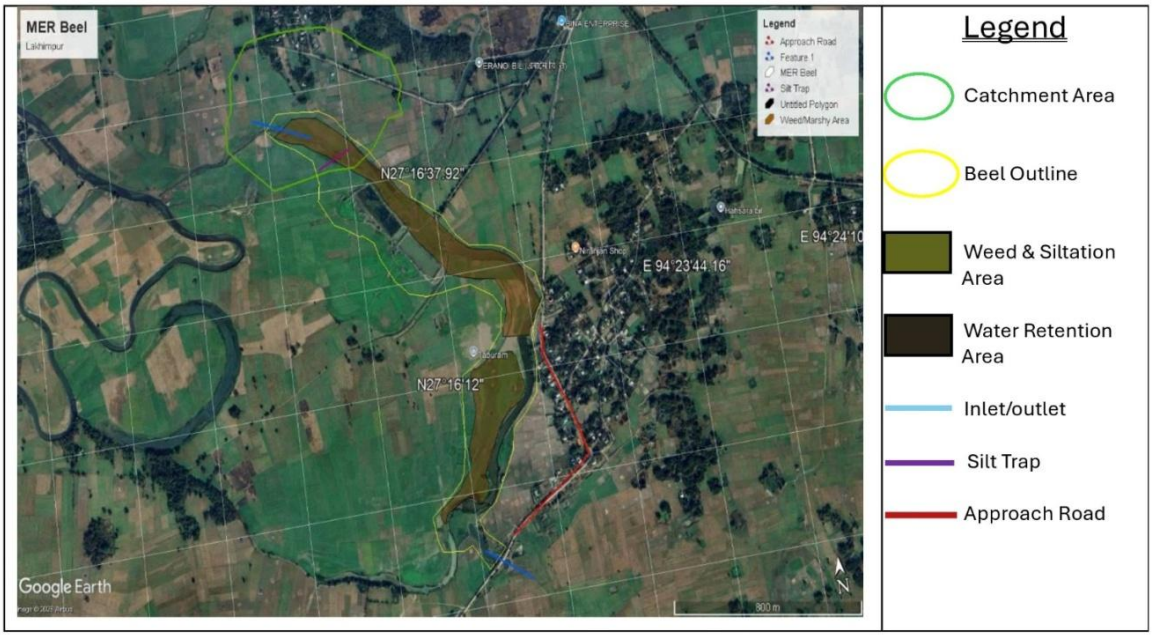



**Figure 3-93. Satellite View of Mer Beel Showing Key Interventions**

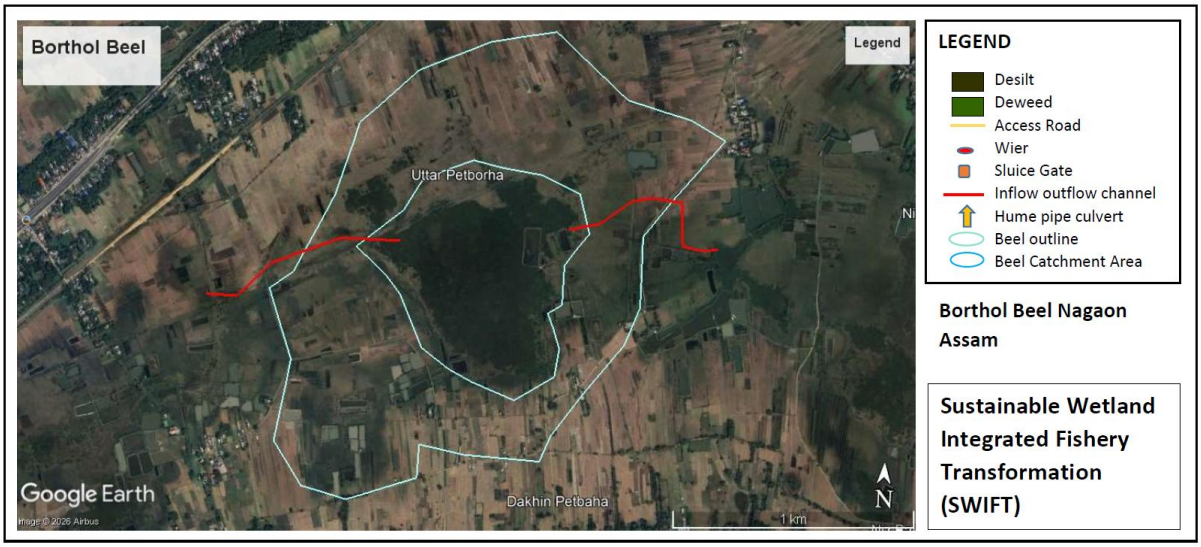



**Figure 3-94. Satellite View of Borthol Beel Showing Key Interventions**

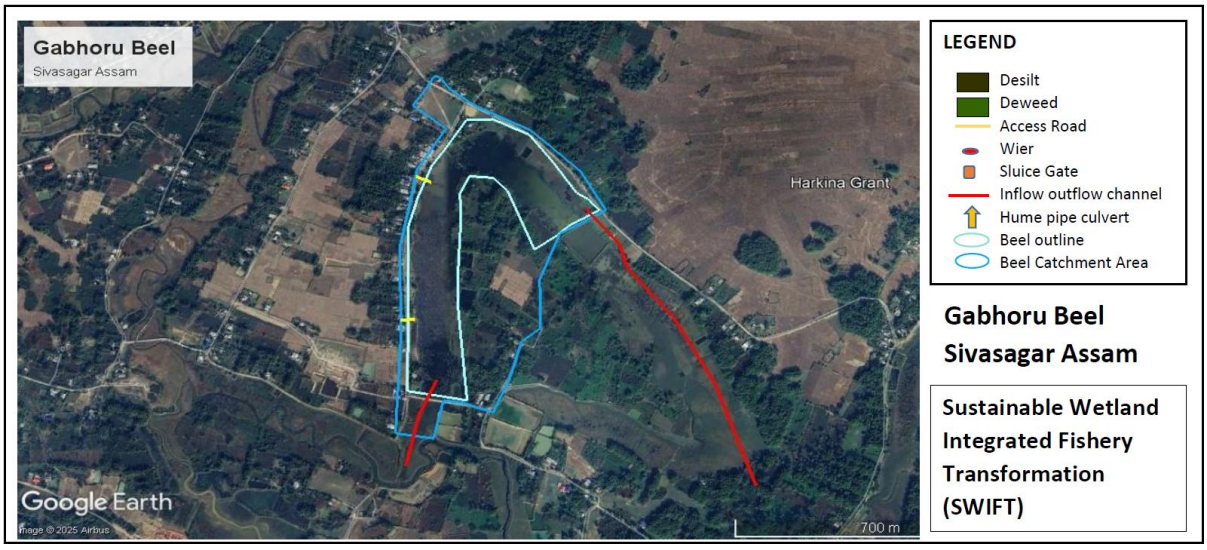



**Figure 3-95. Satellite View of Gabhoru Beel Showing Key Interventions**

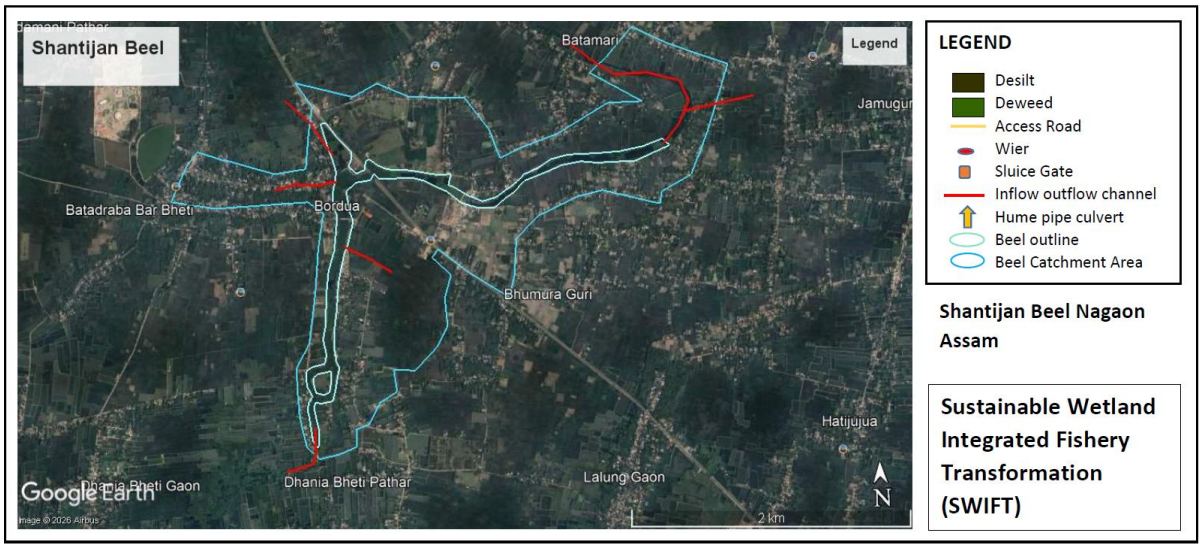



**Figure 3-96. Satellite View of Shantijaan Beel Showing Key Interventions**

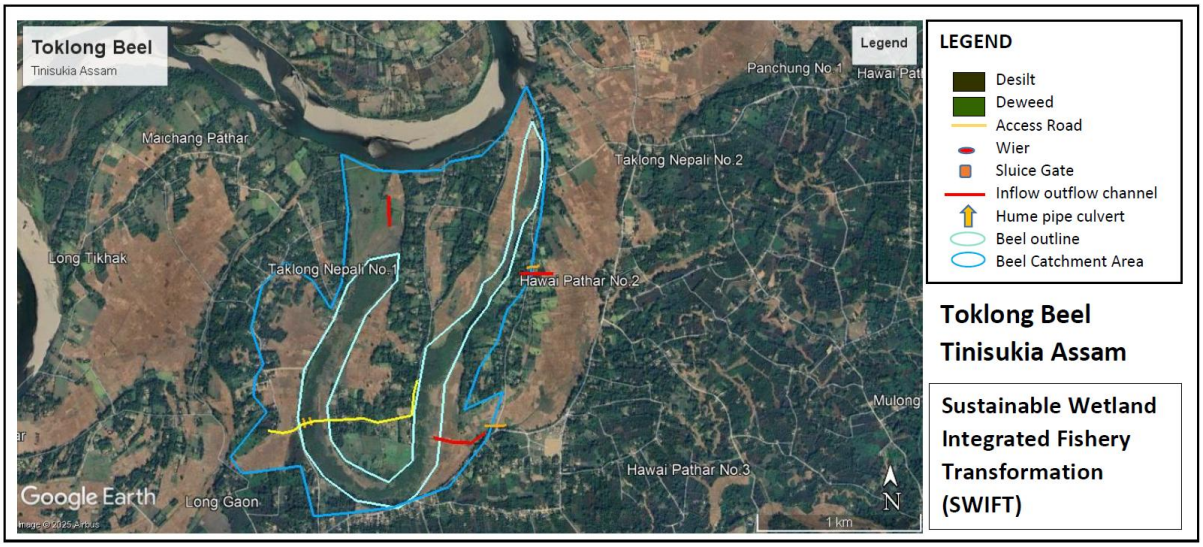



**Figure 3-97. Satellite View of Toklong Beel Showing Key Interventions**




**Figure 3-98. Satellite View of Tatinga Mekheli Beel Showing Key Interventions**

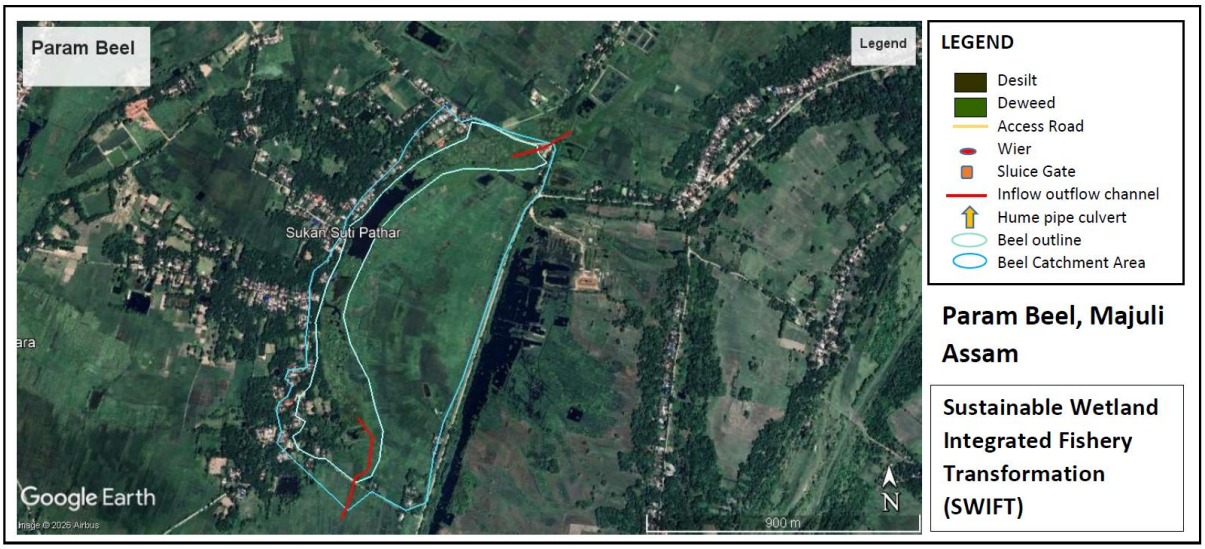



**Figure 3-99. Satellite View of Param Beel Showing Key Interventions**




**Figure 3-100. Satellite View of Bhagamur Beel Showing Key Interventions**

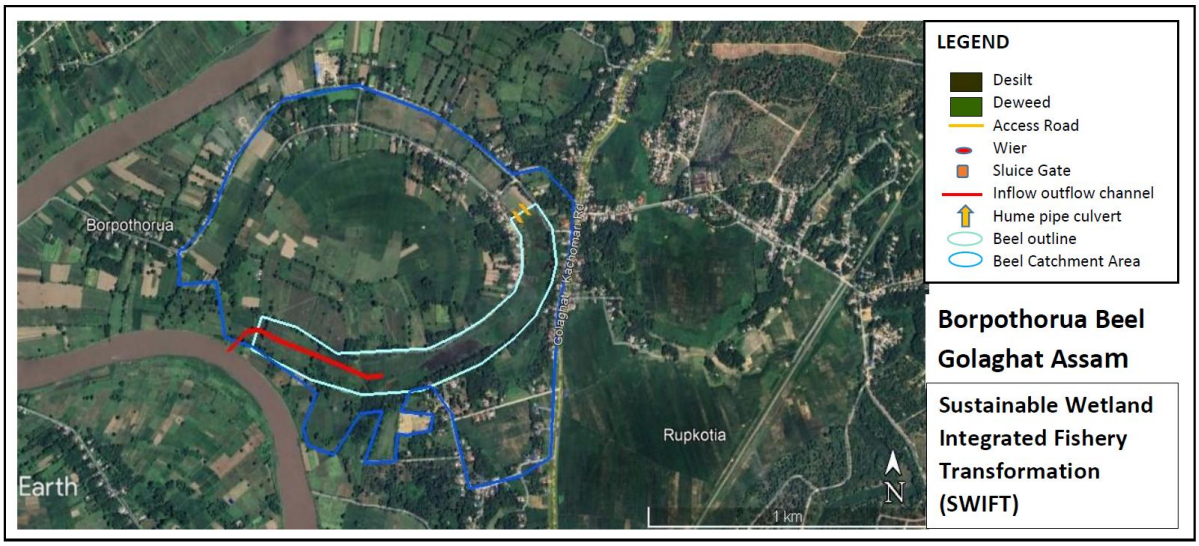



**Figure 3-101. Satellite View of Borpothoura Beel Showing Key Interventions**

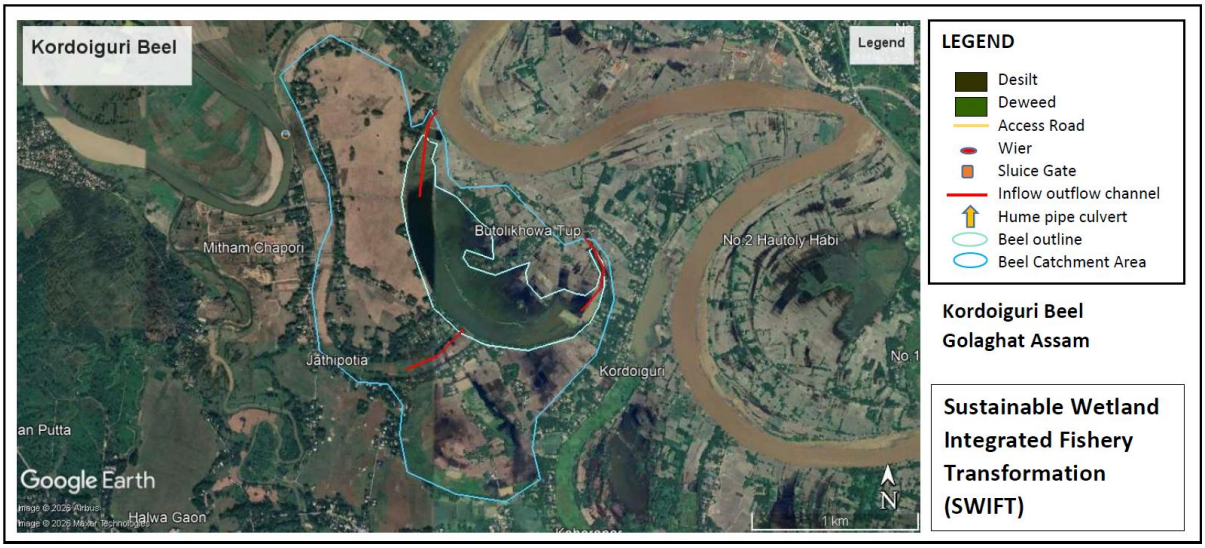



**Figure 3-102. Satellite View of Kordoiguri Beel Showing Key Interventions**

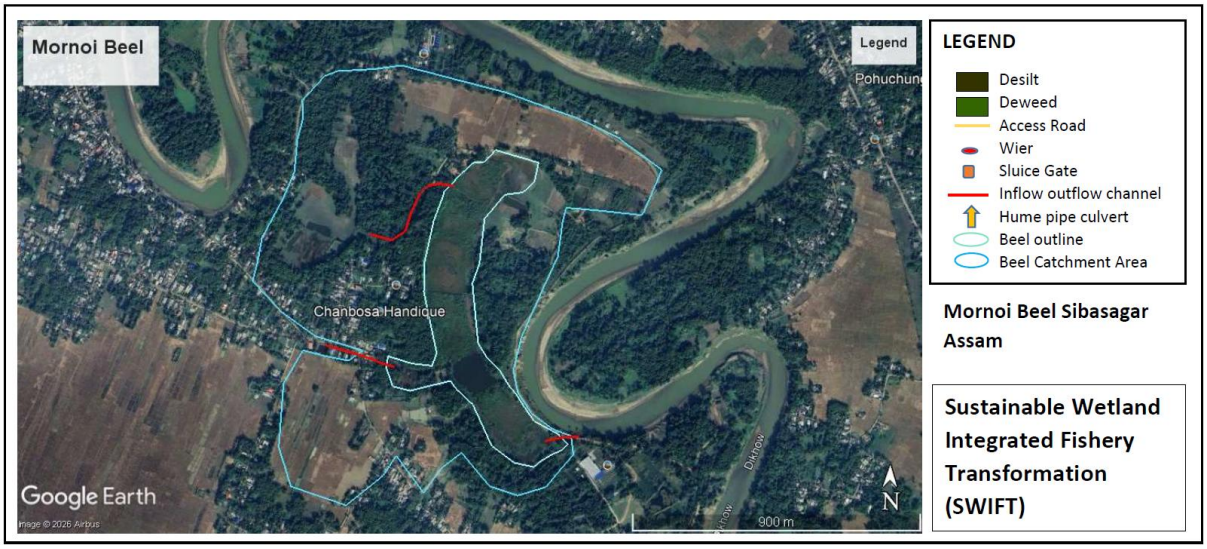



**Figure 3-103. Satellite View of Mornoi Beel Showing Key Interventions**

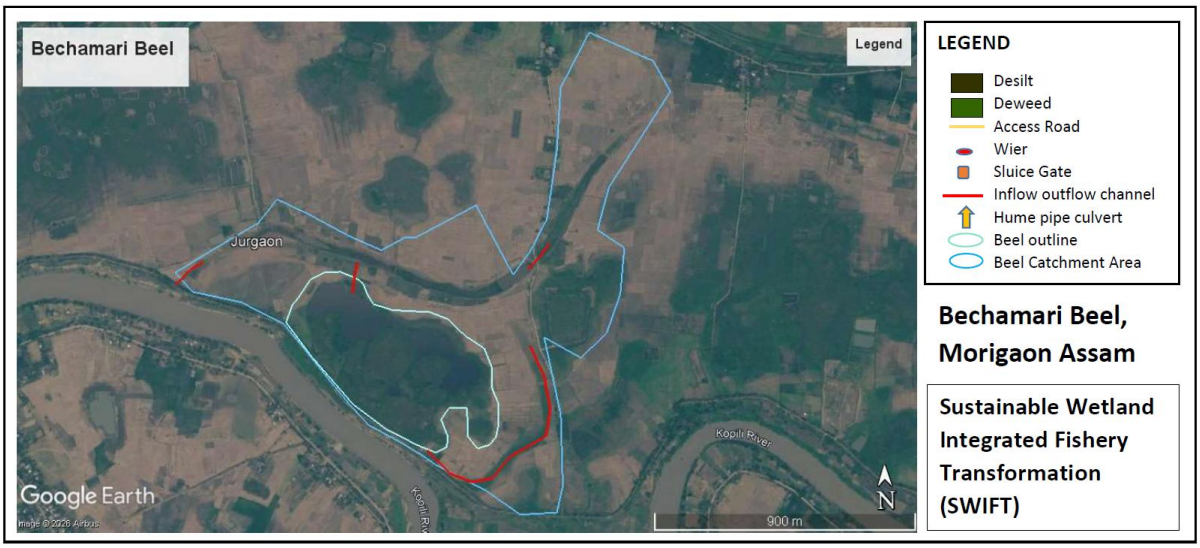



**Figure 3-104. Satellite View of Bechamari Beel Showing Key Interventions**




**Figure 3-105. Satellite View of Pitkati Beel Showing Key Interventions**

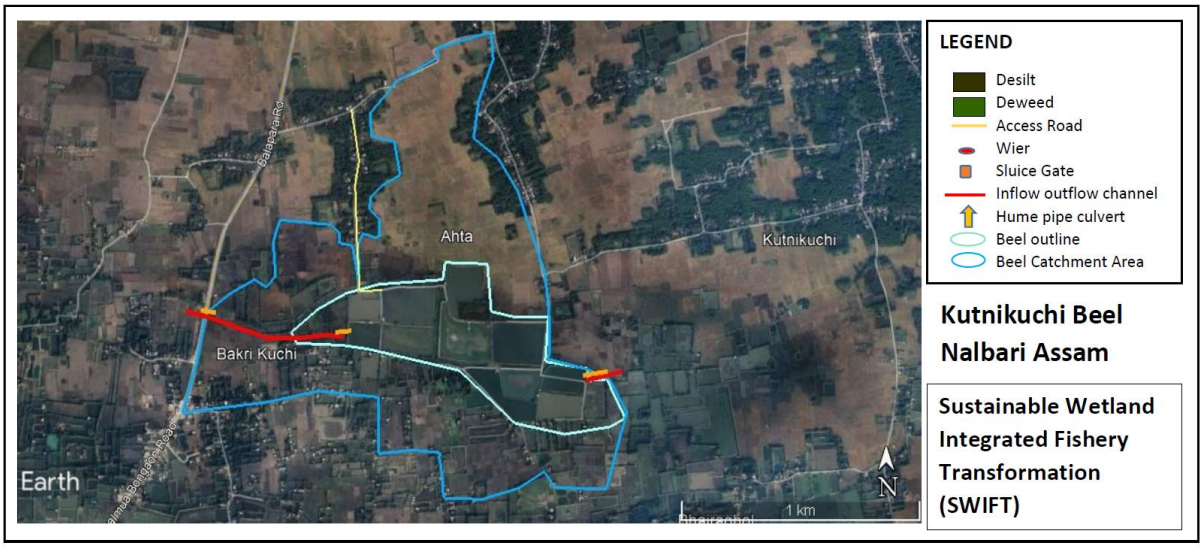



**Figure 3-106. Satellite View of Kutnikuchi Beel Showing Key Interventions**




**Figure 3-107. Satellite View of Bor Beel Showing Key Interventions**

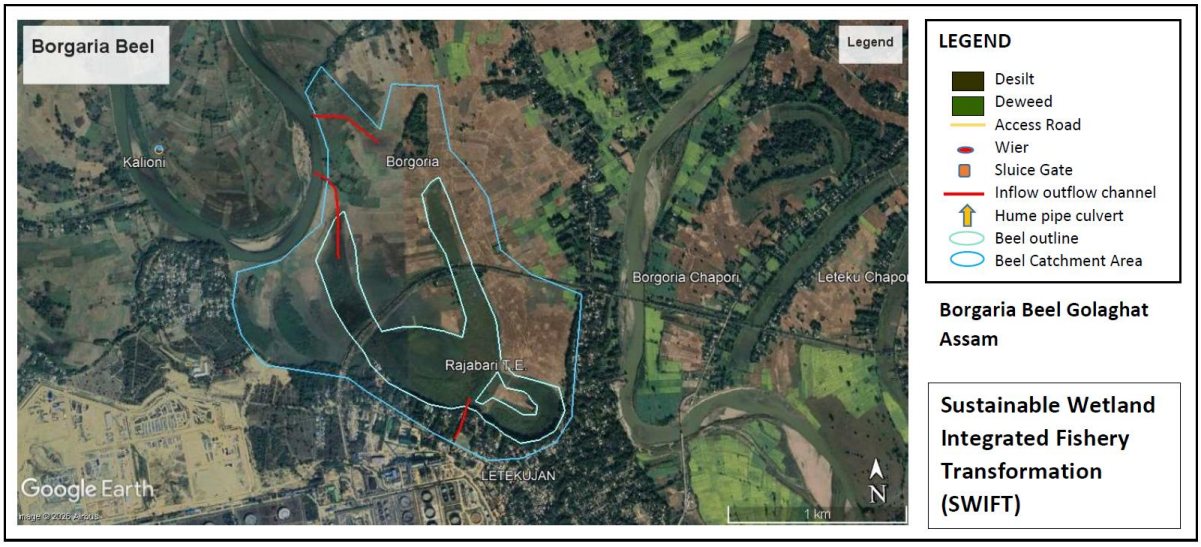



**Figure 3-108. Satellite View of Borgaria Beel Showing Key Interventions**

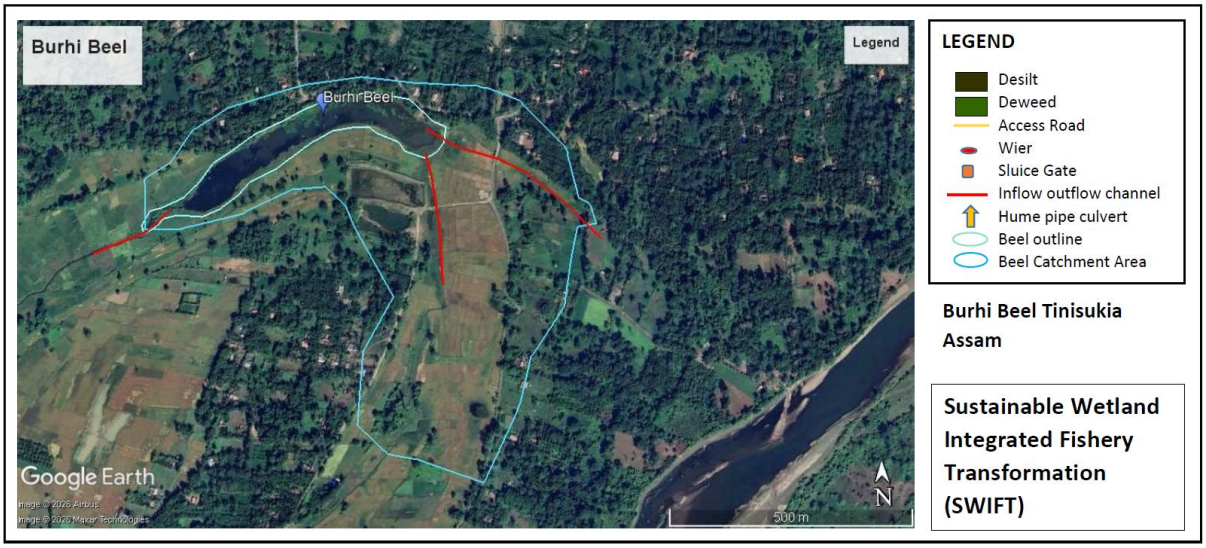



**Figure 3-109. Satellite View of Burhi Beel Showing Key Interventions**




**Figure 3-110. Satellite View of Tinsukia Beel Showing Key Interventions**

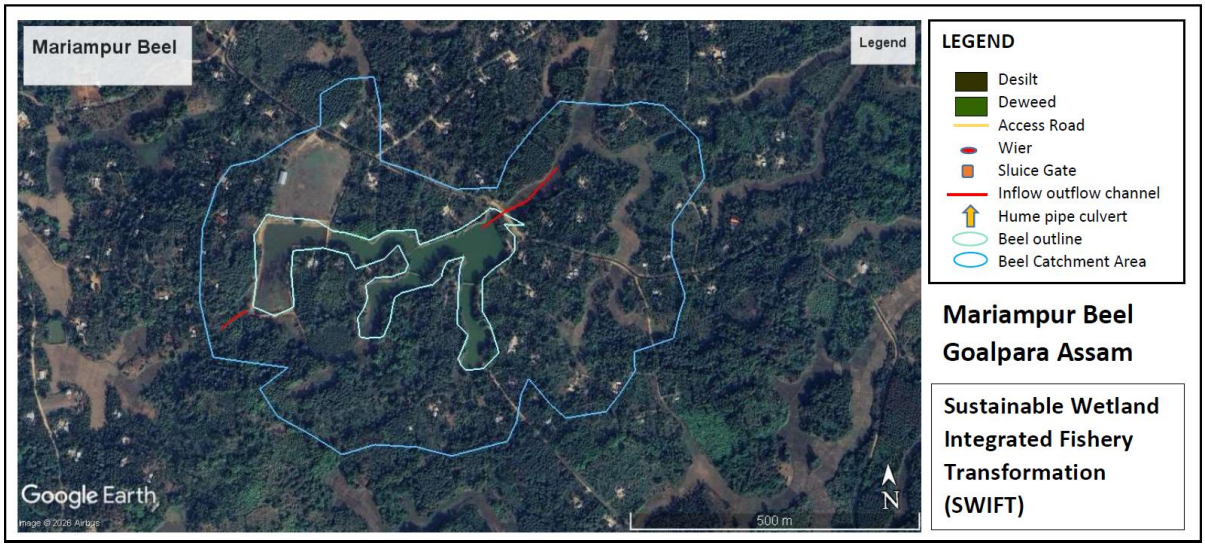



**Figure 3-111. Satellite View of Mariampur Beel Showing Key Interventions**

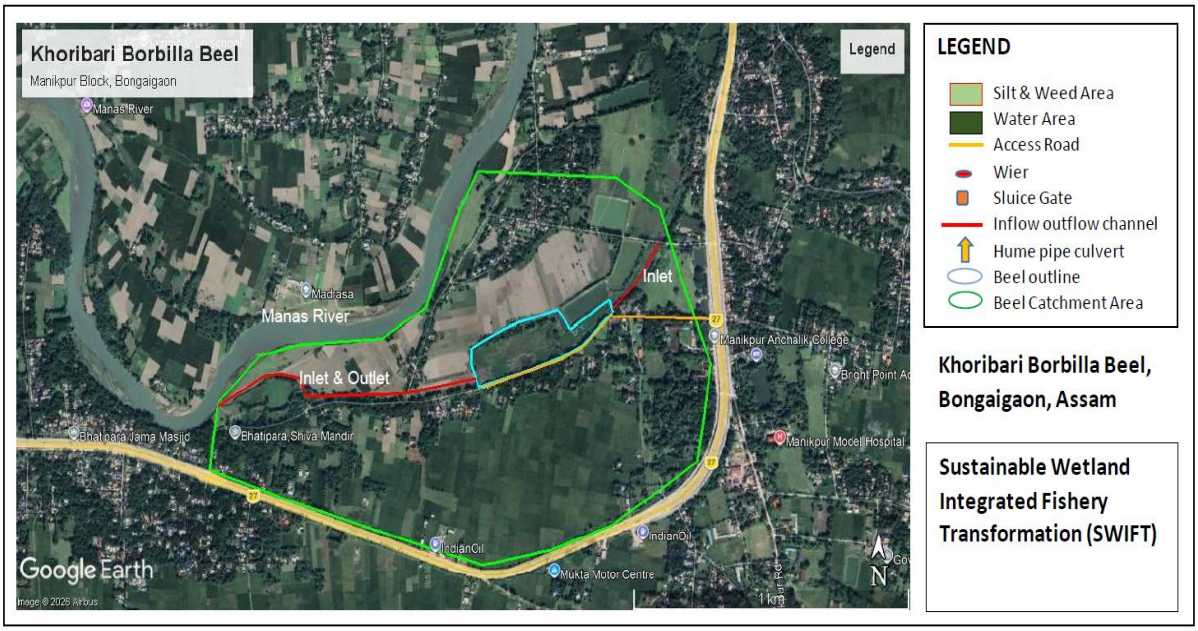



**Figure 3-112. Satellite View of Khoribari Borbilla Beel Showing Key Interventions**

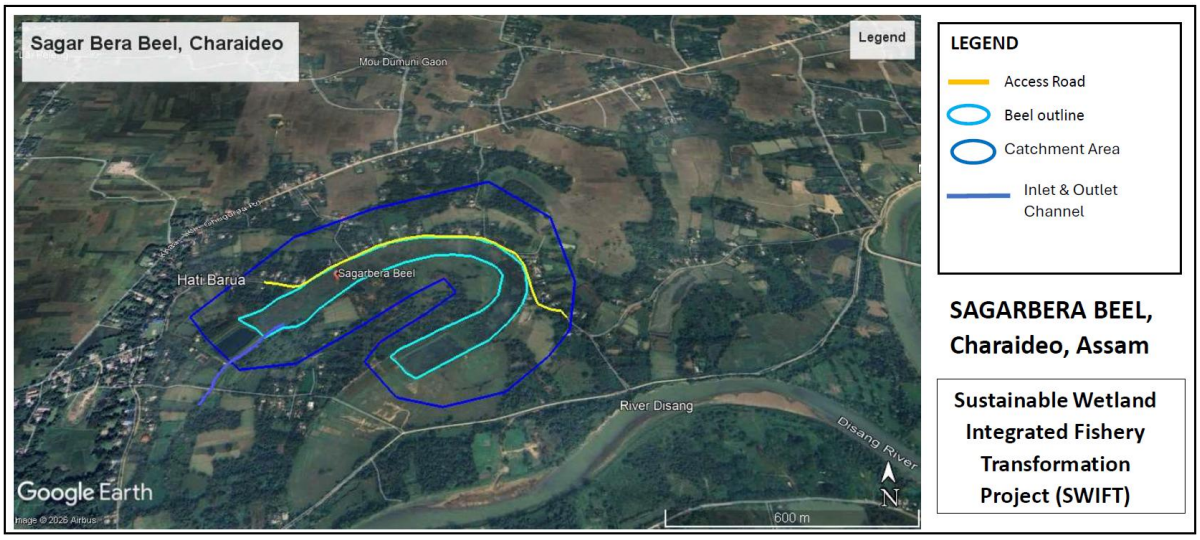



**Figure 3-113. Satellite View of Sagarbera Beel Showing Key Interventions**




**Figure 3-114. Satellite View of Bamuni Beel Showing Key Interventions**




**Figure 3-115. Satellite View of Mirika Beel Showing Key Interventions**

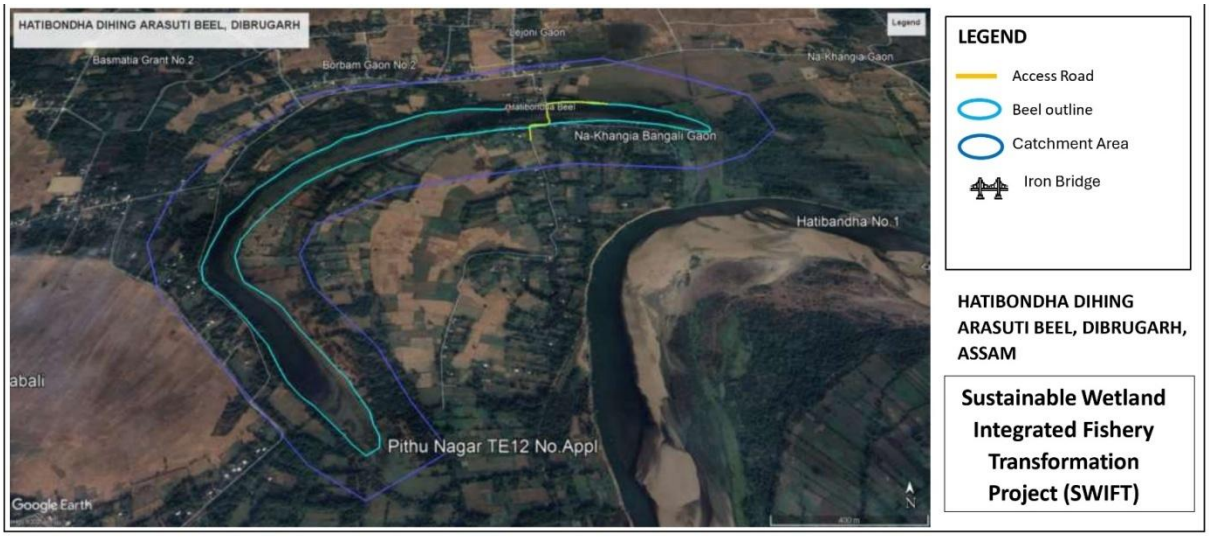



**Figure 3-116. Satellite View of Hatibondha Beel Showing Key Interventions**




**Figure 3-117. Satellite View of Natun Bolai Beel Showing Key Interventions**




**Figure 3-118. Satellite View of Mer Beel Showing Key Interventions**

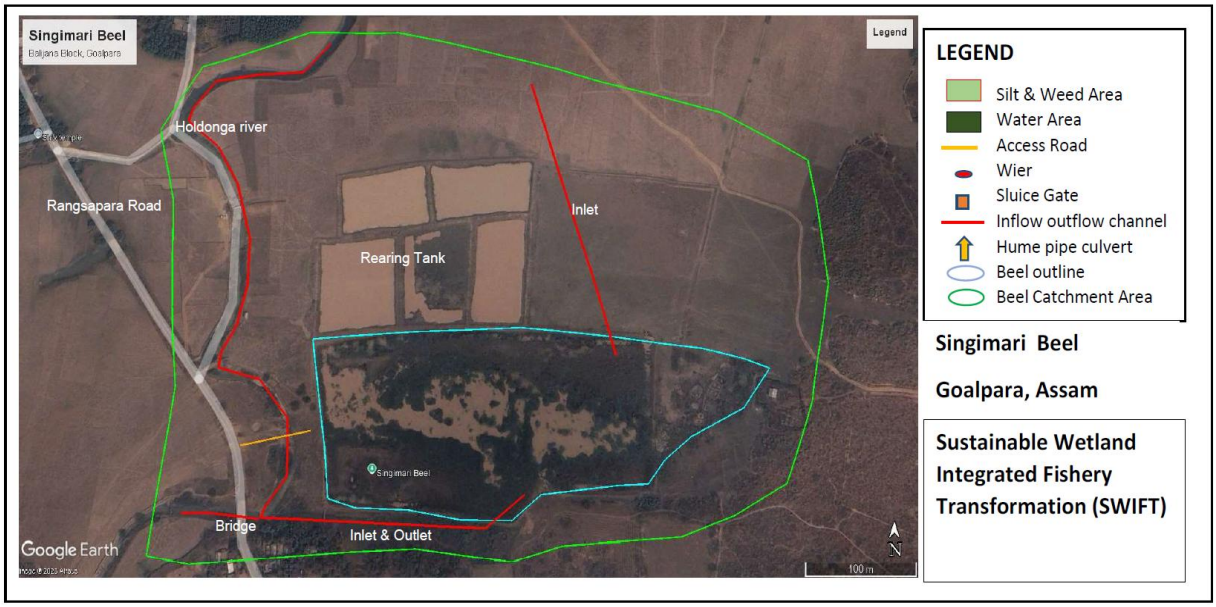



**Figure 3-119. Satellite View of Singimari Beel Showing Key Interventions**




**Figure 3-120. Satellite View of Amguri Showing Key Interventions**




**Figure 3-121. Satellite View of Jengoni Beel Showing Key Interventions**

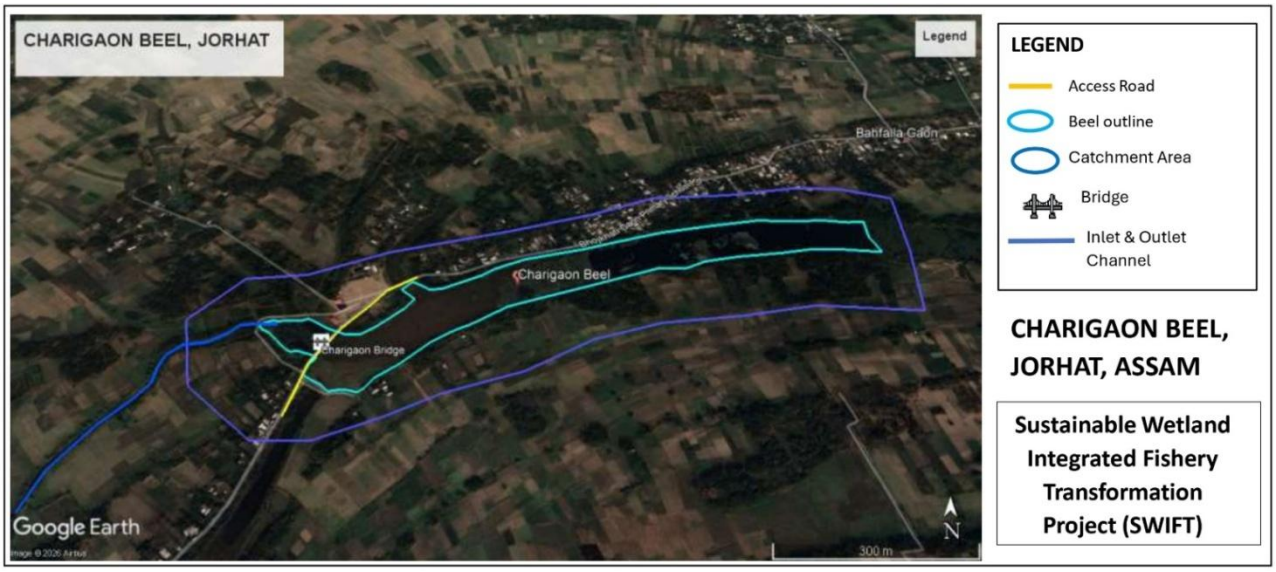



**Figure 3-122. Satellite View of Charigaon Beel Showing Key Interventions**

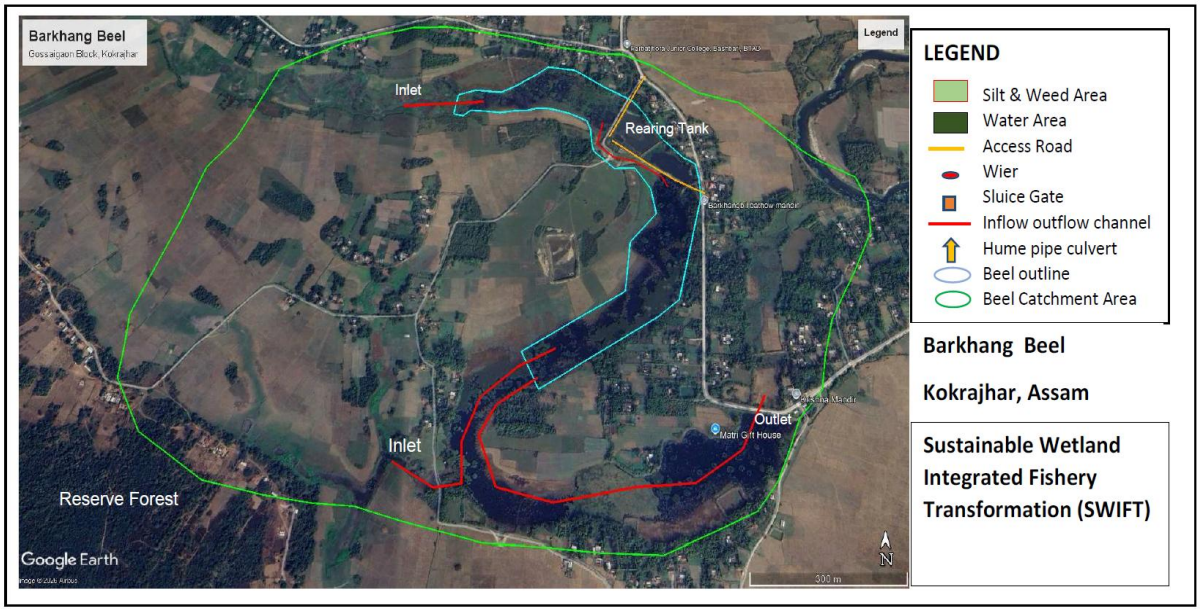



**Figure 3-123. Satellite View of Barkhang Beel Showing Key Interventions**




**Figure 3-124. Satellite View of Inti Beel Showing Key Interventions**

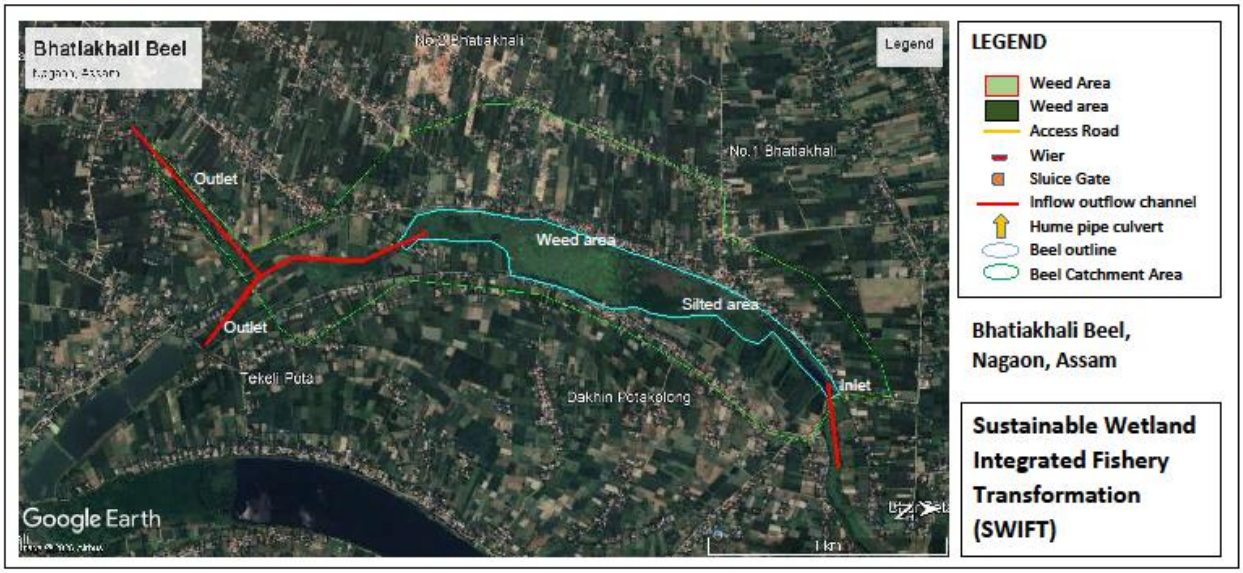
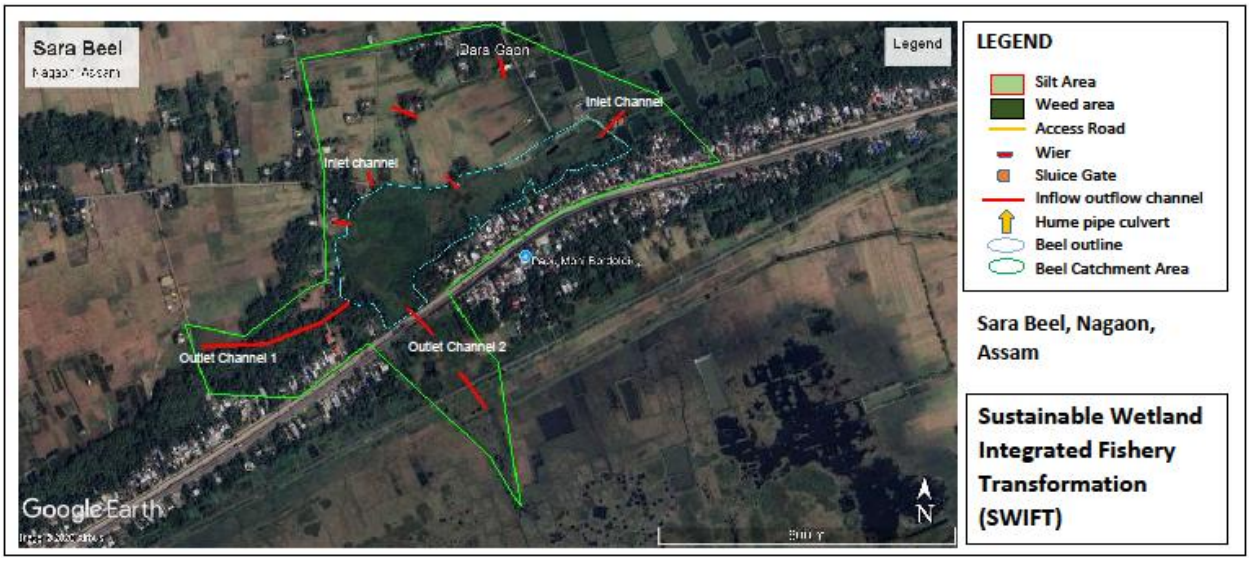



**Figure 3-125. Satellite View of Bhatiakhali Beel Showing Key Interventions**




*Fig*

**Figure 3-126. Satellite View of Sara Beel Showing Key Interventions**

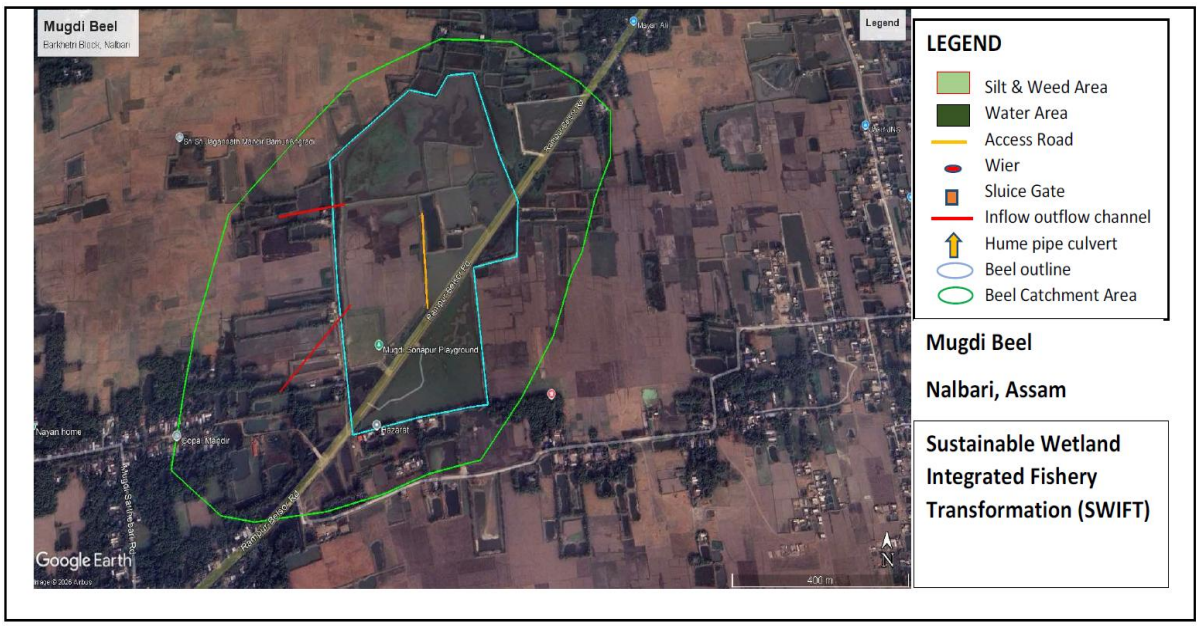



**Figure 3-127. Satellite View of Mugdi Beel Showing Key Interventions**

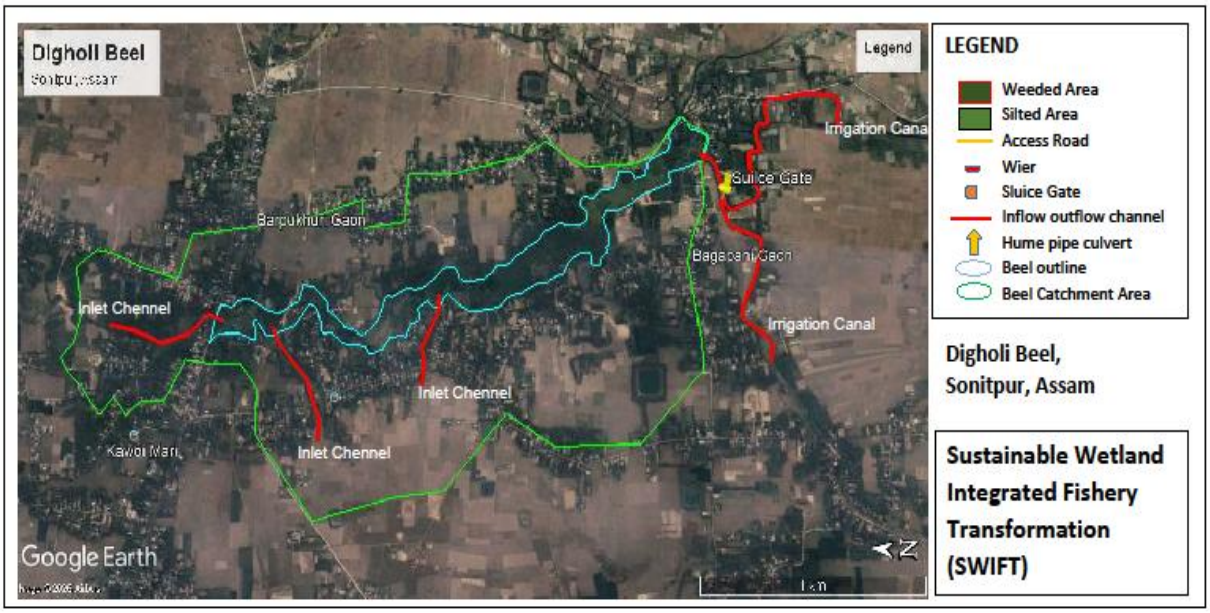



**Figure 3-128. Satellite View of Digholi Beel Showing Key Interventions**

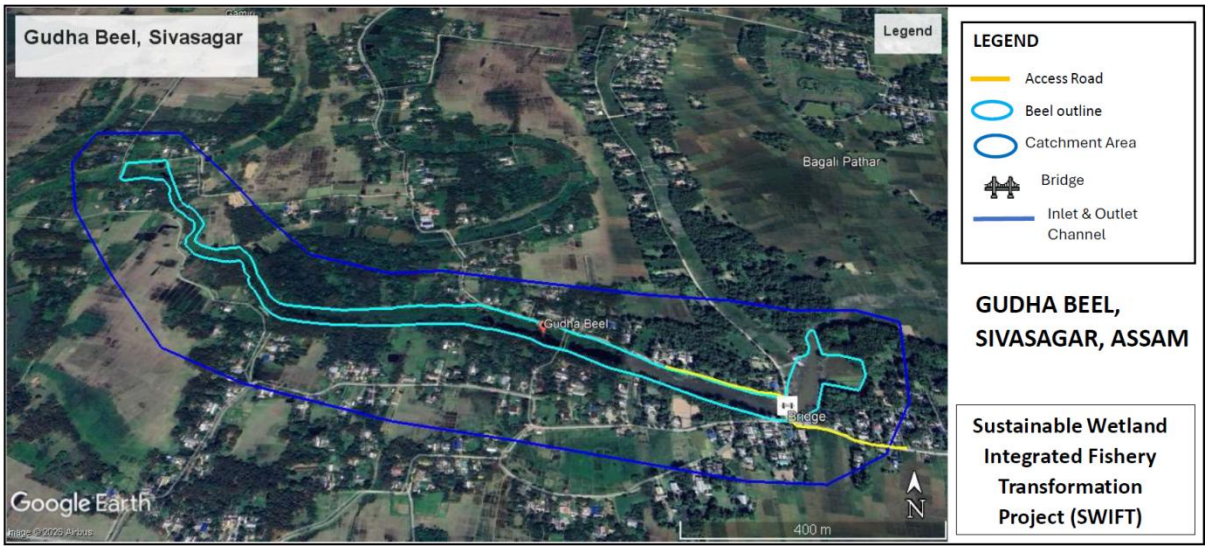



**Figure 3-129. Satellite View of Gudha Beel Showing Key Interventions**

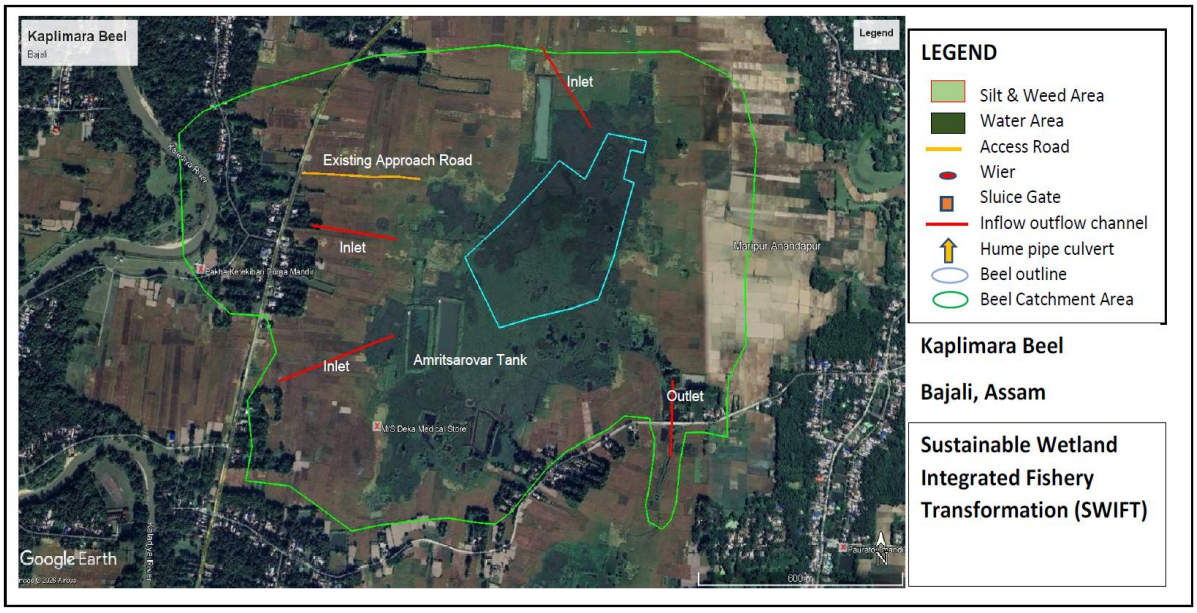



**Figure 3-130. Satellite View of Kaplimara Beel Showing Key Interventions**

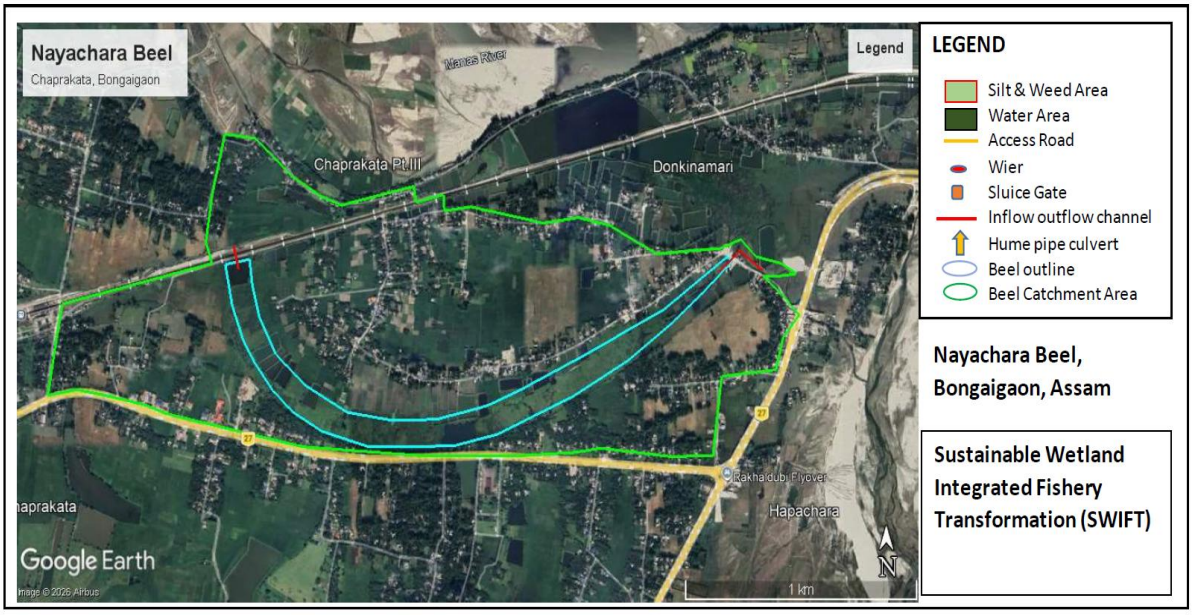



**Figure 3-131. Satellite View of Nayachara Beel Showing Key Interventions**




**Figure 3-132. Satellite View of Borai Pani Beel Showing Key Interventions**

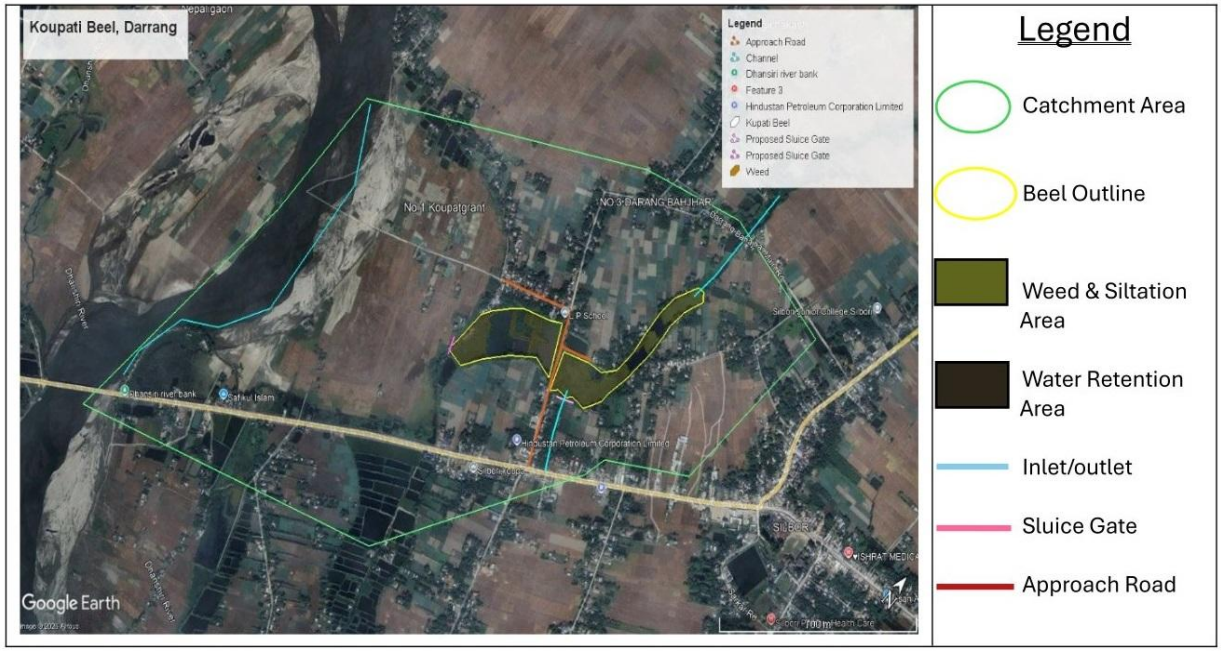



**Figure 3-133. Satellite View of Koupati Beel Showing Key Interventions**




**Figure 3-134. Satellite View of Burisuti Rikseng Beel Showing Key Interventions**

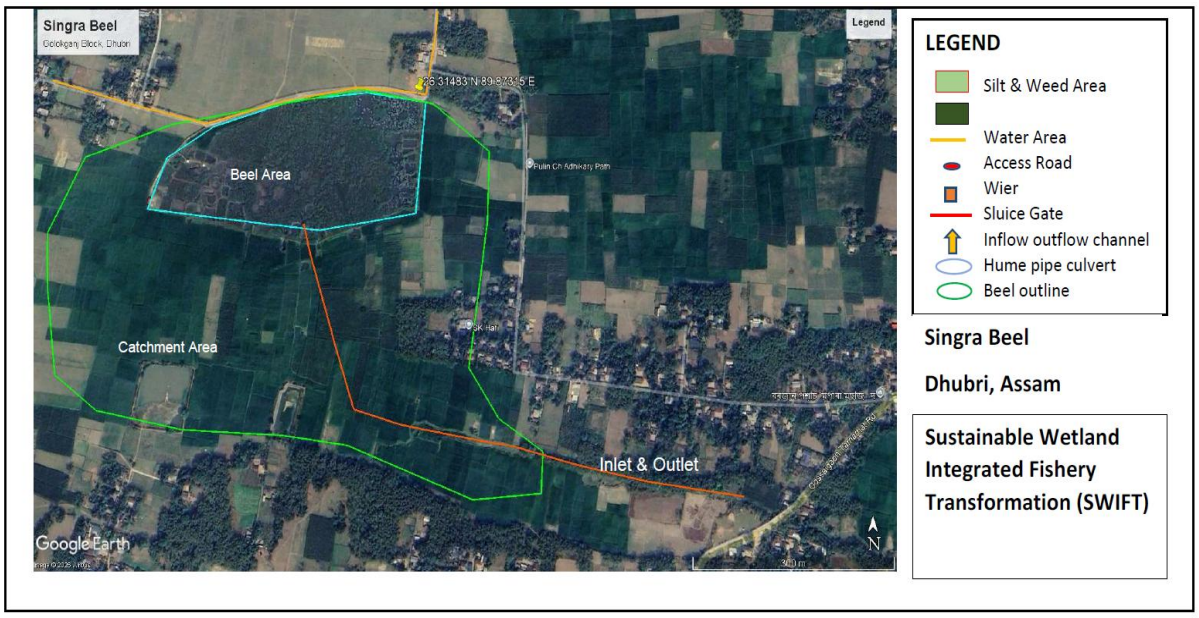



**Figure 3-135. Satellite View of Singra Beel Showing Key Interventions**

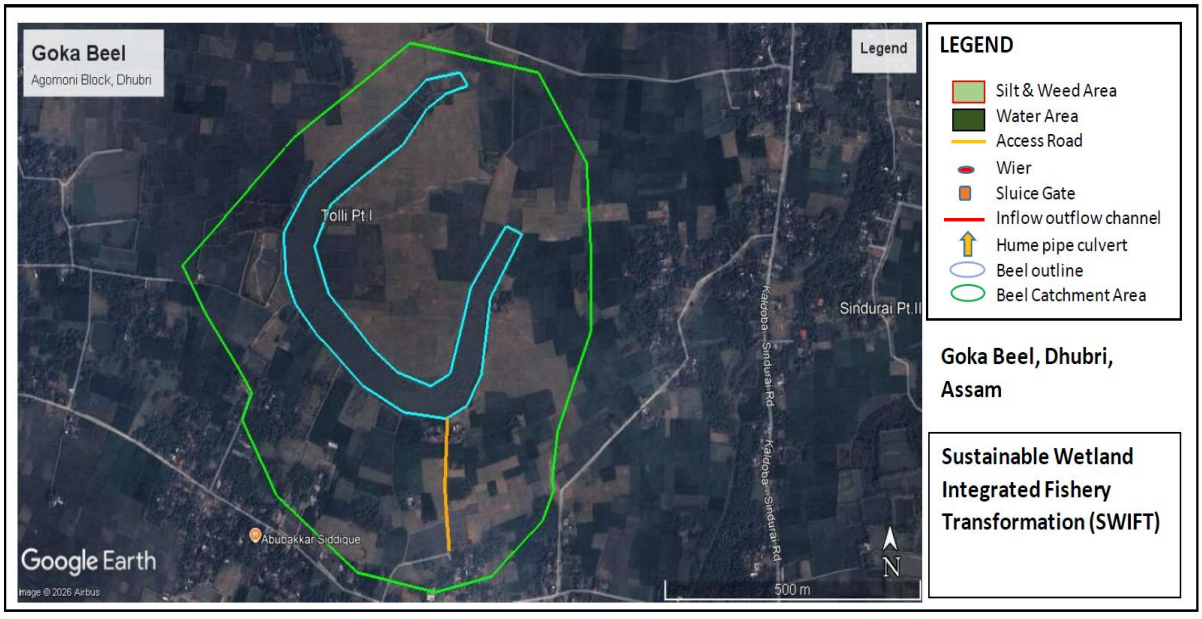



**Figure 3-136. Satellite View of Goka Beel Showing Key Interventions**

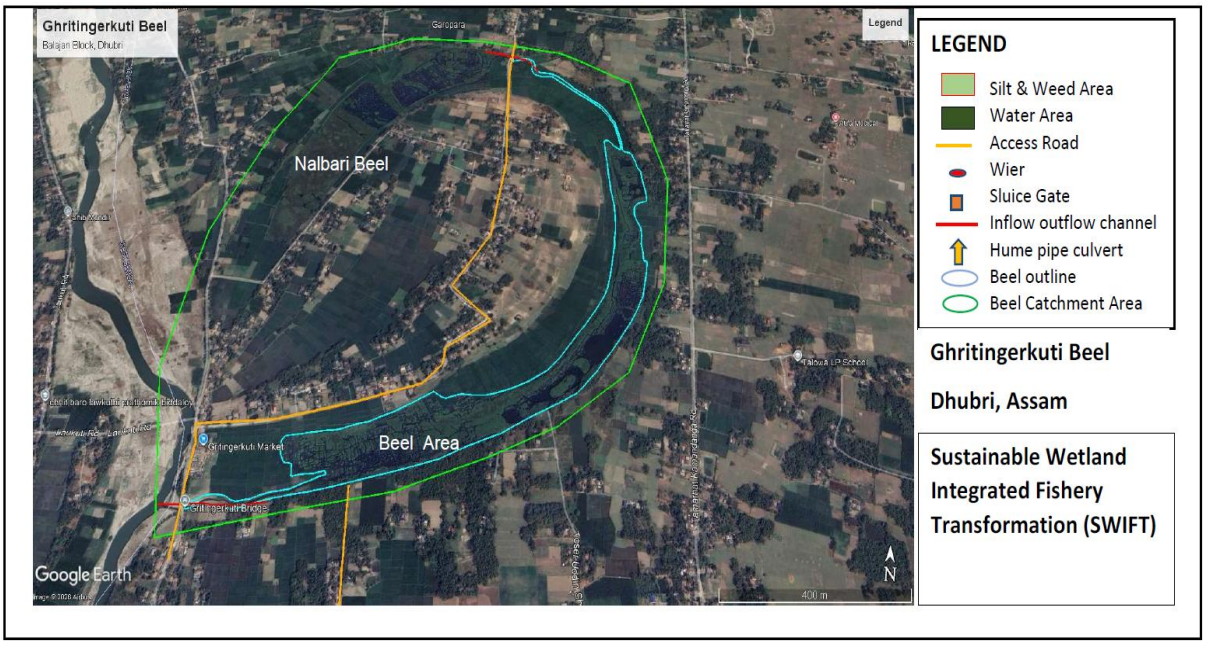



**Figure 3-137. Satellite View of Ghritingerkuti Beel Showing Key Interventions**

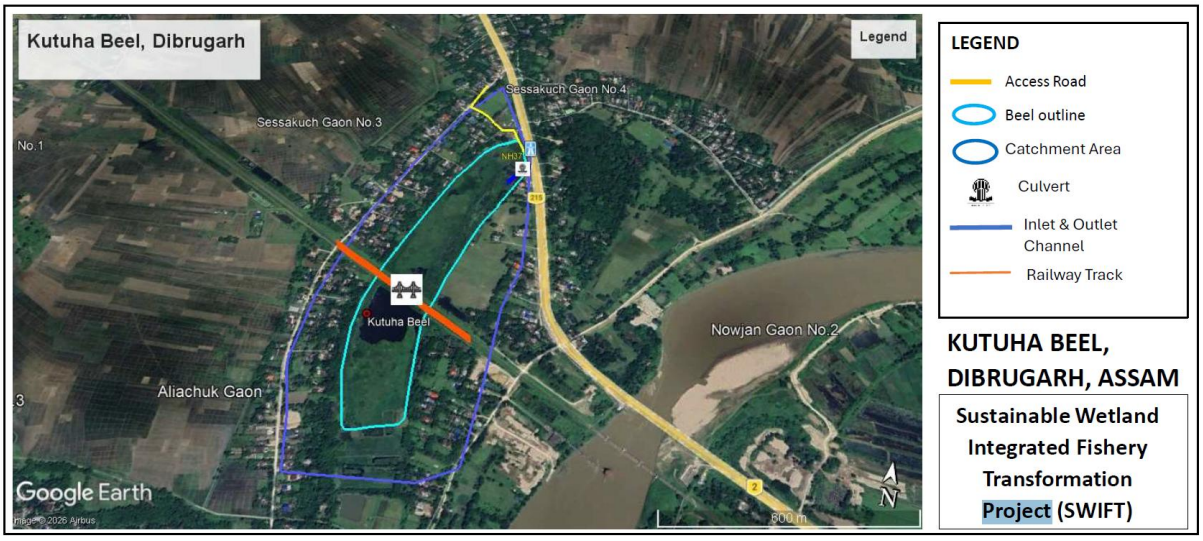



**Figure 3-138. Satellite View of Kutuha Beel Showing Key Interventions**

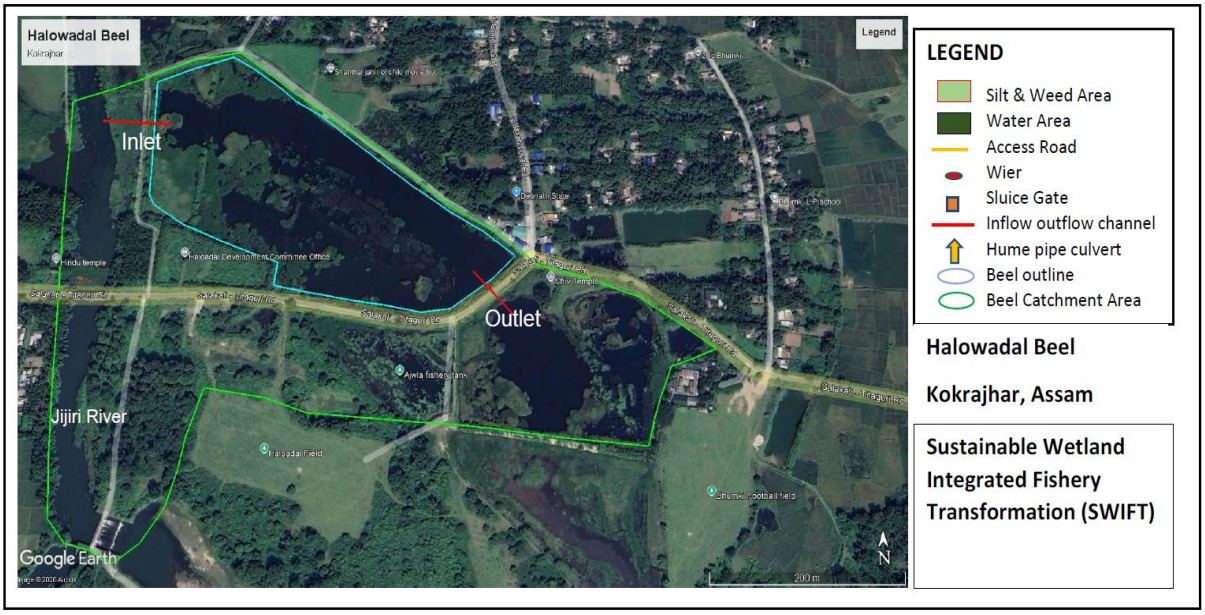



**Figure 3-139. Satellite View of Halowadal Beel Showing Key Interventions**

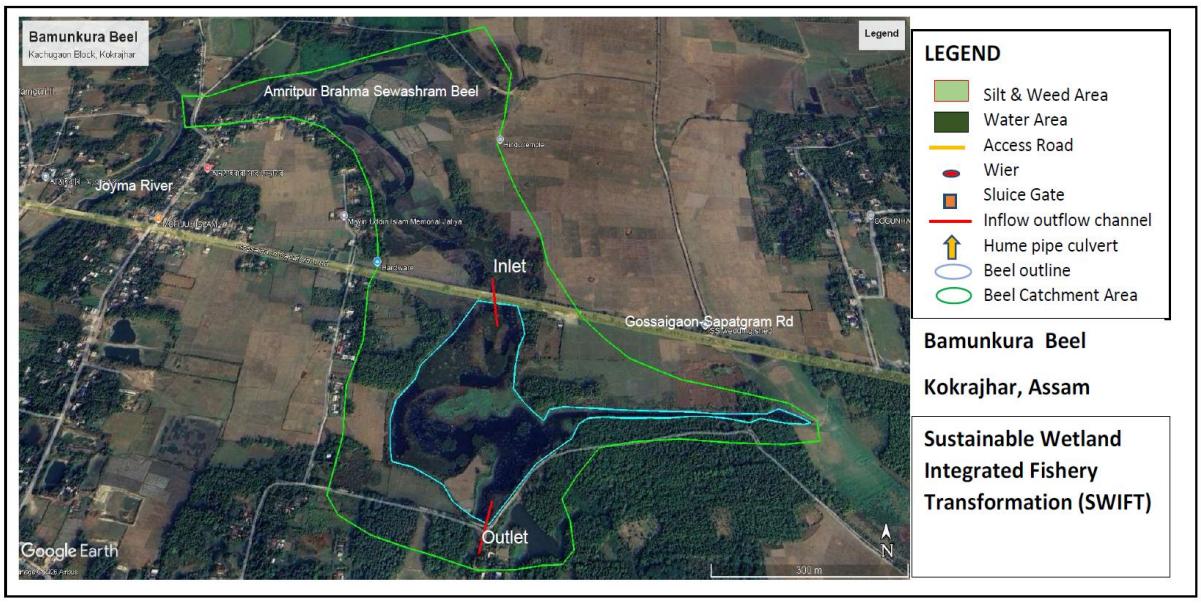



**Figure 3-140. Satellite View of Bamunkura Beel Showing Key Interventions**

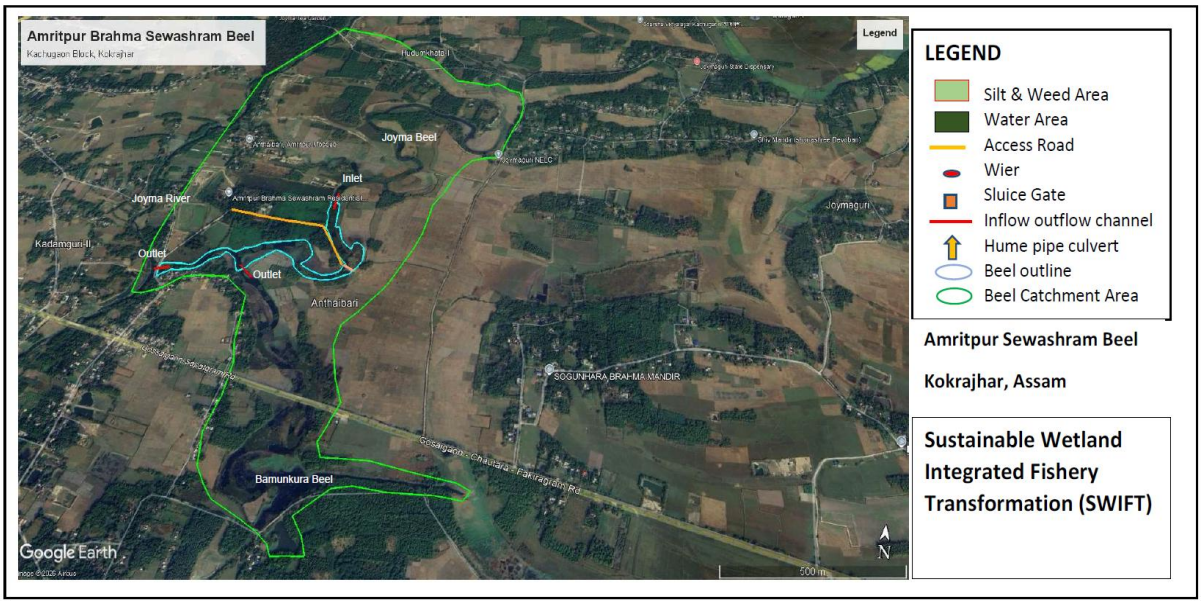



**Figure 3-141. Satellite View of Amritpur Beel Showing Key Interventions**




**Figure 3-142. Satellite View of Tihulia Beel Showing Key Interventions**




**Figure 3-143. Satellite View of Solmari Beel Showing Key Interventions**




**Figure 3-144. Satellite View of Chamkata Beel Showing Key Interventions**




**Figure 3-145. Satellite View of Chola Mikirbheta Beel Showing Key Interventions**

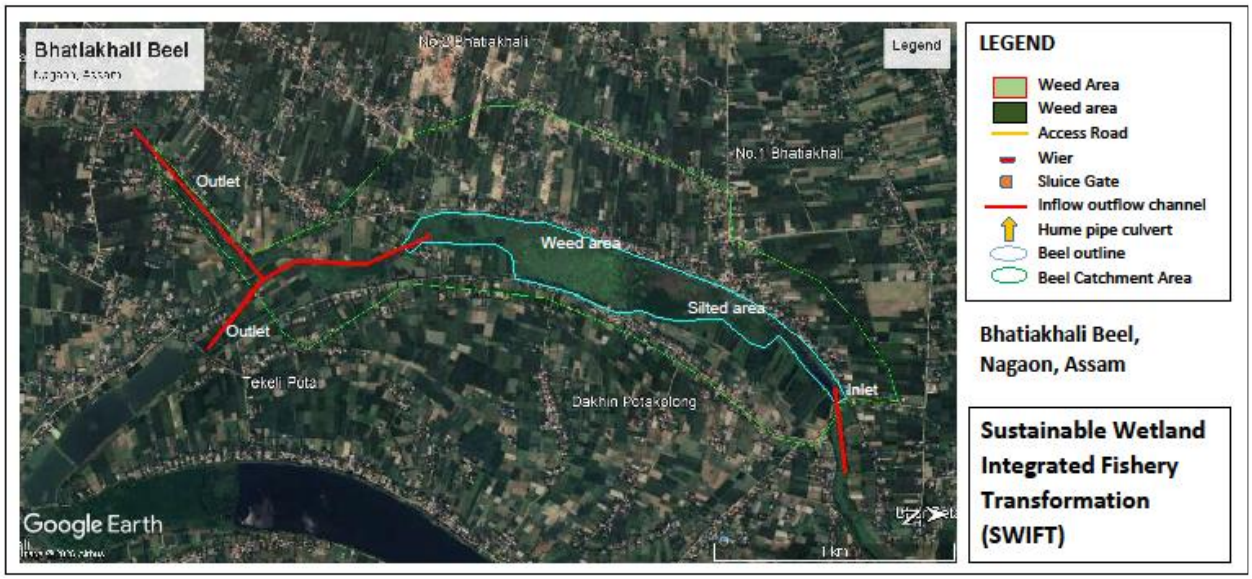



**Figure 3-146. Satellite View of Na-Kollong Beel Showing Key Interventions**

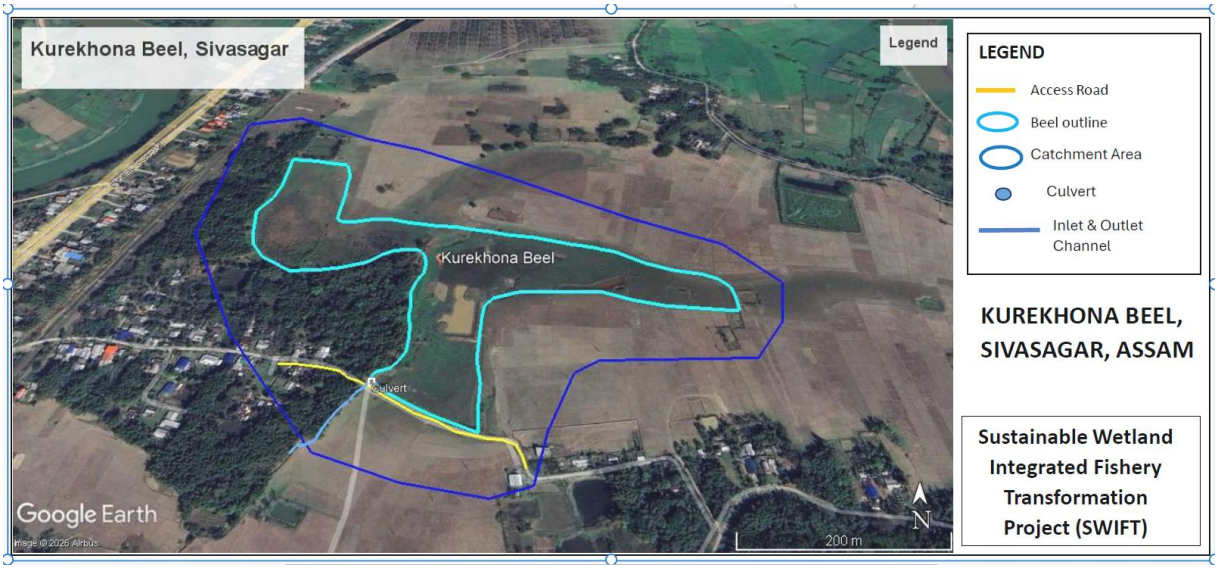



**Figure 3-147. Satellite View of Kurekhona Beel Showing Key Interventions**




**Figure 3-148. Satellite View of Panikheti Beel Showing Key Interventions**

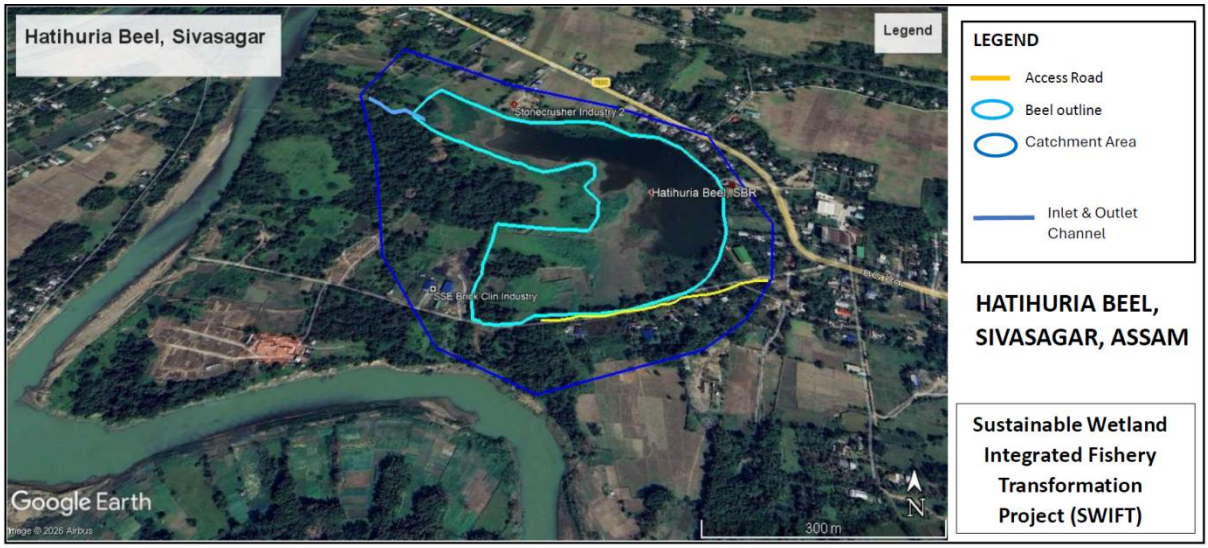



**Figure 3-149. Satellite View of Hatithuria Beel Showing Key Interventions**

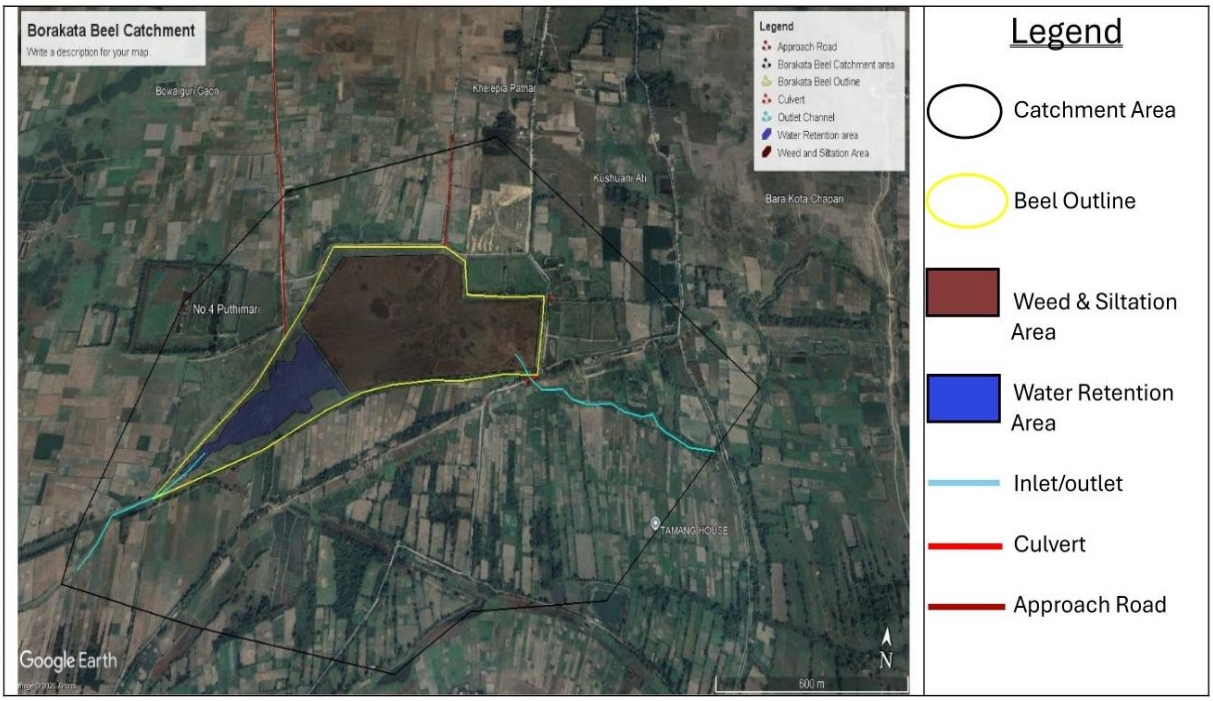



**Figure 3-150. Satellite View of Borakata Showing Key Interventions**

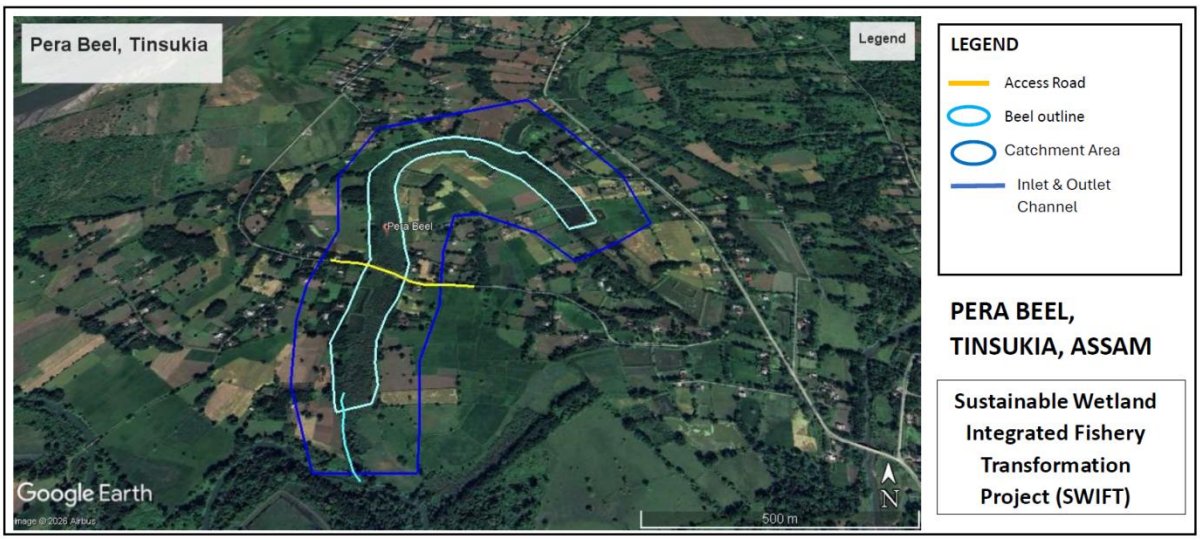



**Figure 3-151. Satellite View of Pera Beel Showing Key Interventions**

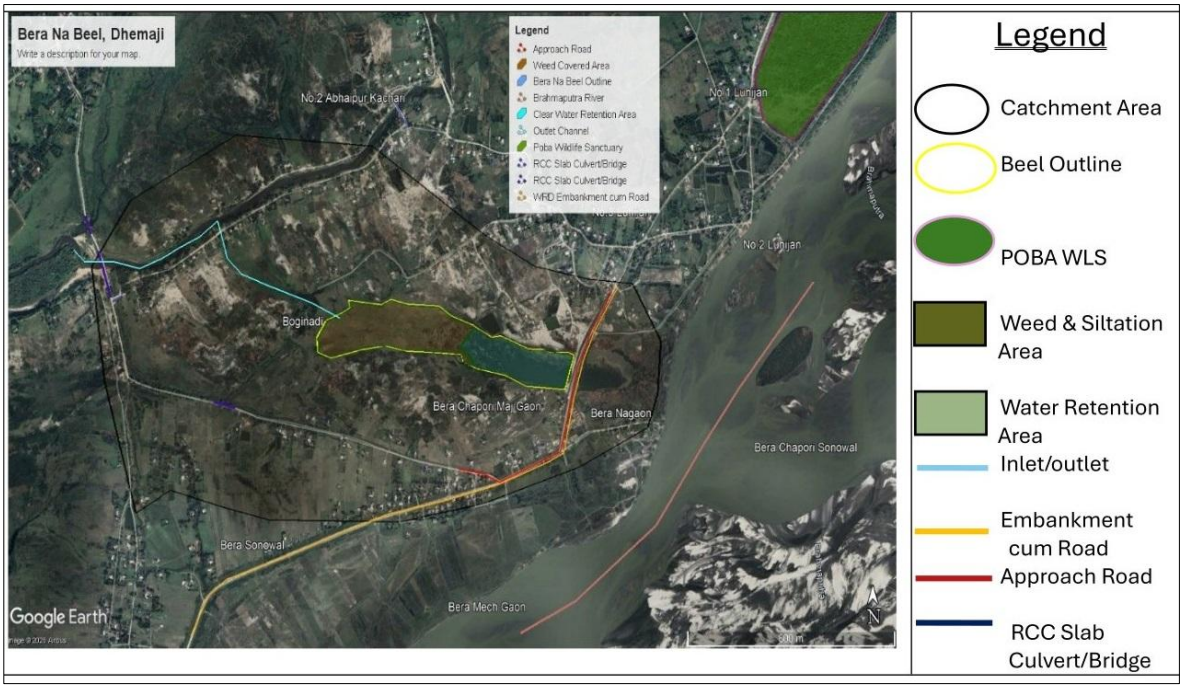



**Figure 3-152. Satellite View of Bera Na Beel Showing Key Interventions**

169. *Infrastructure Construction for PMU and CPIU Offices:* As part of the institutional development and capacity-building components of the project, targeted civil works will be undertaken to office infrastructure for the Central and District-level CPIUs, as well as the PMU. Specifically, the project includes the works on CPIU-2 and CPIU-4 building, along with the construction of a new office building to support expanded operational functions at the central level. These facilities will eventually be equipped with essential utilities, ICT infrastructure, and furnishings to enable efficient service delivery and administrative coordination.

170. The project will also support the renovation and upgradation of new office buildings for CPIU-1, CPIU-3, and CPIU-5, including their respective district offices. These improvements aim to address deficiencies in existing facilities and provide a safe, functional, and climate-resilient working environment for field-level staff involved in implementation, monitoring, and safeguards compliance. While the scope may involve structural retrofitting, new construction, and utility upgrades, it is important to note that the detailed designs for these office buildings are not yet available as of the reporting period. These designs will be developed during the implementation phase, and site-specific environmental considerations will be assessed accordingly.

171. In addition, the project will include the construction and furnishing of the PMU office, which will serve as the central coordination hub for project planning, financial management, and environmental and social safeguards oversight. These works are part of project and will be implemented in accordance with national building regulations and ADB safeguard requirements. Once the designs are finalized, the environmental implications will be reviewed to ensure compliance and integration of sustainability measures into the construction activities.

# 4. ENVIRONMENTAL BASELINE DESCRIPTION

## 4.1. Overview

172. This section presents the existing environmental and socio-economic baseline conditions of the SWIFT Project area in Assam, covering critical aspects that characterize the subproject site. Establishing an environmental baseline is essential for understanding the current environmental and socio-economic status of the region, which is dominated by floodplain wetlands known as *beels*, rich in biodiversity and supporting local fisheries and agriculture. The baseline information provides decision-makers with insights necessary to implement measures that protect the surrounding environment and helps in monitoring any changes resulting from project activities.

173. Relevant information required for the study was gathered from various sources to cover all environmental segments of the SWIFT Project's sites. This included collecting secondary data on environmental components, such as water quality of the beels, soil characteristics, and existing biodiversity, as well as environmental monitoring data from both primary and secondary sources. Reports from previous environmental studies and governmental publications were also reviewed to establish a comprehensive environmental baseline. Field visits to the project area provided valuable insights into its environmental profile, including topography, hydrogeology, drainage patterns, ecology, meteorology, and socio-economic conditions. The area, with its unique ecology and dependence on seasonal flooding, hosts diverse flora and fauna, supporting the livelihoods of local communities engaged in fisheries, farming, and related activities. As illustrated in Figure 4-1, the baseline data are structured into three main categories: physical, biological, and socio-economic components, capturing the intricate interplay of natural resources, ecosystems, and human activity that defines the SWIFT Project site.

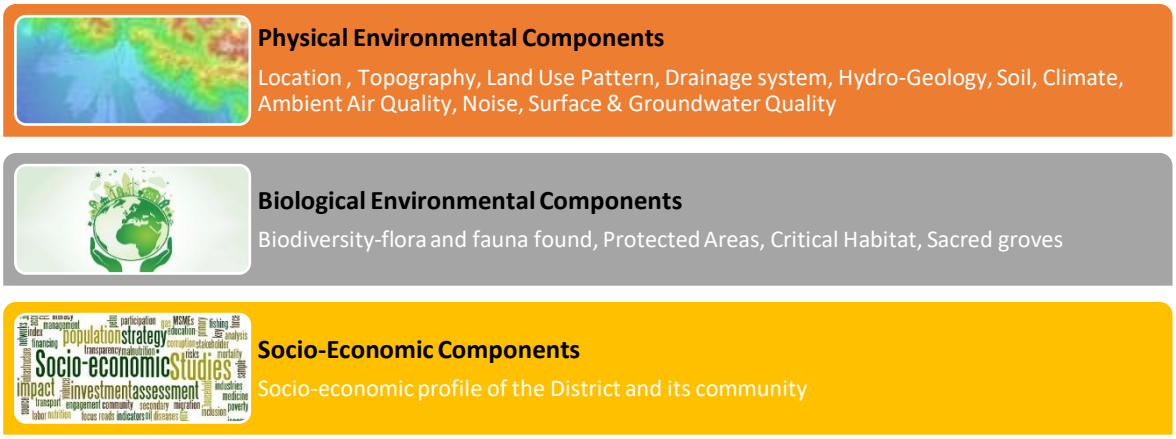



**Figure 4-1. Components covered in description of Baseline Environment of Subproject Area**

## 4.2. Physical Environmental Components

### Location

174. Assam, located at the foothills of the eastern Himalayas, is the largest state in northeast India, positioned in the middle reaches of the Brahmaputra River. Assam spans an area of 78,438 km², accounting for approximately 2.4% of India's total geographical area. The Brahmaputra basin encompasses an area of 580,000 km², of which 70,634 km² lies within Assam. The state's topography is varied, comprising hills, plains, and numerous rivers. Assam shares borders with West Bengal and Bangladesh to the west, Bhutan to the north, and Nagaland, Manipur, Mizoram, Meghalaya, and

Tripura to the south. Geographically, it extends between 88.25°E to 96.00°E longitude and 24.50°N to 28.00°N latitude. The climate is characterized by temperatures ranging from 6°C to 38°C. Known as the "land of the red river and blue hills," Assam serves as the gateway to Northeast India. The state is divided into five regional divisions, with each division comprising several districts. A summary of these divisions is provided in Table 4.1, and a map of Assam's districts is shown in Figure 4-2.

**Table 4-1. Divisions and Districts of Assam**

| Division Name | Divisional Office | Districts |
|---|---|---|
| 1. B. Valley | Silchar | 1. Cachar<br>2. Hailakandi<br>3. Sribhumi |
| 2. Central Assam | Nagaon | 1. Dima Hasao<br>2. East Karbi Anglong<br>3. West Karbi Anglong<br>4. Morigaon<br>5. Nagaon |
| 3. Lower Assam | Guwahati | 1. Baksa<br>2. Barpeta<br>3. Bongaigaon<br>4. Chirang<br>5. Dhubri<br>6. Goalpara<br>7. Nalbari<br>8. Kamrup Metropolitan<br>9. Kamrup Rural<br>10. Kokrajhar<br>11. South Salmara-Mankachar |
| 4. North Assam | Tezpur | 1. Darrang<br>2. Sonitpur<br>3. Udalguri |
| 5. Upper Assam | Jorhat | 1. Charaideo<br>2. Dhemaji<br>3. Dibrugarh<br>4. Golaghat<br>5. Jorhat<br>6. Lakhimpur<br>7. Majuli<br>8. Sivasagar<br>9. Tinsukia |




**Figure 4-2. District Map of Assam[30]**

## Topography

175. The topography of Assam is shaped by its location within the Brahmaputra and B. River valleys, flanked by surrounding hill ranges and plateaus. The Brahmaputra Valley is a defining feature, encompassing much of the state with expansive alluvial plains formed by the Brahmaputra River and its numerous tributaries. This valley is bordered by the Eastern Himalayas to the north and the Meghalaya Plateau to the south. While largely flat, the plains include floodplains, river islands, and wetlands that are subject to frequent flooding during the monsoon season. These seasonal floods enrich the soil, contributing to its fertility and making the area highly suitable for agriculture. Rising above these plains are the Karbi Anglong and North Cachar Hills, creating a landscape of forests and grasslands that adds to the region's ecological diversity.

176. In southern Assam, the B. Valley, part of the Surma Valley system, features a mix of lowland plains and hilly regions. The B. River and its tributaries meander through this area, characterized by rolling hills, valleys, and rivers. Compared to the Brahmaputra Valley, the terrain here is more varied, with small hills, riverbeds, and low-lying areas creating an undulating landscape. This diverse topography across Assam supports a wide range of ecosystems, including tropical rainforests in the hill regions and wetlands and grasslands in the valleys, which collectively contribute to the state's rich biodiversity.

## Topography of Subproject Districts of Assam[31]

177. **Bongaigaon.** Bongaigaon district is situated between 90°22’ E to 90°5' E longitude and 26°9’ N to 26°42’ N latitude. It is surrounded by five districts: Barpeta to the east, Goalpara to the southeast, Kokrajhar and Dhubri to the west, and Chirang to the north. The district’s topography is characterized by a combination of plains and low, rugged terrain, situated on the flat alluvial plains formed by the Brahmaputra River. In the southern part, scattered small hills rise between 1000 and 1500 feet, adding

[30] Source: Assam District List 2024 - BodoPedia.in
[31] Source: Geography of Assam by N. Saikia, 2005

variation to the flat landscape. The district's overall slope shows a gentle tilt southwards, indicated by the presence of longitudinal rivers.

178. **Dhemaji.** Located in the northeast corner of Assam, Dhemaji district lies between 26°48´ and 27°53´ N latitude and 93°41´ and 95°31´ E longitude. It is bounded by Dibrugarh district to the south, Tinsukia district to the east, and Lakhimpur district to the west, covering an area of 3,237 square kilometers. The district's physiography can be divided into three zones: hilly tracts, piedmont areas, and floodplains. The hilly tracts feature moderate-relief hills and rugged landforms composed of Siwalik sediments from the Lesser Himalayas, with slopes generally descending from the northern and eastern parts towards the south.

179. **Dhubri.** Dhubri district is bordered by both inter-state and international boundaries, with West Bengal and Bangladesh to the west, Goalpara and Bongaigaon districts to the east, Kokrajhar district to the north, and Bangladesh and Meghalaya to the south. It lies between 89.42°E to 90.12°E longitude and 25.28°N to 26.22°N latitude, with an average elevation of 30 meters above sea level. The general topography is flat, though interspersed with small hillocks like Tokorabandha, Dudhnath, Chandardinga, Boukumari, Boropahar, and Chakrasila in the northeast. The Brahmaputra River flows through this district from east to west, along with its tributaries such as Champabati, Gourang, Gadadhar, Gangadhar, Tipkai, Sankosh, Silai, and Jinjiram.

180. **Goalpara.** Situated on the southern bank of the Brahmaputra River, Goalpara district covers an area of 1,842 square kilometers. It is bordered by the West and East Garo Hills districts of Meghalaya to the south, Kamrup district to the east, Dhubri district to the west, and the Brahmaputra River along its northern boundary. The district's geographical coordinates range between 25°15' N to 26°53' N latitude and 90°07' E to 91°05' E longitude. The landscape is primarily flat plains with occasional low-forested hills that provide some relief to the terrain.

181. **Jorhat.** Located in eastern Assam, Jorhat district spans from 26°20' N to 27°10' N latitude and 93°57' E to 94°37' E longitude, covering an area of 2,851 square kilometers. It is bordered by North Lakhimpur district to the north, Sibsagar district to the east, Nagaland state to the south and southeast, and Golaghat district to the west. The district's topography is mostly flat plains with limited occurrences of lakes, beels, and marshy lands, mainly found in Majuli, resulting from river course changes.

182. **Sribhumi.** Located at the southern tip of Assam, Sribhumi district covers 1,809 square kilometers and lies between 24°15' N to 25°55' N latitude and 92°15' E to 92°35' E longitude. It is bordered by Bangladesh and Cachar district to the north, Bangladesh and Tripura to the west, Tripura and Mizoram to the south, and Hailakandi district to the east. The terrain in Sribhumi is diverse, with high hills, lowlands, and flat plains, enriched by numerous swamps and beels. The district is nestled between two hill ranges, Chhatachura and Adamail (Patharia).

183. **Majuli.** Majuli, the world's largest river island, is located in the north of Jorhat district, between 93°30' E to 94°35' E longitude and 26°50' N to 27°10' N latitude. The island covers an area of 352 square kilometers and is formed by the Brahmaputra River to the south and the Kherkutia Xuti, an anabranch of the Brahmaputra, joined by the Subansiri River to the north.

184. **Lakhimpur.** This district lies between 26°48' N to 27°53' N latitude and 93°42' E to 94°20' E longitude. It is bounded by Siang and Papumpare districts to the north, Dhemaji district and the Subansiri River to the east, Majuli sub-division of Jorhat district to the south, and Gohpur sub-division of Sonitpur district to the west. The district's topography varies from foothills, medium and low lands, to deep water and riverine areas, characterized by rivers, beels, swamps, tanks, and ponds.

185. **Morigaon.** It is centrally located in Assam on the southern bank of the Brahmaputra River, between 26.25°N to 26.50°N latitude and 92.00°E to 92.50°E longitude, covering an area of 1,704

square kilometers. It is bounded by Karbi Anglong and Ri-Bhoi districts to the south, Nagaon district to the east, Kamrup district to the west, and Darrang district to the north.

186. **Nagaon.** Centrally located in Assam, Nagaon district lies on the southern bank of the Brahmaputra River between 26°20’39” N latitude and 92°41’39” E longitude. It is bounded by Sonitpur district and the Brahmaputra to the north, West Karbi Anglong, Hojai, and Dima Hasao districts to the south, East Karbi Anglong and Golaghat to the east, and Morigaon to the west. The district’s topography includes high hills, lowlands, and level plains, with expansive grasslands in the northwest and forests and hills in the south and east.

187. **Sivasagar.** This district, situated in eastern Assam, is located between 26.98°N to 27.26°N latitude and 94.25°E to 94.85°E longitude, covering an area of 2,668 square kilometers. It is bordered by Dibrugarh district to the north and east, Jorhat district to the west and southwest, and Nagaland to the south. The district’s geography includes the Brahmaputra River on its northern edge, with a mix of plains and low hills.

188. **Tinsukia.** Tinsukia district, located at the extreme northeastern corner of Assam, lies between 27°14' N to 27°48' N latitude and 95°13' E to 96°00' E longitude, covering 3,790 square kilometers in the Brahmaputra Basin. It shares borders with Changlang, Namsai, and Lower Dibang Valley districts. The district’s landscape is divided into floodplains, younger and older alluvial plains, terrace deposits, and hillocks, with elevations ranging from 87 to 350 meters above mean sea level, providing varied terrain for tea gardens and cultivated floodplain areas.

189. **Barpeta.** This district lies between 26° 5’ N to 26° 49’ N latitude and 90° 39’ E to 91° 17’ E longitude. It is bordered by Nalbari district to the north, Kamrup district to the east, Bongaigaon district to the west, and Goalpara district to the south. The district is primarily composed of alluvial plains formed by the Brahmaputra River and its tributaries, including Beki, Manas, and Pahumara. Barpeta’s terrain is mostly flat with occasional low-lying flood-prone areas, reflecting its susceptibility to seasonal inundation.

190. **Biswanath.** Biswanath district, situated between 26° 45’ N to 27° 30’ N latitude and 92° 30’ E to 93° 15’ E longitude, is bordered by Lakhimpur district to the east, Sonitpur district to the west, and the Brahmaputra River to the south. The district encompasses a mix of plains and forested areas, with a significant portion of its geography forming part of the Kaziranga National Park and the Nameri National Park. The region features rich biodiversity, with riverine plains and the foothills of the Eastern Himalayas dominating its physiography.

191. **Golaghat.** Golaghat district lies between 26° 7’ N to 27° 10’ N latitude and 93° 30’ E to 94° 30’ E longitude. It is bounded by the Brahmaputra River and Majuli district to the north, Nagaland to the south, Jorhat district to the east, and Karbi Anglong district to the west. The district’s topography is characterized by plains interspersed with small hills, with the Dhansiri River and its tributaries playing a vital role in shaping the landscape. Golaghat also includes a large part of the Kaziranga National Park, which is known for its rich flora and fauna, contributing to the district’s ecological significance.

192. **Kamrup Metropolitan.** Kamrup Metropolitan district is situated between 25° 49’ N to 26° 14’ N latitude and 91° 20’ E to 91° 47’ E longitude. It is bordered by Kamrup Rural district to the north, west, and south, and the Brahmaputra River flows along its northern boundary. The district is predominantly urban, with Guwahati, the largest city in Assam, serving as its administrative headquarters. The terrain includes plains interspersed with hills like Narakasur, Nilachal, and Chunsali. The area’s physiography is shaped by the Brahmaputra River, which influences the local climate and hydrology.

193. **Kamrup Rural.** Kamrup Rural district lies between 25° 46’ N to 26° 49’ N latitude and 90° 48’ E to 91° 47’ E longitude. It is bordered by Nalbari and Baksa districts to the north, Darrang and Kamrup

Metropolitan districts to the east, Goalpara district to the west, and Meghalaya to the south. The district's topography consists of a combination of fertile alluvial plains and undulating terrain, with numerous rivers such as the Brahmaputra, Kulsi, and Baralia flowing through it. The region's agricultural productivity and natural resources make it a vital area for Assam's economy.

**Geomorphology**

194. Assam's geomorphology is characterized by a diverse landscape shaped by tectonic activity, river systems, and varying elevations. The state is located within the Brahmaputra and B. River valleys, flanked by the Eastern Himalayas, the Patkai hills, and the Meghalaya plateau. The Brahmaputra Valley, a prominent geomorphic feature, dominates central Assam and consists of fertile alluvial plains created by sediment deposits from the Brahmaputra River and its numerous tributaries. This valley is largely flat, though interspersed with elevated plateaus and isolated hillocks. The region is highly susceptible to flooding and riverbank erosion, influenced by intense monsoon rainfall and the dynamic behavior of the Brahmaputra River.

195. In contrast, southern Assam is composed of the B. Valley and portions of the Meghalaya plateau, where the terrain is hillier, with elevations higher than those in the central plains. The landscape in this area is formed through the weathering and erosion of sedimentary rocks, with multiple smaller rivers cutting through the hills. Assam also contains extensive wetlands, known locally as *beels*, along with large forested areas, including tropical rainforests in the foothills of the Himalayas and the Patkai Range. These geomorphic variations contribute to Assam's rich biodiversity and complex ecological systems. A geomorphology map of Assam State is shown in Figure 4-3, with a summary of the various project districts provided below.

**Geomorphology of Subproject Districts of Assam[32]**

196. **Bongaigaon**. The geomorphology of Bongaigaon district is predominantly influenced by the alluvial plains formed by the Brahmaputra River and its tributaries. This district includes both low-lying floodplains and hilly regions located in the southern part, near the foothills of the Bhutan Himalayas. The landscape is marked by *beels* (wetlands) and riverine sandbars, which are common features in this area. These characteristics contribute to the district's high susceptibility to seasonal flooding, especially during the monsoon months when the Brahmaputra's water levels rise significantly.

197. **Dhemaji**. The district is situated in a highly flood-prone zone, primarily influenced by the Brahmaputra River and its tributaries, including the Subansiri and Jiadhol rivers. The geomorphology of Dhemaji is characterized by extensive alluvial plains, riverine deposits, and floodplains, which make it particularly vulnerable to flash floods and riverbank erosion. The district frequently experiences severe flooding, leading to soil erosion and changes in the river courses, impacting local agriculture and infrastructure.

198. **Dhubri**. Located on the western edge of Assam, lies near the confluence of the Brahmaputra and Ganges river systems. This district is characterized by low-lying alluvial plains, vast floodplains, and river islands (chars). Its geomorphology makes Dhubri one of the most flood-susceptible areas in Assam, with extensive flooding occurring regularly due to the dynamic behavior of the Brahmaputra River and its tributaries.

199. **Goalpara**. The topography of Goalpara district is a blend of low-lying alluvial plains and rising hills of the Meghalaya plateau in the southern part. The north near the Brahmaputra River are prone to flooding, while the southern part features undulating hills and dense forest cover. This varied terrain

[32] Source: Geomorphology of the Brahmaputra Basin" by D.N. Bezbaruah, 2007 and Geography of Assam" by N. Saikia, 2005

supports a range of ecosystems, but also presents challenges due to seasonal flooding in the plains and soil erosion in the hilly areas.

200. **Jorhat**. Located in the upper Brahmaputra Valley, Jorhat district is defined by flat alluvial plains interspersed with *beels* and complex riverine systems. The presence of river islands further contributes to the district's diverse terrain. Jorhat experiences seasonal flooding and erosion, especially during the monsoon season, which impacts agriculture and infrastructure along the riverbanks.

201. **Sribhumi**. Situated in the B. Valley, Sribhumi district is characterized by a mix of hilly terrain and floodplains along the B. River. The landscape includes rolling hills, valley bottoms, and wetlands, with the geomorphology shaped by the B. and Kushiyara rivers. The district's varied topography makes it vulnerable to both riverine floods and landslides, particularly in areas with steep slopes.

202. **Majuli**. As the world's largest river island, Majuli is located within the Brahmaputra River and is heavily shaped by riverine processes. Its geomorphology is dominated by sediment deposition, erosion, and shifting river channels. Continuous erosion by the Brahmaputra has resulted in significant shrinkage of the island, posing a threat to its unique cultural and ecological heritage.

203. **Lakhimpur**. Located in northeastern Assam, Lakhimpur district is largely composed of floodplains shaped by the Brahmaputra and Subansiri rivers. The area's alluvial deposits create fertile soil but also make it highly susceptible to flooding. The district is dotted with *beels* and extensive wetlands, contributing to its rich biodiversity but also increasing its vulnerability to seasonal floods.

204. **Morigaon.** Situated in the Brahmaputra Valley, Morigaon consists of low-lying floodplains formed by the Brahmaputra River and its tributaries. The area is known for its numerous *beels*, which enhance the district's vulnerability to seasonal flooding and fluctuations in the riverine landscape, affecting local agriculture and settlements.

205. **Nagaon**. Located in central Assam, Nagaon district is primarily composed of alluvial plains and intersected by rivers such as the Kolong and Kopili. This network of rivers makes Nagaon flood-prone, with a landscape that includes abundant wetlands and river islands. The district's geomorphology is complex, shaped by the sedimentation and flooding cycles of its rivers.

206. **Sivasagar**. The district is located in the upper Brahmaputra Valley and features fertile alluvial plains crossed by numerous rivers. Known for its agricultural productivity, the district is, however, prone to flooding and riverbank erosion. Wetlands are also common, contributing to the district's rich ecosystem but making it susceptible to seasonal floods.

207. **Tinsukia**. The district, situated in the easternmost part of Assam, has a diverse geomorphology that includes floodplains, marshes, and rolling hills. The district is influenced by the Brahmaputra and Dibru rivers, with wetlands such as those in Dibru-Saikhowa National Park enhancing its ecological diversity. The combination of floodplains and elevated areas provides a unique landscape but also poses challenges related to flooding and soil erosion.

208. **Barpeta.** The geomorphology of Barpeta district is defined by its expansive alluvial plains formed by the Brahmaputra River and its tributaries, including the Beki and Pahumara rivers. The district features low-lying floodplains, riverine sandbars, and wetlands (beels), which make it highly prone to seasonal flooding. The dynamic river systems and frequent changes in river courses contribute to the district's susceptibility to floods, particularly during the monsoon months.

209. **Biswanath.** Biswanath district's geomorphology is shaped by the Brahmaputra River and its tributaries, such as the Jiabharali and Buroi rivers. It is characterized by vast alluvial plains, riverine floodplains, and wetlands. These features make the district vulnerable to flooding and riverbank

erosion, particularly during the monsoon season. The district also includes some hilly terrains in the northern parts border.

210. **Golaghat.** The geomorphology of Golaghat district is predominantly influenced by the Brahmaputra River and its tributaries, including the Dhansiri and Kakodonga rivers. The landscape consists of extensive alluvial plains, riverine floodplains, and wetlands (beels), making it susceptible to seasonal flooding. The dynamic hydrology of the river systems frequently leads to flood-related challenges such as erosion and sediment deposition.

211. **Kamrup Metro.** Kamrup Metro district is marked by an interplay of alluvial plains and hilly terrains, influenced by the Brahmaputra River and its tributaries like the Bharalu and Basistha rivers. The low-lying floodplains and wetlands in the district make it vulnerable to urban flooding during the monsoon, while the undulating terrains in certain areas contribute to surface runoff and waterlogging issues.

212. **Kamrup Rural.** The geomorphology of Kamrup Rural district is largely defined by the Brahmaputra River and its tributaries, such as the Puthimari and Kulsi rivers. It comprises extensive alluvial plains, riverine sandbars, and wetlands. The district faces high flood risks during the monsoon, with riverbank erosion and sediment deposition being common issues. The foothills of the Meghalaya plateau add a distinct topographical variation in the southern parts

213. **Kokrajhar.** The geomorphology of Kokrajhar district is influenced by the foothills of the Eastern Himalayas and several river systems, including the Gaurang, Saralbhanga, and Sankosh rivers. The landscape comprises alluvial plains, piedmont zones, riverine floodplains, and low-lying wetlands. Seasonal flooding, riverbank erosion, and sediment deposition are common in the floodplain areas, while the northern foothill regions exhibit undulating terrain and higher drainage gradients.

214. **Nalbari.** The geomorphology of Nalbari district is predominantly shaped by the Brahmaputra River and its tributaries, including the Pagladia, Nona, and Tihu rivers. The district is characterized by extensive alluvial plains, floodplains, and wetlands. Frequent flooding during the monsoon season results in riverbank erosion, waterlogging, and sediment deposition, significantly influencing the district's landforms and agricultural landscape.

215. **Sonitpur.** The geomorphology of Sonitpur district is strongly influenced by the Brahmaputra River and its major tributaries, such as the Jia Bharali, Gabharu, and Belsiri rivers. The district consists of extensive alluvial plains, active floodplains, riverine islands, and wetlands. Seasonal flooding and riverbank erosion are recurring phenomena, while the northern part adjoining foothills exhibits piedmont and gently undulating terrains.

216. **Darrang.** The geomorphology of Darrang district is shaped by the Brahmaputra River and its tributaries, including the Mangaldoi, Dhansiri, and Barnadi rivers. The district is characterized by fertile alluvial plains, floodplains, and wetlands. The dynamic river systems contribute to recurrent flooding, bank erosion, and sediment deposition during the monsoon season, resulting in continuous modification of the landscape.

217. **Hojai.** The geomorphology of Hojai district is characterized by a combination of alluvial plains, low hills, and interspersed wetlands. The district is influenced by the Kopili River and its tributaries, which contribute to the formation of fertile floodplains and low-lying areas. Seasonal flooding, localized waterlogging, and sediment deposition are common geomorphic processes, while the southern and eastern parts exhibit gently undulating terrain.

218. **Charaideo.** The geomorphology of Charaideo district is influenced by the Burhi Dihing River and its tributaries. The landscape comprises alluvial plains, low-lying floodplains, wetlands, and gently

undulating uplands. The district experiences seasonal flooding in certain areas, accompanied by sediment deposition and localized erosion. The presence of elevated terrain and residual hillocks contributes to variations in relief across the district.

219. **Dibrugarh.** The geomorphology of Dibrugarh district is predominantly shaped by the Brahmaputra River and its tributaries, including the Burhi Dihing and Disang rivers. The district is characterized by extensive alluvial plains, active floodplains, wetlands, and riverine sandbars. Frequent flooding, riverbank erosion, and sediment deposition are significant geomorphic processes that continually modify the landscape, particularly during the monsoon season. The southern part of the district also includes gently elevated terrain associated with the foothills of the Patkai range.

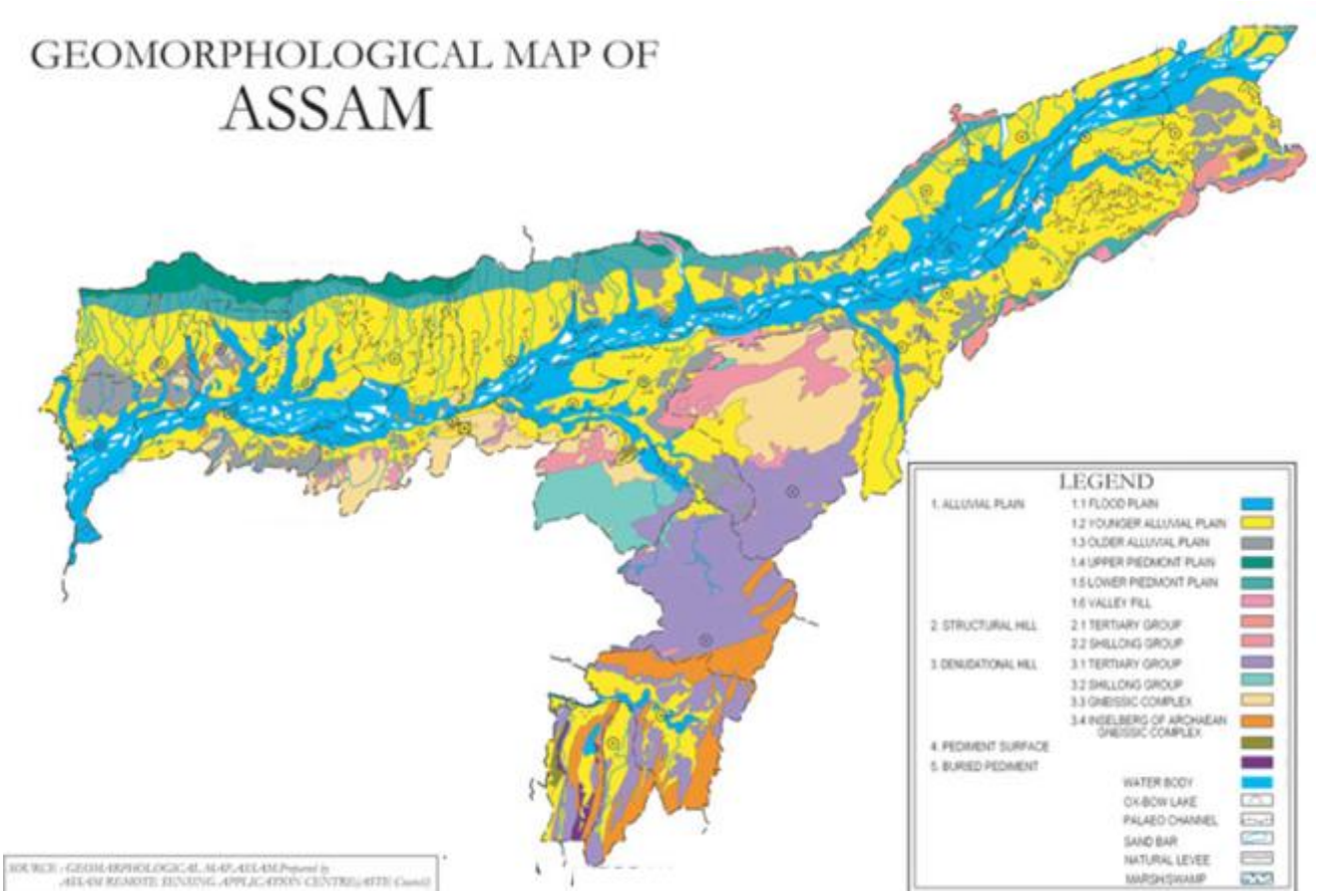



**Figure 4-3. Geomorphological Map of Assam**

## Land Utilization

220. Assam covers a total geographical area of 7,843,800 hectares, with a reporting area of 7,829,113 hectares under land utilization statistics. The state encompasses diverse land use categories, reflecting a wide range of natural resources and economic activities. Assam is distinguished by its significant forest cover, spanning 1,828,936 hectares. This forested area plays a vital role in biodiversity conservation, ecosystem support, watershed protection, and the provision of resources such as timber, medicinal plants, and wildlife habitats. Forests in Assam also contribute substantially to carbon sequestration and climate change mitigation.

221. In addition to its forested areas, Assam has 1,336,259 hectares allocated to non-agricultural uses, including urban settlements, industrial areas, transportation infrastructure, and other developmental activities. With increasing urbanization and infrastructure expansion, this figure is expected to grow further, potentially exerting pressure on agricultural land and influencing future land use patterns. Furthermore, 1,179,840 hectares of land are classified as barren and unculturable, indicating areas unsuitable for cultivation due to terrain constraints, soil conditions, or other environmental limitations.
222. The agricultural landscape of Assam includes 93,217 hectares designated as permanent pastures and other grazing lands, supporting livestock rearing and providing livelihoods for rural communities. In addition, 106,888 hectares are categorized under miscellaneous tree crops and groves not included in net area sown, contributing to agricultural diversification and supplementary income generation for farmers. Assam also has 200,105 hectares of culturable waste land, representing areas with potential for future agricultural development through suitable land improvement measures.

223. Other uncultivated land excluding fallow land covers 527,481 hectares across the state. This category comprises permanent pastures and grazing lands, land under miscellaneous tree crops and groves, and culturable waste land. These lands represent important resources that can support agriculture, livestock development, and agroforestry interventions when managed sustainably.

224. Fallow land in Assam covers 355,195 hectares, including 210,322 hectares of fallow land other than current fallows and 144,873 hectares of current fallows. These areas are temporarily left uncultivated for various reasons, including soil fertility restoration, moisture conservation, and local agricultural practices. The presence of substantial fallow land indicates opportunities for enhancing agricultural productivity through improved land management, irrigation development, and adoption of sustainable farming practices.

225. Agriculture continues to be a dominant land use in Assam, with a net sown area of 2,756,492 hectares and a total cropped area of 4,121,576 hectares. The difference between net sown area and total cropped area indicates a considerable extent of multiple cropping, with 1,365,084 hectares sown more than once during the agricultural year. These statistics highlight the importance of agriculture to the state's economy and emphasize the potential for further productivity enhancement through sustainable land and water resource management. A summary of land utilization patterns in the various districts of Assam is elaborated in the following.

**Land Utilization in Subproject Districts of Assam**[33]

226. **Dhubri.** The district has a geographical area of 184991 hectares. Forest cover extends over 2345 hectares. Land under non-agricultural uses accounts for 72150 hectares, while 13618 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 6508 hectares. Fallow land comprises 3160 hectares of fallow land other than current fallow and 8869 hectares of current fallow, bringing the total fallow land area to 12029 hectares. The net area sown is 78341 hectares and the total cropped area is 183697 hectares, indicating the extent of agricultural activity in the district.

227. **Kokrajhar.** The district has a geographical area of 329600 hectares. Forest cover extends over 173465 hectares. Land under non-agricultural uses accounts for 21576 hectares, while 24142 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 25535 hectares. Fallow land comprises 3535 hectares of fallow land other than current fallow and 1446 hectares of current fallow, bringing the total fallow land area to 4981 hectares. The net area sown is 79901 hectares and the total cropped area is 137281 hectares, indicating the extent of agricultural activity in the district.

[33] Source: Assam Land utilization statistics 2020-21

228. **Bongaigaon.** The district has a geographical area of 109300 hectares. Forest cover extends over 14028 hectares. Land under non-agricultural uses accounts for 13103 hectares, while 2827 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 11977 hectares. Fallow land comprises 2880 hectares of fallow land other than current fallow and 2736 hectares of current fallow, bringing the total fallow land area to 5616 hectares. The net area sown is 61749 hectares and the total cropped area is 101985 hectares, indicating the extent of agricultural activity in the district.

229. **Goalpara.** The district has a geographical area of 182400 hectares. Forest cover extends over 36459 hectares. Land under non-agricultural uses accounts for 27074 hectares, while 28767 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 17280 hectares. Fallow land comprises 295 hectares of fallow land other than current fallow and 148 hectares of current fallow, bringing the total fallow land area to 443 hectares. The net area sown is 72377 hectares and the total cropped area is 132272 hectares, indicating the extent of agricultural activity in the district.

230. **Kamrup ( R ).** The district has a geographical area of 318850 hectares. Forest cover extends over 87424 hectares. Land under non-agricultural uses accounts for 51225 hectares, while 16622 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 42536 hectares. Fallow land comprises 7725 hectares of fallow land other than current fallow and 6815 hectares of current fallow, bringing the total fallow land area to 14540 hectares. The net area sown is 105800 hectares and the total cropped area is 182506 hectares, indicating the extent of agricultural activity in the district.

231. **Kamrup ( M ).** The district has a geographical area of 87150 hectares. Forest cover extends over 29590 hectares. Land under non-agricultural uses accounts for 24279 hectares, while 4288 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 4895 hectares. Fallow land comprises 771 hectares of fallow land other than current fallow and 767 hectares of current fallow, bringing the total fallow land area to 1538 hectares. The net area sown is 22560 hectares and the total cropped area is 26777 hectares, indicating the extent of agricultural activity in the district.

232. **Nalbari.** The district has a geographical area of 104644 hectares. Forest cover extends over 0 hectares. Land under non-agricultural uses accounts for 17422 hectares, while 6811 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 5573 hectares. Fallow land comprises 3092 hectares of fallow land other than current fallow and 157 hectares of current fallow, bringing the total fallow land area to 3249 hectares. The net area sown is 67861 hectares and the total cropped area is 104112 hectares, indicating the extent of agricultural activity in the district.

233. **Barpeta.** The district has a geographical area of 228200 hectares. Forest cover extends over 0 hectares. Land under non-agricultural uses accounts for 39153 hectares, while 12739 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 25753 hectares. Fallow land comprises 5236 hectares of fallow land other than current fallow and 9621 hectares of current fallow, bringing the total fallow land area to 14857 hectares. The net area sown is 135698 hectares and the total cropped area is 193440 hectares, indicating the extent of agricultural activity in the district.

234. **Sonitpur.** The district has a geographical area of 340900 hectares. Forest cover extends over 115554 hectares. Land under non-agricultural uses accounts for 107410 hectares, while 15553 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 12044 hectares. Fallow land comprises 2449 hectares of fallow land other than current fallow and 6469 hectares of current fallow, bringing the total fallow land area to 8918 hectares. The net area

sown is 81421 hectares and the total cropped area is 159336 hectares, indicating the extent of agricultural activity in the district.

235. **Biswanath.** The district has a geographical area of 179500 hectares. Forest cover extends over 47428 hectares. Land under non-agricultural uses accounts for 56088 hectares, while 8104 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 6542 hectares. Fallow land comprises 1382 hectares of fallow land other than current fallow and 1377 hectares of current fallow, bringing the total fallow land area to 2759 hectares. The net area sown is 58579 hectares and the total cropped area is 102000 hectares, indicating the extent of agricultural activity in the district.

236. **Darrang.** The district has a geographical area of 158500 hectares. Forest cover extends over 7927 hectares. Land under non-agricultural uses accounts for 19299 hectares, while 14214 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 14428 hectares. Fallow land comprises 3717 hectares of fallow land other than current fallow and 5874 hectares of current fallow, bringing the total fallow land area to 9591 hectares. The net area sown is 93041 hectares and the total cropped area is 150380 hectares, indicating the extent of agricultural activity in the district.

237. **Nagaon.** The district has a geographical area of 276605 hectares. Forest cover extends over 51093 hectares. Land under non-agricultural uses accounts for 31285 hectares, while 9192 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 22066 hectares. Fallow land comprises 944 hectares of fallow land other than current fallow and 834 hectares of current fallow, bringing the total fallow land area to 1778 hectares. The net area sown is 161191 hectares and the total cropped area is 263611 hectares, indicating the extent of agricultural activity in the district.

238. **Hojai.** The district has a geographical area of 120695 hectares. Forest cover extends over 26487 hectares. Land under non-agricultural uses accounts for 11326 hectares, while 5143 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 8602 hectares. Fallow land comprises 1894 hectares of fallow land other than current fallow and 1710 hectares of current fallow, bringing the total fallow land area to 3604 hectares. The net area sown is 65533 hectares and the total cropped area is 92218 hectares, indicating the extent of agricultural activity in the district.

239. **Morigaon.** The district has a geographical area of 155100 hectares. Forest cover extends over 8561 hectares. Land under non-agricultural uses accounts for 38689 hectares, while 3134 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 20798 hectares. Fallow land comprises 1340 hectares of fallow land other than current fallow and 2047 hectares of current fallow, bringing the total fallow land area to 3387 hectares. The net area sown is 71486 hectares and the total cropped area is 123610 hectares, indicating the extent of agricultural activity in the district.

240. **Jorhat.** The district has a geographical area of 160588 hectares. Forest cover extends over 25247 hectares. Land under non-agricultural uses accounts for 11994 hectares, while 4862 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 11535 hectares. Fallow land comprises 4576 hectares of fallow land other than current fallow and 8432 hectares of current fallow, bringing the total fallow land area to 13008 hectares. The net area sown is 93942 hectares and the total cropped area is 115527 hectares, indicating the extent of agricultural activity in the district.

241. **Majuli.** The district has a geographical area of 124512 hectares. Forest cover extends over 0 hectares. Land under non-agricultural uses accounts for 58460 hectares, while 3073 hectares are

classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 13026 hectares. Fallow land comprises 4660 hectares of fallow land other than current fallow and 8515 hectares of current fallow, bringing the total fallow land area to 13175 hectares. The net area sown is 36778 hectares and the total cropped area is 53256 hectares, indicating the extent of agricultural activity in the district.

242. **Golaghat.** The district has a geographical area of 350200 hectares. Forest cover extends over 157642 hectares. Land under non-agricultural uses accounts for 15265 hectares, while 6243 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 18622 hectares. Fallow land comprises 3868 hectares of fallow land other than current fallow and 5239 hectares of current fallow, bringing the total fallow land area to 9107 hectares. The net area sown is 143321 hectares and the total cropped area is 189406 hectares, indicating the extent of agricultural activity in the district.

243. **Sivasagar.** The district has a geographical area of 159885 hectares. Forest cover extends over 10090 hectares. Land under non-agricultural uses accounts for 26950 hectares, while 8167 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 20157 hectares. Fallow land comprises 5127 hectares of fallow land other than current fallow and 5534 hectares of current fallow, bringing the total fallow land area to 10661 hectares. The net area sown is 83860 hectares and the total cropped area is 92704 hectares, indicating the extent of agricultural activity in the district.

244. **Charaideo.** The district has a geographical area of 106915 hectares. Forest cover extends over 20375 hectares. Land under non-agricultural uses accounts for 12950 hectares, while 3574 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 11695 hectares. Fallow land comprises 3439 hectares of fallow land other than current fallow and 2576 hectares of current fallow, bringing the total fallow land area to 6015 hectares. The net area sown is 52306 hectares and the total cropped area is 58312 hectares, indicating the extent of agricultural activity in the district.

245. **Lakhimpur.** The district has a geographical area of 227700 hectares. Forest cover extends over 31061 hectares. Land under non-agricultural uses accounts for 71107 hectares, while 40 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 16561 hectares. Fallow land comprises 6240 hectares of fallow land other than current fallow and 6483 hectares of current fallow, bringing the total fallow land area to 12723 hectares. The net area sown is 96208 hectares and the total cropped area is 179775 hectares, indicating the extent of agricultural activity in the district.

246. **Dhemaji.** The district has a geographical area of 323700 hectares. Forest cover extends over 59355 hectares. Land under non-agricultural uses accounts for 87513 hectares, while 49469 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 46751 hectares. Fallow land comprises 1844 hectares of fallow land other than current fallow and 1494 hectares of current fallow, bringing the total fallow land area to 3338 hectares. The net area sown is 77274 hectares and the total cropped area is 118126 hectares, indicating the extent of agricultural activity in the district.

247. **Dibrugarh.** The district has a geographical area of 338100 hectares. Forest cover extends over 21794 hectares. Land under non-agricultural uses accounts for 103082 hectares, while 23267 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 25994 hectares. Fallow land comprises 3762 hectares of fallow land other than current fallow and 4195 hectares of current fallow, bringing the total fallow land area to 7957 hectares. The net area sown is 156006 hectares and the total cropped area is 168474 hectares, indicating the extent of agricultural activity in the district.

248. **Tinsukia.** The district has a geographical area of 379000 hectares. Forest cover extends over 126468 hectares. Land under non-agricultural uses accounts for 33759 hectares, while 51394 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 23432 hectares. Fallow land comprises 8990 hectares of fallow land other than current fallow and 4252 hectares of current fallow, bringing the total fallow land area to 13242 hectares. The net area sown is 130705 hectares and the total cropped area is 160180 hectares, indicating the extent of agricultural activity in the district.

249. **Sribhumi.** The district has a geographical area of 180900 hectares. Forest cover extends over 48120 hectares. Land under non-agricultural uses accounts for 37702 hectares, while 7562 hectares are classified as barren and unculturable land. Other uncultivated land excluding fallow land covers 10776 hectares. Fallow land comprises 1295 hectares of fallow land other than current fallow and 2731 hectares of current fallow, bringing the total fallow land area to 4026 hectares. The net area sown is 72714 hectares and the total cropped area is 90384 hectares, indicating the extent of agricultural activity in the district.

250. **Sribhumi**Land use pattern in districts of Assam is presented in Table 4-2.

**Table 4-2. Land use pattern in districts of Assam (2023-24 Area in Ha)**

| Classification of Reporting Area | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sl. No. | DISTRICT | Geographical Area | Reporting Area for land utilisation statistics | Forest | Not available for cultivation | | |
| | | | | | Area under Non-Agricultural uses | Barren & Unculturable Land | Total Col (5+6) |
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 1 | **Dhubri** | 184991 | 184991 | 2345 | 72150 | 13618 | 85768 |
| 2 | **South Salmara** | 32609 | 32609 | 1101 | 8152 | 1286 | 9438 |
| 3 | **Kokrajhar** | 329600 | 329600 | 173465 | 21576 | 24142 | 45718 |
| 4 | **Bongaigaon** | 109300 | 109300 | 14028 | 13103 | 2827 | 15930 |
| 5 | **Chirang** | 192300 | 192300 | 71253 | 35108 | 12539 | 47647 |
| 6 | **Goalpara** | 182400 | 182400 | 36459 | 27074 | 28767 | 55841 |
| 7 | **Kamrup ( R )** | 318850 | 318147 | 87424 | 51225 | 16622 | 67847 |
| 8 | **Kamrup ( M )** | 87150 | 87150 | 29590 | 24279 | 4288 | 28567 |
| 9 | **Nalbari** | 104644 | 100916 | 0 | 17422 | 6811 | 24233 |
| 10 | **Barpeta** | 228200 | 228200 | 0 | 39153 | 12739 | 51892 |
| 11 | **Baksa** | 246256 | 245045 | 48540 | 73392 | 11736 | 85128 |
| 12 | **Sonitpur** | 340900 | 340900 | 115554 | 107410 | 15553 | 122963 |
| 13 | **Biswanath** | 179500 | 179500 | 47428 | 56088 | 8104 | 64192 |
| 14 | **Darrang** | 158500 | 158500 | 7927 | 19299 | 14214 | 33513 |
| 15 | **Udalguri** | 201200 | 201200 | 21996 | 29267 | 14475 | 43742 |
| 16 | **Nagaon** | 276605 | 276605 | 51093 | 31285 | 9192 | 40477 |
| 17 | **Hojai** | 120695 | 120695 | 26487 | 11326 | 5143 | 16469 |
| 18 | **Morigaon** | 155100 | 146055 | 8561 | 38689 | 3134 | 41823 |
| 19 | **Jorhat** | 160588 | 160588 | 25247 | 11994 | 4862 | 16856 |

| Classification of Reporting Area | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sl. No. | DISTRICT | Geographical Area | Reporting Area for land utilisation statistics | Forest | Not available for cultivation | | |
| | | | | | Area under Non-Agricultural uses | Barren & Unculturable Land | Total Col (5+6) |
| 20 | **Majuli** | 124512 | 124512 | 0 | 58460 | 3073 | 61533 |
| 21 | **Golaghat** | 350200 | 350200 | 157642 | 15265 | 6243 | 21508 |
| 22 | **Sivasagar** | 159885 | 159885 | 10090 | 26950 | 8167 | 35117 |
| 23 | **Charaideo** | 106915 | 106915 | 20375 | 12950 | 3574 | 16524 |
| 24 | **Lakhimpur** | 227700 | 227700 | 31061 | 71107 | 40 | 71147 |
| 25 | **Dhemaji** | 323700 | 323700 | 59355 | 87513 | 49469 | 136982 |
| 26 | **Dibrugarh** | 338100 | 338100 | 21794 | 103082 | 23267 | 126349 |
| 27 | **Tinsukia** | 379000 | 379000 | 126468 | 33759 | 51394 | 85153 |
| 28 | **Cachar** | 378600 | 378600 | 138409 | 51255 | 7086 | 58341 |
| 29 | **Hailakandi** | 132700 | 132700 | 59007 | 9676 | 4371 | 14047 |
| 30 | **Sribhumi** | 180900 | 180900 | 48120 | 37702 | 7562 | 45264 |
| 31 | **Karbi Anglong** | 739900 | 739900 | 199689 | 107838 | 343139 | 450977 |
| 32 | **West Karbi Anglong** | 303500 | 303500 | 121151 | 32710 | 83099 | 115809 |
| 33 | **Dima Hasao** | 488800 | 488800 | 67277 | B | 379304 | 379304 |
| **Assam** | | **7843800** | **7829113** | **1828936** | **1336259** | **1179840** | **2516099** |

| | Classification of Reporting Area | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| DISTRICT | Other uncultivated land excluding fallow land | | | | Fallow lands other than current fallows | Current fallow | Total (Col. 12+13) | Net Area Sown | Total Cropped Area | Area sown more than once |
| | Permanent pastures & other grazing land | Land under Misc. tree crops & groves not included in | Culturable waste land | Total (Col. | | | | | | |
| **1** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** |
| **Dhubri** | 1825 | 2482 | 2201 | 6508 | 3160 | 8869 | 12029 | 78341 | 183697 | 105356 |
| **South Salmara** | 392 | 522 | 714 | 1628 | 768 | 904 | 1672 | 18770 | 37067 | 18297 |
| **Kokrajhar** | 15012 | 5480 | 5043 | 25535 | 3535 | 1446 | 4981 | 79901 | 137281 | 57380 |
| **Bongaigaon** | 6050 | 3352 | 2575 | 11977 | 2880 | 2736 | 5616 | 61749 | 101985 | 40236 |
| **Chirang** | 2103 | 4060 | 3450 | 9613 | 2044 | 1466 | 3510 | 60277 | 87757 | 27480 |
| **Goalpara** | 2786 | 6995 | 7499 | 17280 | 295 | 148 | 443 | 72377 | 132272 | 59895 |
| **Kamrup ( R )** | 11674 | 17477 | 13385 | 42536 | 7725 | 6815 | 14540 | 105800 | 182506 | 76706 |
| **Kamrup ( M )** | 840 | 3040 | 1015 | 4895 | 771 | 767 | 1538 | 22560 | 26777 | 4217 |
| **Nalbari** | 3440 | 756 | 1377 | 5573 | 3092 | 157 | 3249 | 67861 | 104112 | 36251 |
| **Barpeta** | 10115 | 9149 | 6489 | 25753 | 5236 | 9621 | 14857 | 135698 | 193440 | 57742 |
| **Baksa** | 6618 | 7854 | 1177 | 15649 | 1883 | 1140 | 3023 | 92705 | 136445 | 43740 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sonitpur** | 7621 | 3747 | 676 | 12044 | 2449 | 6469 | 8918 | 81421 | 159336 | 77915 |
| **Biswanath** | 3618 | 2288 | 636 | 6542 | 1382 | 1377 | 2759 | 58579 | 102000 | 43421 |
| **Darrang** | 5704 | 5216 | 3508 | 14428 | 3717 | 5874 | 9591 | 93041 | 150380 | 57339 |
| **Udalguri** | 5959 | 8719 | 3627 | 18305 | 155 | 178 | 333 | 116824 | 155611 | 38787 |
| **Nagaon** | 10293 | 4533 | 7240 | 22066 | 944 | 834 | 1778 | 161191 | 263611 | 102420 |
| **Hojai** | 2999 | 2540 | 3063 | 8602 | 1894 | 1710 | 3604 | 65533 | 92218 | 26685 |
| **Morigaon** | 8049 | 10277 | 2472 | 20798 | 1340 | 2047 | 3387 | 71486 | 123610 | 52124 |
| **Jorhat** | 2442 | 4837 | 4256 | 11535 | 4576 | 8432 | 13008 | 93942 | 115527 | 21585 |
| **Majuli** | 2124 | 8874 | 2028 | 13026 | 4660 | 8515 | 13175 | 36778 | 53256 | 16478 |
| **Golaghat** | 6868 | 3940 | 7814 | 18622 | 3868 | 5239 | 9107 | 143321 | 189406 | 46085 |
| **Sivasagar** | 8685 | 6042 | 5430 | 20157 | 5127 | 5534 | 10661 | 83860 | 92704 | 8844 |
| **Charaideo** | 4738 | 4230 | 2727 | 11695 | 3439 | 2576 | 6015 | 52306 | 58312 | 6006 |
| **Lakhimpur** | 2916 | 7335 | 6310 | 16561 | 6240 | 6483 | 12723 | 96208 | 179775 | 83567 |
| **Dhemaji** | 15711 | 18107 | 12933 | 46751 | 1844 | 1494 | 3338 | 77274 | 118126 | 40852 |
| **Dibrugarh** | 4731 | 12604 | 8659 | 25994 | 3762 | 4195 | 7957 | 156006 | 168474 | 12468 |
| **Tinsukia** | 5637 | 14118 | 3677 | 23432 | 8990 | 4252 | 13242 | 130705 | 160180 | 29475 |
| **Cachar** | 8641 | 21498 | 19160 | 49299 | 4484 | 2951 | 7435 | 125116 | 171242 | 46126 |
| **Hailakandi** | 1600 | 3867 | 4434 | 9901 | 1662 | 1928 | 3590 | 46155 | 67542 | 21387 |
| **Sribhumi** | 3095 | 6383 | 1298 | 10776 | 1295 | 2731 | 4026 | 72714 | 90384 | 17670 |
| **Karbi Anglong** | B | B | B | B | B | B | B | 89234 | 132469 | 43235 |
| **West K. Anglong** | B | B | B | B | B | B | B | 66540 | 97970 | 31430 |
| **Dima Hasao** | B | B | B | B | B | B | B | 42219 | 56104 | 13885 |
| **Assam** | **172286** | **210322** | **144873** | **527481** | **93217** | **106888** | **200105** | **2756492** | **4121576** | **1365084** |

## Drainage

251. Assam's drainage system is defined primarily by two major river valleys: the Brahmaputra Valley and the B. Valley. The Brahmaputra Valley is the larger of the two, with an average width of about 80 kilometers. The Brahmaputra River originates in the Kailash range of the Himalayas at an elevation of 5,300 meters. It enters India, meanders through Assam, and ultimately flows into Bangladesh before joining the Bay of Bengal. The Brahmaputra's catchment area spans 293,000 square kilometers in outside India and 240,000 square kilometers in India and Bhutan, and 47,000 square kilometers in Bangladesh. Overall, the Brahmaputra basin covers approximately 580,000 square kilometers up to its confluence in Bangladesh.

252. In Assam, the Brahmaputra River has an average width of about 5.46 kilometers. Its discharge varies significantly, with a recorded maximum of 72,779 $m^3$ at Pandu near Guwahati on August 23, 1962, and a minimum of 1,757 $m^3$ on February 22, 1963. The river's average annual discharge is around 20,000 $m^3$, while the dry season average is about 4,420 $m^3$ The river experiences a steep slope as it flows through areas dropping approximately 4,800 meters over a length of 1,700 kilometers, resulting in an average slope of 2.82 m/km. However, as the Brahmaputra enters the Assam Valley, the slope flattens to about 0.1 m/km, causing the river to adopt a braided pattern due to the sudden decrease in gradient. In the Assam Valley, from Kobo to Dhubri, the river is joined by about 20 major tributaries on its northern bank and 13 on its southern bank, all of which contribute significant sediment loads and intensify the river's braiding.

253. In contrast, the B. Valley lies in the southern part of Assam, covering a geographical area of

6,922 square kilometers, excluding two hill districts. The B. River flows southward, fed by several tributaries including the Katakhal, Jiri, Chiri, Modhura, Longai, Sonai, Rukni, and Singla. The B. sub-basin spans regions in India, Bangladesh, and Myanmar, with a drainage area in India of 41,723 square kilometers, which represents nearly 1.38% of the country's total geographical area. The valley is bordered to the north by the Barail range, separating it from the Brahmaputra sub-basin, to the east by the Na Lushai hills, and to the south and west by Bangladesh.

254. The river system map of Assam is illustrated in Figure 4-4. The map illustrates the extensive river system of Assam, highlighting the Brahmaputra River as the central waterway traversing the state from east to west. Numerous tributaries, depicted clearly on the map, branch off from the Brahmaputra, reflecting a complex and dense hydrological network. This intricate network of rivers and streams covers the entire state, contributing significantly to Assam's unique wetland ecosystems, or "beels," and influencing agricultural practices, fisheries, and biodiversity. The map also delineates the state boundaries, offering context to the spatial distribution and interconnectedness of these rivers, which play a critical role in shaping the environmental and socio-economic landscape of Assam.

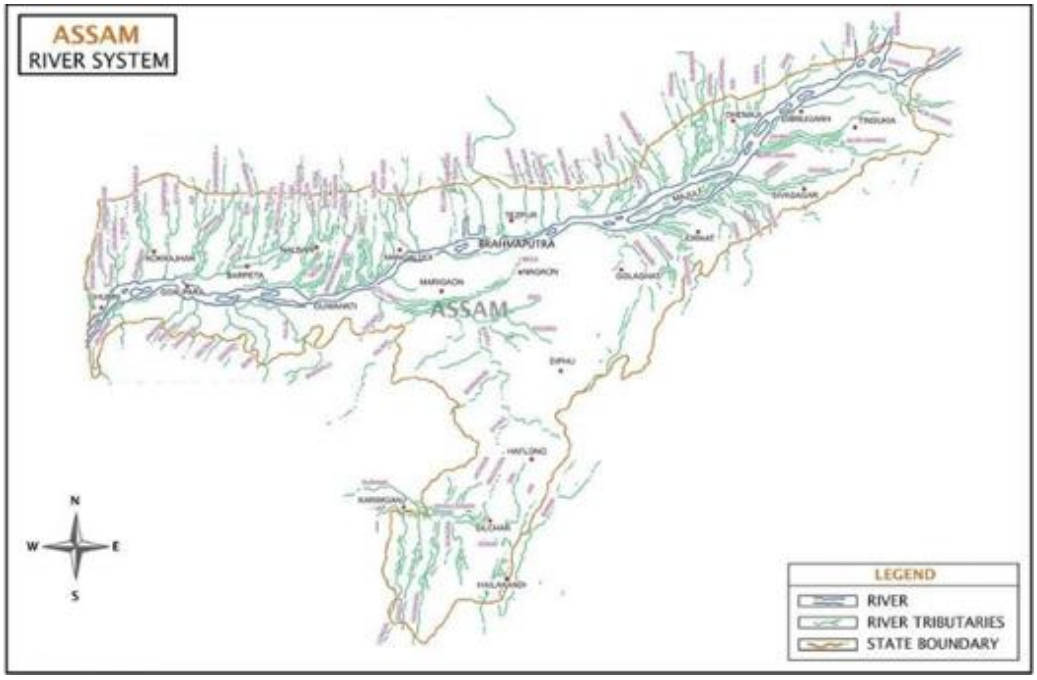



**Figure 4-4. River System map of Assam (Source: DPR)**

## Hydrogeology

255. Assam's hydrogeological framework is diverse and shaped by various geological formations. The state's groundwater resources can be classified into three primary categories based on the underlying geological formations.`

256. The first category includes areas underlain by porous, unconsolidated formations, predominantly consisting of Quaternary alluvium. These alluvial deposits, made up of sand, silt, and clay, form extensive aquifers, both confined and unconfined. These aquifers are primarily located in the alluvial plains and low-level terraces of the Brahmaputra Valley and are known for their high yield potential. Many of these aquifers can yield between 150 to 200 cubic meters per hour with drawdowns of less than 8 meters, making them essential for supporting agricultural and domestic water supplies in the region.

257. The second category comprises areas underlain by porous, semi-consolidated formations, mostly Tertiary sedimentary rocks, especially along the southern bank of the Brahmaputra River. These aquifers are typically moderately thick but discontinuous, with thicknesses often exceeding 50 meters. They have good yield potential, producing up to 150 cubic meters per hour for drawdowns between 6 to 12 meters. In the B. Valley, particularly in synclinal regions, semi-confined to confined aquifers are composed of fine to medium-grained sandstone and can yield between 30 to 50 cubic meters per hour, though they require drawdowns of up to 20 meters.

258. The third category includes areas with consolidated formations, comprising weathered and fissured crystalline rocks, along with effusive and intrusive rocks from the Archaean and Precambrian periods. Although these formations do not offer substantial groundwater resources compared to the alluvial and Tertiary sedimentary formations, they contain local aquifers with lower yields. Groundwater availability in Assam varies significantly due to these geological differences. The extensive alluvial plains provide the most substantial groundwater resources, but seasonal variations in rainfall and human activities lead to fluctuations in hydrogeological conditions. Effective water management strategies are essential to ensure sustainable groundwater use across Assam's diverse landscape.

259. The hydrogeological map of Assam is illustrated in Figure 4-5, with further details on the hydrogeology of specific subproject districts provided below.

**Hydrogeology of Subproject Districts of Assam**[34]

260. **Bongaigaon.** The hydrogeology of Bongaigaon is defined by alluvial deposits from the Brahmaputra River and its tributaries. Groundwater is primarily found in shallow aquifers composed of sand, silt, and clay, with depths ranging from 10 to 30 meters. Seasonal fluctuations in water levels, driven by monsoonal rainfall, impact agricultural practices and the availability of water for domestic use.

261. **Dhemaji.** In Dhemaji, groundwater resources are mainly derived from alluvial deposits along river valleys. The aquifers are typically shallow, with substantial recharge during the monsoon season. The presence of rivers and beels in the area influences hydrogeological conditions, resulting in a high rate of evaporation and variability in groundwater levels.

262. **Dhubri.** The district features an extensive alluvial plain, where the Brahmaputra River significantly contributes to groundwater recharge. Shallow aquifers in the area are vulnerable to pollution from agricultural runoff and human activities. Groundwater quality is variable and often requires treatment to meet potable standards.

263. **Goalpara.** The hydrogeology of Goalpara is dominated by alluvial sediments deposited by the Brahmaputra and other rivers. Groundwater occurs in both shallow and deeper aquifers, though shallow aquifers are more common. While water quality is generally good, it can be affected by surface runoff and seasonal flooding.

264. **Jorhat.** Jorhat's hydrogeology is a combination of alluvial and sedimentary rock formations. Groundwater is predominantly found in shallow aquifers, with recharge occurring mainly through rainfall and surface water bodies. Challenges include over-extraction and water quality issues stemming from agricultural practices.

265. **Sribhumi.** In Sribhumi, groundwater is largely confined to alluvial formations along river valleys,

[34] Source: Hydrogeology of the Brahmaputra Valley" by S. Bhattacharyya and D. Das (2009) and Aquifer Mapping and Management of Groundwater Resources in Assam" by A.K. Dey et al. (2018)

with shallow aquifers being most common. These aquifers are replenished mainly by monsoonal rains, though water quality issues, including arsenic contamination, have been reported in certain areas.

266. **Majuli.** As a river island, Majuli has a unique hydrogeological profile dominated by shallow aquifers. Seasonal flooding of the Brahmaputra influences groundwater quality, which can vary widely. Rainwater harvesting is critical to maintaining water supply in this region.

267. **Lakhimpur.** Lakhimpur's hydrogeology is shaped by its proximity to the Brahmaputra River, with groundwater primarily occurring in shallow aquifers recharged by seasonal rains. Water table levels fluctuate during the monsoon, impacting both agriculture and domestic water supply.

268. **Morigaon.** The hydrogeology of Morigaon is characterized by alluvial deposits, with groundwater primarily found in shallow aquifers. The district relies on monsoonal rainfall for recharge, leading to seasonal variations in groundwater levels. Water quality is generally acceptable, though localized pollution can be an issue.

269. **Nagaon.** Nagaon's hydrogeological framework consists of alluvial deposits, providing ample groundwater resources. Aquifers are recharged through rainfall and river systems, though water quality may vary due to agricultural runoff and industrial activity.

270. **Sivasagar.** The hydrogeology of Sivasagar is influenced by alluvial plains and sedimentary formations. Groundwater is primarily located in shallow aquifers, with water levels fluctuating seasonally. The numerous tea gardens in the district contribute to water quality concerns due to runoff from fertilizers and pesticides.

271. **Tinsukia.** Tinsukia district has a mix of alluvial and sedimentary deposits, with groundwater occurring in both shallow and deeper aquifers. The Brahmaputra River influences local hydrogeological conditions, and water quality requires monitoring due to potential contamination from industrial activities.

272. **Barpeta.** Barpeta district's hydrogeology is influenced by its alluvial soil composition, primarily composed of sand, silt, and clay deposits. The groundwater in the district is primarily found in the shallow aquifers, which are replenished by seasonal monsoon rains. The district has a relatively high-water table, especially in low-lying areas, with a general trend of moderate to high groundwater availability for agricultural and domestic use. Wells and tube wells are common sources of water in rural areas, and groundwater quality is generally good, though localized contamination from agricultural runoff can occur in certain areas.

273. **Biswanath.** The hydrogeology of Biswanath district is characterized by the presence of both shallow and deep aquifers, with groundwater being sourced primarily from alluvial deposits. These deposits are composed of sand, gravel, and clay, which allow for good recharge during the monsoon season. The water table varies across the district, with areas near rivers and streams having higher groundwater levels. Groundwater is widely used for irrigation and domestic purposes. However, the district faces seasonal variations in water availability, and the groundwater quality is generally suitable for most uses, though some areas may experience salinity or fluoride contamination.

274. **Golaghat.** Golaghat district's hydrogeology is dominated by its alluvial plains, with groundwater mainly stored in the shallow and deep aquifers formed by loose sand, gravel, and clay. The district experiences a high recharge rate during the monsoon, which ensures good groundwater availability for both agriculture and drinking purposes. The groundwater table is relatively shallow in many parts of the district, although it tends to dip in the more elevated areas. The quality of groundwater is generally good, with a few pockets experiencing elevated levels of iron and other trace elements, which can affect its potability without treatment.

275. **Kamrup Metro.** In Kamrup Metro district, groundwater is sourced from both shallow and deep aquifers, with the presence of alluvial deposits providing good recharge potential. The water table in the district is generally shallow, especially near rivers and low-lying areas, making groundwater easily accessible for domestic and agricultural needs. However, the district's urbanization has led to localized issues of groundwater depletion and contamination due to over-extraction and pollution from industrial and sewage discharges. Despite this, groundwater quality is generally considered good in rural and peri-urban areas, with most water being suitable for agricultural use but requiring treatment for domestic consumption in urban zones.

276. **Kamrup Rural**. Kamrup Rural district's hydrogeology is similar to Kamrup Metro, with alluvial soil deposits facilitating the storage and movement of groundwater in both shallow and deep aquifers. The groundwater table is generally shallow, especially in low-lying floodplain areas, which allows for good groundwater availability. The district faces a relatively high recharge rate during the monsoon season, which helps sustain agricultural activities. However, over-extraction for irrigation and domestic use can lead to localized depletion of groundwater levels. The quality of groundwater is generally suitable for most uses, though there are occasional reports of iron contamination in certain pockets.

277. **Kokrajhar.** Kokrajhar district's hydrogeology is characterized by extensive alluvial deposits in the plains and piedmont formations along the northern foothill regions. Groundwater occurs in both shallow and deep aquifers composed of sand, gravel, and clay layers, providing moderate to good groundwater potential. Recharge is primarily through monsoonal rainfall and river infiltration. The groundwater table is generally shallow in the floodplain areas but becomes deeper towards the elevated piedmont zones. Groundwater quality is generally suitable for domestic and agricultural use, although localized occurrences of iron enrichment have been reported in certain areas.

278. **Nalbari.** Nalbari district's hydrogeology is dominated by alluvial formations deposited by the Brahmaputra River and its tributaries. Groundwater is stored in multi-layered shallow and deep aquifers consisting of sand, silt, clay, and gravel. The district receives substantial recharge during the monsoon season, resulting in good groundwater availability for irrigation and drinking purposes. The water table remains relatively shallow across most parts of the district. Groundwater quality is generally good, though elevated iron concentrations are occasionally observed in some locations.

279. **Sonitpur.** Sonitpur district's hydrogeology is influenced by extensive alluvial deposits and piedmont formations along the foothills. Groundwater occurs under both unconfined and confined conditions within sand and gravel aquifers. The district benefits from high groundwater recharge due to abundant rainfall and infiltration from major rivers such as the Jia Bharali. The water table is generally shallow in the plains and deeper in the piedmont areas. Groundwater quality is largely suitable for domestic and agricultural use, although iron content may exceed desirable limits in certain pockets.

280. **Darrang.** Darrang district's hydrogeology is characterized by thick alluvial deposits that support productive shallow and deep aquifer systems. Groundwater availability is generally high owing to significant recharge from rainfall and river systems. The water table remains shallow in most parts of the district, particularly within the floodplain zones. Groundwater is extensively utilized for irrigation and domestic purposes. The quality of groundwater is generally satisfactory, though localized occurrences of iron and manganese have been reported in some areas.

281. **Hojai.** Hojai district's hydrogeology comprises alluvial deposits interspersed with localized hilly formations. Groundwater occurs in both shallow and deeper aquifers formed by sand, gravel, and clay sequences. Recharge is mainly derived from rainfall and surface water infiltration, ensuring moderate to good groundwater availability. The groundwater table is generally shallow in low-lying areas and relatively deeper in elevated terrains. Groundwater quality is generally suitable for drinking and agricultural purposes, although elevated iron concentrations are reported in certain locations.

282. **Charaideo.** Charaideo district's hydrogeology is influenced by alluvial plains and gently undulating upland areas. Groundwater is stored within shallow and deep aquifer systems comprising sand, silt, and clay formations. The district receives substantial recharge from monsoonal rainfall, resulting in adequate groundwater availability for domestic and agricultural use. The water table is relatively shallow in the plains and deeper in elevated areas. Groundwater quality is generally good, although iron-rich groundwater is encountered in some pockets.

283. **Dibrugarh.** Dibrugarh district's hydrogeology is dominated by thick alluvial deposits laid down by the Brahmaputra River and its tributaries. Groundwater occurs in highly productive shallow and deep aquifers composed of sand, gravel, and clay layers. High rainfall and river infiltration contribute to substantial groundwater recharge, maintaining a shallow water table across much of the district. Groundwater is widely utilized for drinking, irrigation, and industrial purposes. The quality of groundwater is generally good; however, elevated concentrations of iron and other trace elements are observed in certain areas, necessitating treatment before domestic use.

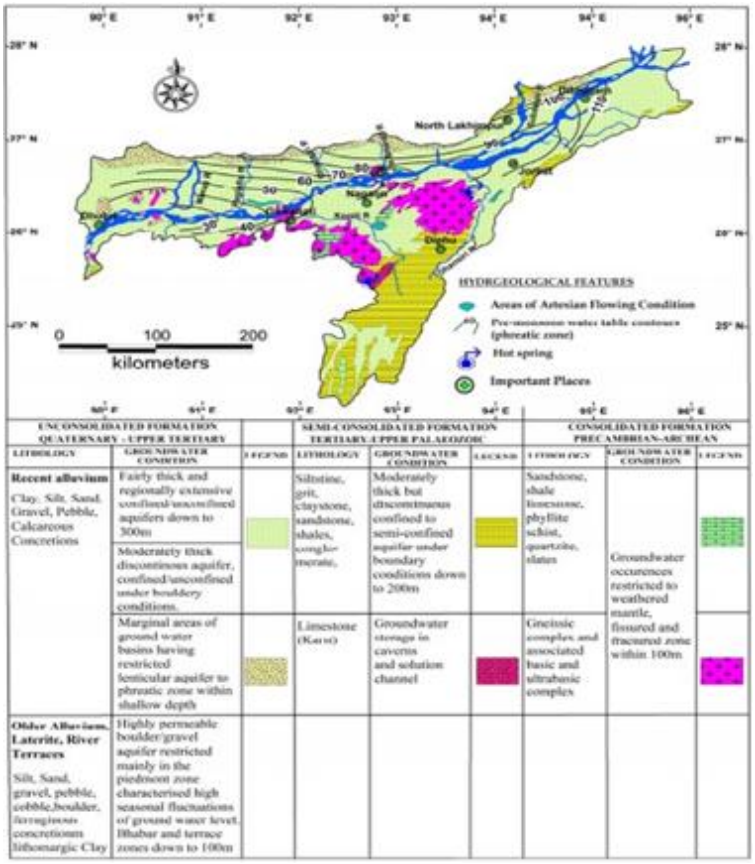



**Figure 4-5. Hydrogeological Map of Assam**[35]

**Soil**

284. The soils of Assam can be broadly categorized into four primary types, each associated with distinct geographical and environmental conditions. Alluvial soils are the most extensive, covering the Brahmaputra and B. plains. These soils owe their fertility to alluvium deposited by the rivers and their tributaries. They are further classified into two sub-types: New Alluvial Soils and Old Alluvial Soils. New Alluvial Soils are found in extensive belts along the banks of the Brahmaputra and B. rivers. These soils are characterized by recent deposits, grey coloration, and textures ranging from sandy to silty loams. While these soils are fertile, they are slightly acidic and often deficient in phosphoric acid,

[35] Source: Assam.pdf (cgwb.gov.in)

nitrogen, and humus. In contrast, Old Alluvial Soils are brown and acidic, making them suitable for cultivation. These soils are located in patches across districts such as Kokrajhar and Dhemaji, particularly in areas between the northern piedmont soil belt and the southern new alluvial soils of the Brahmaputra Valley.

285. The second category, Piedmont Soils, is confined to a narrow zone along the Himalayan foothills, running from west to east. This soil belt is further subdivided into two distinct zones: the Bhabar Belt and the Tarai Belt. The Bhabar Belt is characterized by alluvial cones made up of boulders, pebbles, sands, and silts, where water easily percolates through the riverbed. The Tarai Belt, located south of the Bhabar zone, is typically saturated with water, creating unique soil conditions ideal for specific types of vegetation.

286. Hill Soils, the third type, are predominantly found in the southern hill regions of Assam. These soils are rich in nitrogen and organic materials, supporting diverse vegetation. Hill soils are further classified into Red Sandy Soils and Red Loamy Soils. Red Sandy Soils are prevalent along the Assam-Meghalaya border and are light-textured. Red Loamy Soils, on the other hand, consist of fine to coarse sandy silt and clay, making them particularly suitable for tea cultivation.

287. The fourth type, Lateritic Soils, is widely distributed across the North Cachar (NC) Hills and parts of the Karbi Plateau. These soils are black and sandy in nature, rich in nitrogen, potash, and phosphoric acid. With appropriate treatment and soil management, lateritic soils can be transformed into highly productive land for tea plantations.

288. The diversity of Assam's soils supports a wide range of agricultural and ecological activities. The fertile alluvial soils sustain the extensive agriculture of the plains, while the specialized hill and lateritic soils provide ideal conditions for tea cultivation and other crops. A map of Assam’s soil regions is depicted in Figure 4-6, and further details of the soils available in the subproject districts are summarized below.

**Types of Soil of Subproject Districts of Assam**[36]

289. **Bongaigaon**. The hydrogeological profile of Bongaigaon district is predominantly defined by fertile alluvial soils derived from sediments deposited by the Brahmaputra River and its tributaries. These soils, characterized by a balanced texture of sand, silt, and clay, exhibit good drainage and high organic matter content, making them ideal for agriculture. The district supports intensive cultivation of crops such as rice, tea, and oilseeds.

290. **Dhemaji**. The district features alluvial soils formed from riverine sediments, with a textural composition ranging from sandy loam to clayey soils. These soils are highly fertile and critical for agriculture; however, they are vulnerable to frequent flooding and erosion due to the dynamic nature of the Brahmaputra River and its tributaries. The region's hydrogeological conditions make groundwater recharge significant during the monsoon season, though excessive runoff and soil loss affect long-term agricultural viability.

291. **Dhubri.** The district is characterized by extensive clayey and loamy alluvial soils formed through fluvial deposition by the Brahmaputra River. These soils are advantageous for water-retentive crops like rice but are susceptible to pollution from agricultural runoff and anthropogenic activities. Seasonal flooding further impacts soil stability, necessitating interventions such as embankments and sustainable drainage systems to protect the agricultural landscape.

[36] Source: Hydrogeology of the Brahmaputra Valley" by S. Bhattacharyya and D. Das (2009) and Aquifer Mapping and Management of Groundwater Resources in Assam" by A.K. Dey et al. (2018)

292. **Goalpara.** The soils in Goalpara district comprise nutrient-rich alluvial deposits that are conducive to intensive farming of rice, mustard, and pulses. The soil's fertility, however, is threatened by localized salinity issues and periodic flooding along the Brahmaputra River's banks. The district's southern regions, bordered by the Meghalaya plateau, exhibit slight variations in soil properties due to erosion and sediment deposition.

293. **Jorhat.** The district's soils include a mix of alluvial and clayey types, highly suitable for both agricultural activities and tea cultivation. The soils retain nutrients effectively and support a range of cropping systems. However, intensive agriculture and reliance on fertilizers pose risks to soil quality over time.

294. **Sribhumi**. The district's fertile alluvial soils are found predominantly in river valleys, supporting high-yield agriculture of rice, jute, and vegetables. While the soils have excellent moisture retention capabilities, the district is prone to seasonal flooding, which adversely affects soil stability.

295. **Majuli.** As a river island, Majuli exhibits unique hydrogeological conditions with a mix of sandy and clayey alluvial soils. While these soils are generally fertile and suitable for agriculture, erosion and seasonal flooding by the Brahmaputra River significantly affect soil sustainability. The adoption of rainwater harvesting and erosion-control measures is vital to improving agricultural productivity and preserving soil health.

296. **Lakhimpur.** Lakhimpur district's soil profile is dominated by nutrient-rich alluvial deposits from the Brahmaputra River. These soils facilitate the cultivation of rice, pulses, and oilseeds, with good natural fertility. However, seasonal waterlogging and fluctuating groundwater levels during the monsoon season necessitate improved irrigation management and soil conservation measures to ensure sustainable agricultural practices.

297. **Morigaon.** The district features fertile alluvial soils enriched by deposits from the Brahmaputra River and its tributaries. These soils support diverse agricultural systems, including rice, jute, and horticultural crops.

298. **Nagaon**. The district's soils, primarily alluvial, demonstrate high fertility and water retention capacity, making them suitable for intensive cultivation of rice and other crops. The district also experiences salinity challenges in certain irrigated areas.

299. **Sivasagar.** The fertile alluvial soils of Sivasagar district are conducive to agricultural production, particularly for tea and rice. These soils are rich in organic matter but are prone to seasonal flooding and erosion due to the district's proximity to major river systems.

300. **Tinsukia.** Soil composition in the district includes a mix of alluvial and clayey types, supporting diverse cropping systems, including rice and tea cultivation. The soils' fertility is influenced by organic matter content and hydrogeological conditions associated with the Brahmaputra River. However, industrial activities in the region pose potential risks of soil contamination, necessitating regular monitoring and mitigation efforts.

301. **Barpeta**. Barpeta district predominantly features alluvial soils, which are rich in nutrients and well-suited for agriculture. These soils are deposited by rivers and are highly fertile, supporting the district’s extensive agricultural activities. The area also has pockets of acidic soils in some parts, which can affect crop growth but are often managed with soil treatment and fertilizers. The fertile alluvial soils contribute to Barpeta’s large net sown area and robust cropping patterns.

302. **Biswanath**. Biswanath district is primarily characterized by alluvial soils, which are common in the floodplains of the Brahmaputra and its tributaries. These soils are highly fertile and well-drained,

making them ideal for rice, tea, and other agricultural crops. Additionally, the district has some areas with laterite soils, which are less fertile but can be found in hilly regions. Overall, Biswanath's soil profile supports a strong agricultural sector, particularly in rice cultivation.

303. **Golaghat**. Golaghat district has a variety of soil types, with alluvial soils dominating the floodplain areas. These soils are rich in nutrients and support the extensive agriculture in the district, especially paddy cultivation. In the upland regions, there are pockets of laterite soils, which are typically more acidic and less fertile but can be used for certain crops with proper soil management techniques. The soil diversity in Golaghat makes it suitable for a wide range of crops, from rice to tea.

304. **Kamrup Metro**. Kamrup Metro district, located in a largely urbanized area, has soils that vary depending on the region. The floodplains of the Brahmaputra River feature alluvial soils, which are rich in organic matter and support agriculture in the rural parts of the district. In the hilly and upland areas, laterite and red soils are more common, typically found in areas with higher elevation. These soils can be acidic and require proper soil treatment for productive agriculture. However, due to the urban nature of Kamrup Metro, soil types are influenced by human development, with some areas experiencing soil degradation.

305. **Kamrup Rural**. Kamrup Rural district exhibits a mix of alluvial and laterite soils. The floodplains along the Brahmaputra and its tributaries are predominantly alluvial, providing fertile soil for agriculture. In contrast, the upland regions have laterite soils, which are less fertile and more acidic but can support certain crops with proper management. The diversity in soil types across Kamrup Rural contributes to the agricultural potential of the district, especially in rice and vegetable cultivation.

306. **Kokrajhar.** Kokrajhar district is characterized by a combination of alluvial and sandy loam soils, particularly in the river valleys and floodplain areas. These soils are generally fertile and support the cultivation of paddy, maize, pulses, and other agricultural crops. In the northern foothill regions, the soils tend to be coarser and less fertile due to higher sand and gravel content. The district also contains patches of acidic soils, which require appropriate soil management practices to maintain agricultural productivity.

307. **Nalbari.** Nalbari district predominantly consists of alluvial soils deposited by the Brahmaputra River and its tributaries. These soils are rich in nutrients, moderately textured, and highly suitable for agriculture, particularly paddy, pulses, oilseeds, and vegetables. The district's soils generally possess good moisture-retention capacity and fertility. However, seasonal flooding and sand deposition in certain areas can affect soil quality and agricultural productivity.

308. **Sonitpur.** Sonitpur district is largely covered by fertile alluvial soils derived from the Brahmaputra River and its tributaries. These soils are well-suited for the cultivation of rice, tea, mustard, and a variety of horticultural crops. In the northern foothill regions, the soils are often sandy to loamy in texture with comparatively lower nutrient content. The district also contains localized acidic soils, particularly in tea-growing areas, where appropriate soil management practices are commonly adopted.

309. **Darrang.** Darrang district is dominated by recent alluvial soils that are highly fertile and support intensive agricultural activities. The soils are generally loamy to silty loam in texture, providing favorable conditions for paddy, jute, pulses, and vegetable cultivation. Frequent flooding contributes to the periodic replenishment of nutrients through fresh sediment deposition. However, excessive sand deposition in some flood-affected areas can adversely impact soil fertility and crop production.

310. **Hojai.** Hojai district exhibits a mix of alluvial, loamy, and lateritic soils. The alluvial soils found in the plains are fertile and suitable for the cultivation of paddy, vegetables, and other field crops. The upland and hilly areas contain lateritic soils, which are generally acidic and lower in fertility but can

support plantation crops and horticulture with proper soil management. The district's diverse soil profile supports a wide range of agricultural activities.

311. **Charaideo.** Charaideo district is characterized by alluvial and acidic soils, with significant areas supporting tea plantations and agricultural crops. The alluvial soils in the plains are fertile and suitable for paddy cultivation, while the upland areas contain more acidic soils with moderate fertility. Organic matter content is generally adequate in many parts of the district, contributing to agricultural productivity. Proper nutrient management is often required to sustain soil health and crop yields.

312. **Dibrugarh.** Dibrugarh district predominantly consists of fertile alluvial soils deposited by the Brahmaputra River and its tributaries. These soils are rich in organic matter and nutrients, making them highly suitable for rice, tea, and other agricultural crops. The district also contains acidic soils, particularly in tea-growing regions, which are well-adapted to plantation agriculture. However, recurrent flooding and localized industrial activities may influence soil quality in certain areas, highlighting the need for periodic monitoring and sustainable soil management practices.

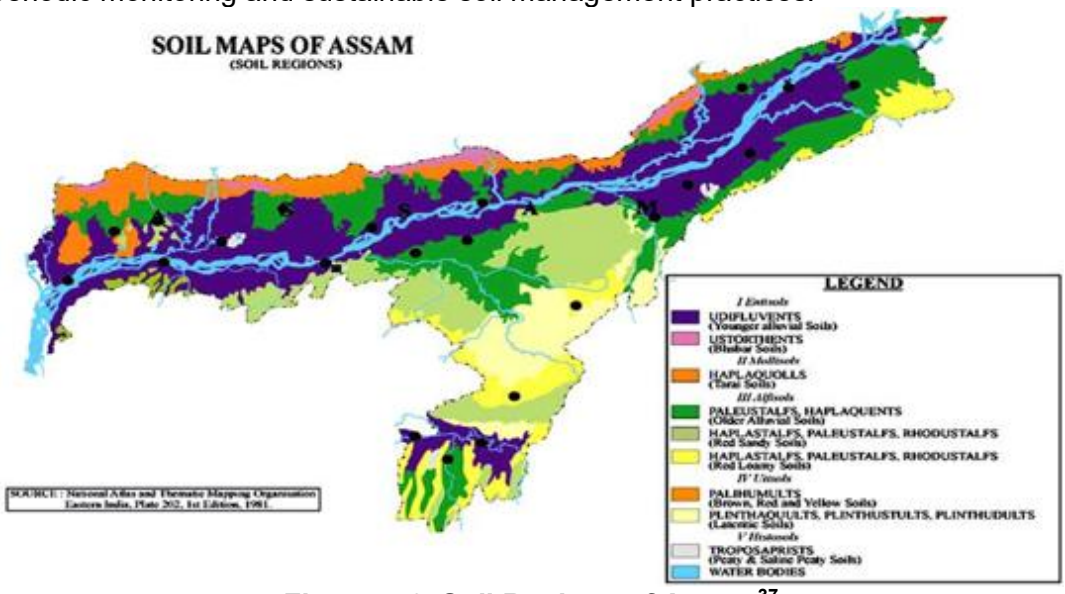



**Figure 4-6. Soil Regions of Assam**[37]

313. Shown figure above, the soil map of Assam illustrates a diverse range of soil regions, prominently characterized by alluvial soils (Udifluvents and Fluvaquents), predominantly spread along the extensive Brahmaputra River valley, signifying fertile regions beneficial for agriculture. The northern and southern boundaries of the Brahmaputra Valley feature Ultisols (Palehumults and Paleudults), representing areas of moderate fertility. Interspersed throughout the state, notably in the central and eastern regions, are Alfisols (Hapludalfs), Histosols (Haplaquepts and Haplaquents), and Entisols (Ustorthents), indicating a mosaic of soil types that reflect varied agricultural potentials and hydrological conditions. Additionally, Inceptisols (Dystrudepts and Eutrochrepts) dominate parts of southern Assam, particularly near Karbi Anglong and Dima Hasao districts. This detailed classification underscores Assam's rich soil diversity, directly influencing agricultural productivity, land management strategies, and environmental planning across the region.

**Seismicity of the State**

314. Northeast India, including its surrounding regions, is characterized by high seismic activity. The

[37] https://www.icar-crida.res.in/CP/Assam/Assam21-Chirang.pdf

region encompasses the eastern Himalayas, the Indo-Myanmar arc, the Mishmi Massif, the Shillong Plateau, the Tripura folded belt, the Assam intermountain depression, and the northern part of the Bengal basin. Collectively, these areas form the northern segment of the Assam-Arakan geological province. According to the seismic hazard zonation map of India (Figure 4-7), the entire northeastern region is classified under Zone V, the highest seismic risk zone in the country. Recent studies indicate that the impact of earthquake shaking varies significantly across neighboring areas, primarily due to site-specific conditions that influence the intensity of seismic shaking.

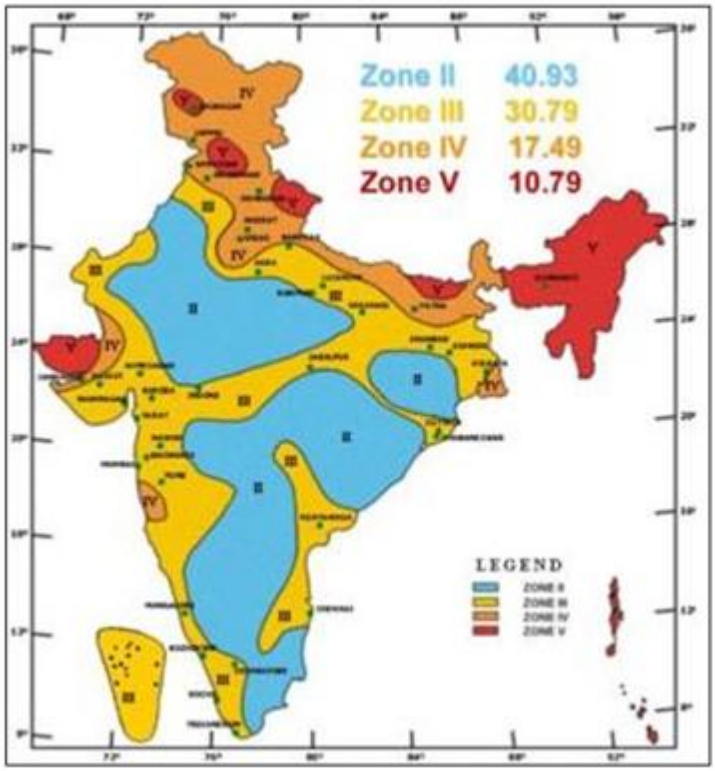



**Figure 4-7. Seismic Zonation Map of India[38]**

315. According to Global Seismic Hazard Assessment Program (GSHAP) data, the state of Assam falls in a region of moderate to high seismic hazard. As per the 2002 Bureau of Indian Standards (BIS) map, Assam also falls in V (Zone I is low Risk and Zone V is high Risk). Historically, parts of this state have experienced seismic activity in the M6, which means strong as per US Geological Survey. Even though the majority of northeast India is susceptible to earthquakes, their magnitudes typically range from 5 to 8 or higher. Low-magnitude earthquakes with a Richter scale value of less than 5 are widely distributed in the area. However, the majority of earthquakes with a magnitude of greater than 5 have been recorded in the lower Brahmaputra Valley. Earthquakes measuring between 5 and 6 on the Richter scale have primarily been felt in Assam's northern, western, southern, and eastern rims. The Brahmaputra Valley saw the majority of the earthquakes, which typically had Richter scale magnitudes between 6 and 7, on a regular basis. The areas with the highest densities of powerful earthquakes, with magnitudes ranging from 7 to 8, have been found to be central and lower Brahmaputra Valley. Assam earthquake hazard map is depicted in Figure 4-8.

[38] National Institute of Disaster Management (NIDM). https://nidm.gov.in/safety_earthquake.asp

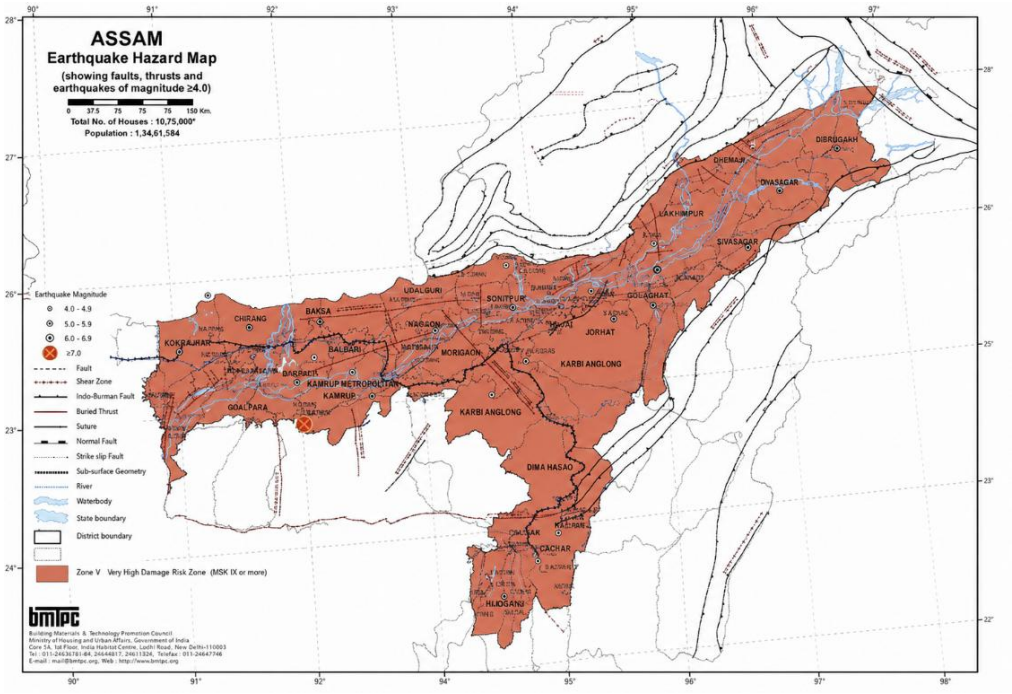



**Figure 4-8.Earthquake Hazard Map of Assam[39]**

## Climate

316. The climate of Assam is categorized as a "Tropical Monsoon Rainforest Climate," marked by high humidity and substantial rainfall. Summer temperatures range from 27°C to 38°C, while winter temperatures drop between 3.4°C and 11°C. Humidity levels remain consistently high throughout the year, varying from 74% to 87%. The climate is predominantly influenced by the South-West Tropical Monsoon, which brings substantial rainfall from June to September, although non-monsoon rains also occur intermittently. Assam's average annual rainfall is approximately 2,454.4 mm, with some regions, such as southern Karbi Anglong and Nagaon, receiving less than 1,500 mm annually due to a rain shadow effect.

317. Based on temperature, rainfall, and humidity, Assam experiences four distinct seasons: (i) Pre-monsoon (March to May) with rising temperatures and occasional thundershowers, contributing to 20-30% of annual rainfall; (ii) Monsoon (June to September), characterized by overcast skies, high humidity, and frequent rainfall, averaging 18-20 rainy days per month; (iii) Post-monsoon (October to November), marked by fair weather, decreasing temperatures, and fewer rainy days; and (iv) Winter (December to February), which brings cool, dry conditions. The climatic conditions of subproject districts are detailed below to support baseline environmental assessment.

318. **Bongaigaon**. The district has a humid subtropical monsoon climate characterized by high humidity throughout the year. Summer temperatures range from 25°C to 32°C, while winters remain mild, fluctuating between 10°C and 22°C. The district receives substantial monsoon rainfall, averaging approximately 2,500 mm annually, contributing to seasonal flooding driven by the Brahmaputra River and its tributaries. During the winter months, rainfall is minimal, and foggy conditions prevail in the early mornings, which may impact visibility.

319. **Dhemaji**. Located in northeastern Assam, Dhemaji experiences a humid subtropical climate. Summer temperatures range from 27°C to 35°C, and winters are relatively cool, with temperatures from 9°C to 20°C. As one of the wettest districts, it records an average annual rainfall of 3,000 mm,

[39] Source: https://www.bmtpc.org/DataFiles/CMS/file/VAI2019/eq-assam.htm

primarily during the monsoon season (June–September). The region is highly vulnerable to flooding and erosion due to its proximity to the Brahmaputra and associated river systems.

320. **Dhubri.** The disctrict experiences a tropical monsoon climate with high humidity and significant precipitation during the monsoon period. Summer temperatures range between 24°C and 34°C, while winters are mild, with temperatures varying from 10°C to 22°C. Annual rainfall averages 2,300 mm, with peak precipitation occurring between June and September. The district is prone to flooding, influenced by the Brahmaputra River and seasonal river dynamics.

321. **Goalpara.** District's climate is dominated by humid subtropical conditions with distinct monsoonal influences. Summers are warm and humid, ranging from 25°C to 35°C, while winters are cooler, between 12°C and 24°C. The district receives an average of 2,100 mm of rainfall annually, with the majority occurring during the monsoon months. Seasonal flooding is common, particularly in areas adjacent to river systems.

322. **Jorhat.** The climate in the dictrict features a humid subtropical climate, with warm, humid summers (27°C to 35°C) and mild winters (8°C to 20°C). The district receives substantial monsoonal rainfall, averaging 2,500 mm annually, primarily concentrated from June to September. The winter season is dry and often accompanied by morning fog, which may impact visibility and daily activities.

323. **Sribhumi.** Located in the B. Valley, Sribhumi has a tropical monsoon climate characterized by high humidity and heavy rainfall. Summers range from 25°C to 32°C, while winters are mild, with temperatures between 10°C and 22°C. The district receives approximately 3,000 mm of rainfall annually, making it one of Assam's wettest regions. Seasonal flooding during the monsoon is a significant challenge for agricultural activities and infrastructure.

324. **Lakhimpur.** The district has a humid subtropical climate with hot, humid summers (27°C to 35°C) and mild winters (10°C to 22°C). The district receives an annual average rainfall of 2,800 mm, predominantly during the monsoon (June–September). Flooding and fluctuating groundwater levels, influenced by the Brahmaputra River and its tributaries, are common phenomena impacting agriculture and settlement patterns.

325. **Majuli**. As the world's largest river island, Majuli experiences a humid subtropical monsoon climate with warm summers (26°C to 32°C) and cool winters (7°C to 18°C). Rainfall is substantial, averaging 2,600 mm annually, and concentrated in the monsoon season. Seasonal flooding and erosion, driven by the Brahmaputra's hydrodynamics, are significant concerns for sustainable development and habitat stability.

326. **Morigaon**. The district has a humid subtropical climate with pronounced seasonal variations. Summers are hot and humid, with temperatures ranging from 25°C to 33°C, while winters are cooler, at 9°C to 22°C. Annual rainfall averages 2,400 mm, primarily during the monsoon (June–September). Seasonal flooding, particularly from the Brahmaputra and Kopili rivers, affects agricultural productivity and settlement planning.

327. **Nagaon**. The disctrict experiences a subtropical monsoon climate with warm summers (25°C to 32°C) and mild winters (10°C to 20°C). Average annual rainfall is approximately 2,200 mm, primarily during the monsoon season. Flooding from the Brahmaputra River and its tributaries is a recurring issue, influencing agricultural and infrastructure development in the district.

328. **Sivasagar**. Disctrict's humid subtropical climate features moderate temperatures throughout the year. Summer temperatures range from 25°C to 33°C, while winter temperatures vary from 10°C to 22°C. The district records annual rainfall of around 2,400 mm, with the monsoon season contributing the majority. Seasonal flooding, driven by local river systems, poses challenges for sustainable

agricultural practices.

329. **Tinsukia.** Situated in northeastern Assam, Tinsukia experiences a humid subtropical climate with warm summers (25°C to 35°C) and mild winters (10°C to 22°C). The district receives heavy rainfall, averaging 2,800 mm annually, with monsoon rains dominating from June to September. Flooding during the monsoon season is frequent, particularly in low-lying areas influenced by the Brahmaputra River system.

330. **Barpeta District.** Barpeta experiences a tropical monsoon climate with significant seasonal rainfall. The average annual temperature is approximately 23.4°C (74.2°F). Rainfall is substantial, averaging around 2,544 mm (100.2 inches) annually. The wettest month is July, receiving about 12.9 inches (327 mm) of rain. The driest period occurs from November 15 to February 2, with minimal rainfall.

331. **Biswanath District.** Biswanath shares a similar tropical monsoon climate with Barpeta. The average annual temperature is 23.4°C (74.2°F). Annual rainfall is approximately 2,544 mm (100.2 inches), with July being the wettest month.

332. **Golaghat District.** Golaghat experiences a tropical monsoon climate with an average annual temperature of 23.4°C (74.1°F). The district receives about 3,130 mm (123.2 inches) of rainfall annually. The wettest month is July, with significant rainfall.

333. **Kamrup Metropolitan District.** Kamrup Metropolitan has a subtropical climate with semi-dry summers and cooler winters. Annual rainfall ranges between 1,500 mm to 2,600 mm. Average humidity is around 76%. Maximum temperatures can reach 37-39°C, while minimum temperatures range from 6-7°C.

334. **Kamrup Rural District**. Kamrup Rural shares a similar climate to Kamrup Metropolitan, with subtropical conditions. Annual rainfall ranges between 1,500 mm to 2,600 mm. Average humidity is around 76%. Maximum temperatures can reach 37-39°C, while minimum temperatures range from 6-7°C.

335. **Kokrajhar.** Kokrajhar district experiences a humid subtropical monsoon climate with warm summers, mild winters, and high humidity during the rainy season. Summer temperatures generally range from 25°C to 35°C, while winter temperatures vary between 10°C and 22°C. The district receives an average annual rainfall of about 2,500–3,000 mm, most of which occurs during the southwest monsoon period from June to September. Seasonal flooding and waterlogging are common in low-lying areas due to intense rainfall and the influence of major river systems.

336. **Nalbari.** Nalbari district has a humid subtropical climate characterized by hot and humid summers and mild winters. Summer temperatures typically range from 25°C to 34°C, whereas winter temperatures vary between 10°C and 22°C. The district receives an average annual rainfall of approximately 2,000–2,500 mm, with the majority concentrated during the monsoon season. Heavy rainfall often results in seasonal flooding, particularly in areas influenced by the Pagladia and other tributary rivers.

337. **Sonitpur.** Sonitpur district experiences a humid subtropical climate with significant monsoonal influence. Summer temperatures generally range from 24°C to 34°C, while winter temperatures vary between 8°C and 22°C. The district receives substantial annual rainfall averaging around 2,500–3,000 mm, primarily during the monsoon months from June to September. Owing to its proximity to the Himalayan foothills and major river systems, the district frequently experiences flooding, riverbank erosion, and prolonged wet conditions during the rainy season.

338. **Darrang.** Darrang district is characterized by a humid subtropical climate with warm summers, cool winters, and high monsoonal rainfall. Summer temperatures generally range from 25°C to 35°C,

while winter temperatures range between 10°C and 22°C. The district receives an average annual rainfall of approximately 2,000–2,500 mm, most of which occurs during the southwest monsoon. Seasonal flooding and waterlogging are common due to the influence of the Brahmaputra River and its tributaries.

339. **Hojai.** Hojai district experiences a humid subtropical climate with warm and humid summers and relatively mild winters. Summer temperatures typically range from 24°C to 34°C, while winter temperatures vary between 10°C and 23°C. The district receives average annual rainfall of about 1,800–2,200 mm, mainly during the monsoon season. Heavy rainfall occasionally causes localized flooding and waterlogging in low-lying areas, while the overall climate remains favorable for agriculture throughout much of the year.

340. **Charaideo.** Charaideo district has a humid subtropical climate influenced by both monsoonal rainfall and the surrounding upland terrain. Summer temperatures generally range from 24°C to 33°C, while winter temperatures vary between 8°C and 21°C. The district receives average annual rainfall of approximately 2,000–2,500 mm, with most precipitation occurring between June and September. The climate supports extensive agricultural and tea plantation activities, although occasional flooding and prolonged wet conditions occur in low-lying areas during the monsoon.

341. **Dibrugarh.** Dibrugarh district experiences a humid subtropical climate with high humidity and abundant rainfall throughout the monsoon season. Summer temperatures generally range from 24°C to 34°C, while winter temperatures vary between 8°C and 22°C. The district receives an average annual rainfall of about 2,700–3,000 mm, making it one of the wetter regions of Assam. Heavy monsoon precipitation, combined with the influence of the Brahmaputra River and its tributaries, frequently leads to flooding, waterlogging, and riverbank erosion in vulnerable areas.

**Ambient Air Quality**

342. The Pollution Control Board, Assam (PCBA), monitors ambient air quality under the National Air Quality Monitoring Programme (NAMP), covering 12 districts and 14 towns across Assam. Due to the absence of primary air quality data for all subproject districts under SWIFT, secondary data from key locations in Assam have been utilized to establish baseline air quality. Some of the subproject districts fall under the NAMP coverage area, and Table 4-3 summarizes the findings. The analysis reveals that air quality in most towns adheres to the National Ambient Air Quality Standards (NAAQS) for residential areas, though elevated particulate matter (PM) levels are observed in a few towns. Beel sites are expected to exhibit similar air quality trends, given their remote locations away from major pollution sources. Ambient air quality of major cities are summarized below for ready reference.

343. Bongaigaon demonstrates moderate air quality. $SO_2$ and $NO_2$ concentrations are well within permissible limits at 5 µg/m³ and 12 µg/m³, respectively. However, $PM_{10}$ levels at 56 µg/m³ are nearing the limit of 60 µg/m³, and $PM_{2.5}$ stands at 30 µg/m³. While acceptable overall, the particulate matter concentrations indicate potential local pollution sources, necessitating targeted control measures.

344. Brynihat faces critical air quality challenges, with $PM_{10}$ levels at 257 µg/m³ and $PM_{2.5}$ at 108 µg/m³-far exceeding permissible limits. $SO_2$ and $NO_2$ levels remain low at 8 µg/m³ and 16 µg/m³, respectively. The extreme particulate pollution suggests significant industrial emissions and vehicular activity, requiring immediate regulatory action to mitigate health risks.

345. Daranga maintains good air quality, with $SO_2$ at 7 µg/m³, $NO_2$ at 15 µg/m³, and $PM_{10}$ at 41 µg/m³. However, $PM_{2.5}$ data is unavailable, leaving a gap in assessing finer particulate pollution. Based on existing data, the air quality is well within permissible limits, indicating limited industrial or traffic-related emissions.

346. Dibrugarh exhibits favorable air quality, with $SO_2$ at 6 µg/m³, $NO_2$ at 11 µg/m³, $PM_{10}$ at 44 µg/m³, and $PM_{2.5}$ at 22 µg/m³-all well within national standards. The low particulate matter levels reflect effective management of local pollution sources, contributing to overall good air quality.

347. Golaghat follows similar trends to Dibrugarh, with pollutant levels significantly below NAAQS limits: $SO_2$ at 6 µg/m³, $NO_2$ at 11 µg/m³, $PM_{10}$ at 43 µg/m³, and $PM_{2.5}$ at 18 µg/m³. The minimal fine particulate pollution supports better public health outcomes in the region.

348. Guwahati faces challenges in air quality management. While $SO_2$ and $NO_2$ levels are within limits at 12 µg/m³ and 8 µg/m³, $PM_{10}$ and $PM_{2.5}$ levels are alarmingly high at 101 µg/m³ and 53 µg/m³, respectively. Urbanization, vehicular emissions, and construction activities are likely contributors, emphasizing the need for stringent air quality control measures.

349. Magherita exhibits excellent air quality, with $SO_2$ at 5 µg/m³, $NO_2$ at 11 µg/m³, $PM_{10}$ at 39 µg/m³, and $PM_{2.5}$ at 17 µg/m³-all pollutants are well within prescribed limits. The region's geographical characteristics and limited industrial activities contribute to its clean air.

350. Nagaon experiences moderate air pollution, with $PM_{10}$ levels at 83 µg/m³ exceeding the permissible limit. $SO_2$ at 7 µg/m³, $NO_2$ at 15 µg/m³, and $PM_{2.5}$ at 38 µg/m³ are within allowable ranges. Dust from local industries or construction activities likely contributes to elevated particulate matter.

351. Nalbari reports poor air quality, with $PM_{10}$ at 95 µg/m³ and $PM_{2.5}$ at 47 µg/m³, both exceeding national standards. $SO_2$ and $NO_2$ levels remain moderate at 7 µg/m³ and 14 µg/m³, respectively. High particulate pollution necessitates mitigation strategies targeting vehicular emissions, construction, and agricultural practices.

352. Air quality in North Lakhimpur is generally acceptable, with $SO_2$ at 7 µg/m³, $NO_2$ at 15 µg/m³, $PM_{10}$ at 60 µg/m³, and $PM_{2.5}$ at 27 µg/m³. While $PM_{10}$ levels reach the permissible threshold, other pollutants remain within limits, highlighting the need for localized dust control measures.

353. Silcher displays good air quality, with all measured pollutants-$SO_2$ at 7 µg/m³, $NO_2$ at 11 µg/m³, $PM_{10}$ at 45 µg/m³, and $PM_{2.5}$ at 20 µg/m³-well within permissible limits. The clean air reflects minimal industrial or vehicular emissions in the area.

354. Sivasagar enjoys favorable air quality conditions, with $SO_2$ at 5 µg/m³, $NO_2$ at 10 µg/m³, $PM_{10}$ at 38 µg/m³, and $PM_{2.5}$ at 19 µg/m³. These values are comfortably below the NAAQS limits, reflecting low pollution levels, possibly due to effective environmental regulations.

355. Tezpur exhibits moderate air quality, with $PM_{10}$ at 57 µg/m³, nearing the permissible limit. $SO_2$ and $NO_2$ are measured at 6 µg/m³ and 15 µg/m³, while $PM_{2.5}$ stands at 24 µg/m³, all within limits. Addressing dust and emissions could further enhance the town's air quality.

356. Tinsukia reports good air quality, with $SO_2$ at 5 µg/m³, $NO_2$ at 11 µg/m³, $PM_{10}$ at 40 µg/m³, and $PM_{2.5}$ at 17 µg/m³. All pollutants are within safe ranges, suggesting minimal industrial or vehicular pollution in the district.

**Table 4-3. Ambient Air Quality data of Assam (2023).** (Annual Average Concentration of MAAQMS integrated with CAAQMS data from January to December)

| Sl. No. | City/Towns | $SO_2$ (µg/m³) | $NO_2$ (µg/m³) | $PM_{10}$ (µg/m³) | $PM_{2.5}$ (µg/m³) |
|---|---|---|---|---|---|
| 1 | Bongaigaon (2 MAAQMS) | 5.3 | 12.1 | 51 | 24 |
| 2 | Tezpur (1 MAAQMS) | 8.0 | 16.5 | 61 | 32 |
| 3 | Dibrugarh (1 MAAQMS) | 5.7 | 11.5 | 46 | 22 |
| 4 | Golaghat (1 MAAQMS) | 6.0 | 12.1 | 53 | 24 |
| 5 | Margherita (1 MAAQMS) | 5.8 | 11.7 | 55 | 26 |
| 6 | Daranga (1 MAAQMS) | 6.2 | 14.0 | 72 | 35 |
| 7 | Lakhimpur (1 MAAQMS) | 5.3 | 14.5 | 65 | 31 |
| 8 | Guwahati (10 MAAQMS+4 CAAQMS) | 12.9 | 12.3 | 109 | 53 |
| 9 | Nalbari (3 MAAQMS+1 CAAQMS) | 5.8 | 10.6 | 111 | 51 |
| 10 | Nagaon (3 MAAQMS+1 CAAQMS) | 8.5 | 15.6 | 101 | 46 |
| 11 | Sivasagar (3 MAAQMS+1 CAAQMS) | 5.6 | 11.3 | 45 | 22 |
| 12 | Silchar (3 MAAQMS+1 CAAQMS) | 8.5 | 9.8 | 46 | 26 |
| 13 | Tinsukia (3 MAAQMS) | 6.0 | 12.1 | 52 | 25 |
| 14 | Byrnihat (1 MAAQMS+1 CAAQMS) | 21.8 | 24.4 | 270 | 133 |
| **National AAQ Standard for Residential/Commercial Area for Annual Average** | | **50** | **40** | **60** | **40** |

*Source: NAAQ Monitoring Data, 2022*

### Noise Levels

357. In the absence of primary noise data specific to all subproject beel locations, secondary data from IEEs of other ADB-funded projects has been utilized to address the data gaps. Noise monitoring data from 15 representative locations (refer Table 4-4), collected under the Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project across various districts, has been analyzed and compared with the noise standards set by the Central Pollution Control Board (CPCB) and the World Bank. The monitoring covered both day and night periods, focusing on residential, institutional, and commercial areas within the subproject sites.

358. The results indicate that in most locations, observed noise levels during the day ranged between 45 dB(A) and 47 dB(A), while night-time levels were between 40 dB(A) and 42 dB(A). These levels generally comply with the permissible limits specified by the CPCB and the World Bank, which are 55 dB(A) for daytime and 45 dB(A) for night-time in residential and institutional areas.

359. However, certain exceptions were identified, particularly in Nagaon and Tezpur districts. In Silghat, the recorded daytime noise level was 62.5 dB(A), exceeding the CPCB limit of 55 dB(A) for residential areas and the World Bank guideline of 55 dB(A). Similarly, in Jahajghat, the daytime noise level reached 51.3 dB(A), slightly surpassing the acceptable threshold. The elevated noise levels in these locations can be attributed to nearby commercial and industrial activities, such as operations at the Assam Cooperative Jute Mill in Silghat and ferry operations at Jahajghat.

360. The subproject sites are located away from densely populated settlements and major roads. Vehicular noise is not a significant concern, as traffic in the vicinity of the beels is minimal and restricted to occasional vehicles. Therefore, it is reasonable to expect that the noise levels at the beel sites would remain low, consistent with their remote and less disturbed surroundings.

361. A summary of ambient noise levels observed in different districts is presented in Table 4-4 for reference.

**Table 4-4. Ambient Noise level recorded at various districts of Assam**

| Name of the Subproject | Name of the division | Village Name | Geographical Coordinates | Date of Monitoring | Noise Monitoring Result | |
|---|---|---|---|---|---|---|
| | | | | | Leq. (Day) dB(A) | Leq. (Night) dB (A) |
| Dibrugarh, Tinsukia Subproject (Zone-A) | Dibrugarh | Mothila 1st Part | 27°30'36.85''N 94°58'3.28''E | 04-04-23 | 47.5 | 41.6 |
| | Dibrugarh | Maijan Bora Saikia Gaon | 27°29'29.06''N 94°55'0.61''E | 03-04-23 | 46.8 | 42.0 |
| | Tinsukia | 1 No. Kardoiguri | 27°39'5.99''N 95°27'3.15''E | 05-04-23 | 46.8 | 42.1 |
| | Tinsukia | Khamti Guwali | 27°34'2.84''N 95°16'46.16''E | 06-04-23 | 47.3 | 41.8 |
| Morigaon, Nagaon, Tezpur Subproject (Zone-B) | Morigaon | Pavkati Mayong | 26°17'23.81''N 92°5'24.13''E | 29-03-23 | 46.3 | 40.4 |
| | Morigaon | Kasarigaon | 26°18'42.26''N 92°8'31.54''E | 30-03-23 | 45.9 | 41.3 |
| | Nagaon | Silghat Town | 26°36'55.65''N 92°56'10.28''E | 31-03-23 | 62.5* | 51.3* |
| | Tezpur | Jaroni | 26°38'2.52''N 92°40'57.79''E | 1-04-23 | 47.0 | 41.2 |
| | Tezpur | Jahajghat | 26°36'59.45''N 92°47'24.96''E | 2-04-23 | 51.3* | 46.2* |
| Goalpara, Barpeta, Dhubri Zone-D | Goalpara | Balijan | 26°11'3.32''N 90°4'15.01''E | 25-03-23 | 46.9 | 42 |
| | Dhubri | Fakirganj | 26°57'25.02''N 90°4'15.01''E | 26-03-23 | 47.0 | 41.1 |
| | Barpeta | Agmand | 26°14'46.69''N 91°1'19.49''E | 27-03-23 | 46.8 | 41.7 |
| | Barpeta | Chakabausi Gaon | 26°15'16.18''N 91°4'37.30''E | 27-03-23 | 47.4 | 41.2 |
| Guwahati West, Palasbari-Gume Subproject (Zone-C) | Kamrup | Dokhala | 26°7'2.02''N 91°30'48.95''E | 24-03-23 | 47.1 | 41.2 |
| | Kamrup | Panikhaity | 26°9'21.87''N 91°9'39.87''E | 23-03-23 | 46.1 | 40.5 |
| | Palasbari-Gumi | Futuri | 26°7'24.12''N 91°26'40.20''E | 28-03-23 | 47.2 | 41.2 |
| | Guwahati West | Gumi | 26°5'55.60''N 91°20.15.76''E | 29-03-23 | 47.0 | 41.5 |

Source: Climate Resilient Brahmaputra Integrated Flood and Riverbank Erosion Risk Management Project, Assam

## Water Quality

### Water Quality of Rivers

362. Pollution Control Board Assam is presently monitoring the water quality status across the entire state of Assam which includes Rivers, Ponds, Beels, Ground Water under National Water Quality Monitoring Program (NWMP). The State of Assam is drained by a large number of rivers rich in aquatic resources. Most of the important towns of the State are located nearby the rivers. At present the Pollution Control Board, Assam is monitoring water quality at various sampling points, covering key rivers such as the Brahmaputra, Dhansiri, Subansiri, and others, including sampling in the Guwahati area. The parameters assessed include temperature, dissolved oxygen (DO), pH, conductivity,

biological oxygen demand (BOD), nitrate levels, and the presence of fecal and total coliform bacteria. Results of water quality of rivers of Assam (March 2023- March-2024) is presented in **Annexure A19**.

363. The water quality of Assam's rivers presents a diverse scenario, influenced by various natural and anthropogenic factors. The Brahmaputra River, which traverses the state, exhibits variations in water quality at different locations. In Dibrugarh, the water temperature ranges from 19°C to 25°C, with dissolved oxygen (DO) levels between 5 mg/L and 8.7 mg/L, reflecting good oxygenation. The pH values remain near neutral, between 6.8 and 7.6, while biochemical oxygen demand (BOD) levels are low, ranging from 2 to 2.7 mg/L, indicating minimal organic pollution. However, high coliform counts (730-2100 MPN/100ml) point to bacterial contamination, which is a concern for public health. Similarly, at Pandu (Guwahati), higher temperatures (18°C to 30°C) and elevated coliform levels (1500-2100 MPN/100ml) highlight the influence of urbanization on water quality. At Nimatighat, the BOD levels are consistently low, but bacterial contamination persists, reflecting the broader challenges of untreated sewage and agricultural runoff entering the river. Near Jogighopa, the Brahmaputra shows good DO levels, but coliform contamination remains consistently high, emphasizing the need for improved waste management practices.

364. The rivers around Guwahati, such as the Bharalu River, reflect severe pollution. The Bharalu shows extremely low DO levels (0.5-1 mg/L) and high BOD levels (30.6-34 mg/L), indicating significant organic pollution. Total coliform counts are alarmingly high at 5300 MPN/100ml, making this river one of the most polluted in the state. This contamination arises from untreated sewage, industrial effluents, and runoff. In contrast, the Brahmaputra at Chandrapur maintains better water quality with higher DO levels (6.9-10 mg/L) and lower BOD (2-2.6 mg/L), although bacterial contamination remains a concern.

365. The Dhansiri River at Golaghat demonstrates relatively good water quality, with DO levels ranging from 5 to 10.5 mg/L and moderate conductivity (136-172 µS/cm). However, coliform levels remain high (1100-2000 MPN/100ml), posing potential health risks. Similarly, the Subansiri River at Gerukamukh exhibits high DO levels (6.2-10.5 mg/L) and low BOD (2-2.5 mg/L), indicating good overall water quality, but bacterial contamination is a recurring issue with total coliform counts reaching 2100 MPN/100ml.

366. Other rivers across Assam display varying water quality parameters. For instance, the Kolong River at Marigaon shows moderate DO levels (5-7.5 mg/L) and low BOD (2-2.5 mg/L), with moderate bacterial contamination (2000 MPN/100ml). The Manas River at Barpeta has DO levels ranging from 5.1 to 5.5 mg/L and a pH between 6.9 and 7.7, but fecal coliform counts of 1100 MPN/100ml indicate bacterial pollution. The Burhidihing River near Margherita displays moderate water quality with DO levels between 5.2 and 8.9 mg/L, although total coliform counts are slightly elevated (910-1600 MPN/100ml). Similarly, the Disang River at Gudamghat has moderate DO levels and low BOD, but contamination persists, with fecal and total coliform counts peaking at 2300 MPN/100ml.

367. Overall, while many rivers in Assam maintain acceptable levels of DO and BOD, indicating adequate oxygenation and low organic pollution, the consistently high levels of coliform bacteria across various locations highlight the widespread issue of bacterial contamination. The contamination is primarily attributed to untreated sewage, agricultural runoff, and other human activities. Addressing these challenges through improved waste management, enhanced sewage treatment, and stricter pollution control measures is essential for safeguarding water quality and public health in the region.

**Water Quality of Beels**

368. The water quality assessment for 15 beels across five zones in Assam was undertaken as part of the ADB-funded SWIFT Project. M/s Advanced Environmental Testing and Research Lab (AETRL) conducted detailed field investigations and laboratory analyses during August and September 2024. A total of 25 water quality parameters were analyzed, with pH, DO, and conductivity measured on-site,

and the remaining parameters analyzed in the laboratory. The pH values ranged from 6.3 to 7.8, averaging at 6.9, indicating slightly acidic conditions, likely influenced by the organic matter richness of the wetlands. Secchi depth, an indicator of water clarity, ranged from 0 to 1.5 meters, with an average of 0.7 meters. These values align with the characteristics of hyper-eutrophic systems, which typically exhibit transparency values of ≤1.5 meters and ≤0.7 meters as maximum and minimum thresholds, respectively. This suggests that the beels are highly productive ecosystems, although water hyacinth overgrowth contributes to a shallow euphotic zone, potentially disrupting limnological balance and fish diversity.

369. Surface water DO levels ranged from 6.2 to 7.8 mg/L, consistently exceeding the Class C water standard of 5.0 mg/L, indicating adequate oxygenation. However, BOD values ranged between 2.5–3.9 mg/L, slightly surpassing the inland surface water threshold of 3 mg/L, indicating moderate organic pollution. COD ranged from 6.5 to 10.2 mg/L, and total nitrogen levels were relatively high, ranging from 2.1 to 5.2 mg/L. Nitrate concentrations varied between 0.5 and 3.2 mg/L. Elevated inorganic phosphate levels, ranging from 0.02 to 0.65 mg/L (exceeding the U.S. EPA eutrophic condition threshold of 0.035 mg/L), further highlight the risk of nutrient enrichment. Coliform bacteria count, although present, remained within safe limits, with total coliforms at 2290–2900 MPN/100 mL and fecal coliforms at 1060–1610 MPN/100 mL, both below the Class C standard.

370. Sediment analysis revealed Total Organic Carbon (TOC) content between 0.8% and 1.3%, reflecting varying organic matter levels across the beels. Sediment phosphorus levels ranged from 30.6 to 56.1 kg/ha, suggesting differential nutrient inputs, likely influenced by agricultural runoff. Nitrogen levels ranged from 483 to 604.8 kg/ha, impacting primary productivity and increasing the risk of eutrophication. Heavy metals, including arsenic, lead, manganese, and zinc, were generally within safe limits, although localized variability was noted. These findings provide valuable insights into the water and sediment quality of Assam's beels, emphasizing the need for integrated nutrient and vegetation management to sustain their ecological health. Detailed Beel quality assessment report is provided in **Annexure A20**.

**Groundwater Quality**

The State Groundwater Quality Report of Assam (2023) highlights the overall suitability of groundwater for irrigation, based on parameters like Sodium Adsorption Ratio (SAR), sodium percentage (Na%), and Residual Sodium Carbonate (RSC). Most groundwater samples analyzed were deemed suitable for irrigation across various soil types, with minimal risk of harmful levels of exchangeable sodium in specific cases. However, several samples exceeded the Bureau of Indian Standards (BIS) permissible limits for drinking water, particularly concerning iron and manganese levels. Arsenic contamination was detected in isolated cases, such as in Morigaon district. Elevated manganese levels in pre-monsoon samples were likely caused by the dissolution of lithogenic and non-lithogenic materials by infiltrating water. A decreasing trend in fluoride levels was observed, while no discernible trend was noted for nitrate and total hardness. Immediate development of sustainable, cost-effective remediation technologies is necessary to mitigate the health impacts of fluoride and other trace elements, ensuring long-term access to safe drinking water.

**Groundwater Quality of Subproject Districts of Assam[40]**

371. **Bongaigaon.** Groundwater quality in Bongaigaon exhibits high Total Dissolved Solids (TDS) levels, peaking at 534.70 µS/cm, particularly in areas such as Manikpur. The elevated TDS may be attributed to the underlying geology and mineral dissolution during groundwater recharge. Iron levels vary significantly between 0.91 to 2.27 ppm, likely due to iron-rich sediments and geological formations in the area. Fluoride concentrations are within permissible limits (0.22 ppm), indicating the absence of

[40] Source: State Groundwater Quality Report of Assam (2023)

significant fluoride-bearing minerals or anthropogenic sources. Localized high hardness in areas like North Salmara is consistent with the dissolution of calcium and magnesium-rich minerals from aquifer materials.

372. **Dhemaji.** Groundwater in Dhemaji is notably characterized by iron contamination, with concentrations ranging from 0.07 to 1.02 ppm. This can be attributed to the region's sedimentary aquifers, which are rich in iron-bearing minerals. Low EC) values, between 55.90 µS/cm and 213.10 µS/cm, suggest minimal salinity and a lack of significant mineralization, likely due to the rapid recharge of aquifers from abundant rainfall and the proximity of rivers.

373. **Dhubri.** In Dhubri, EC values range between 110.90 to 344.50 µS/cm, reflecting moderate levels of mineral content in the groundwater. The relatively stable iron concentrations (0.61–0.66 ppm) align with the natural geochemistry of the region's aquifers. The absence of significant arsenic and fluoride levels suggests that these contaminants are not prevalent in the geological formations or recharge zones.

374. **Goalpara.** Although specific data for Goalpara is unavailable, regional trends indicate the presence of elevated iron levels and moderate TDS. These characteristics are consistent with the region's alluvial aquifers and sedimentary deposits, which contribute to iron-rich groundwater. The geology and hydrology of the area suggest localized variation in groundwater quality due to differences in aquifer composition and recharge rates.

375. **Jorhat.** Groundwater in Jorhat displays moderate to high mineralization, with EC values reaching 1030 µS/cm. The iron concentrations, ranging from 0.09 to 0.56 ppm, are influenced by iron-bearing minerals in the sedimentary aquifers. Low fluoride levels (0.20 ppm) suggest limited interaction with fluoride-bearing geological formations. The groundwater's quality is reflective of the area's sedimentary rock composition and recharge processes.

376. **Sribhumi.** The district exhibits notably high iron concentrations, reaching up to 27.60 ppm. This extreme variability in iron content can be attributed to the dissolution of iron-rich minerals in the region's sedimentary aquifers and prolonged contact time with groundwater. EC values of up to 613.80 µS/cm indicate moderate mineralization. The low fluoride content (0.21 ppm) reflects the limited presence of fluoride-rich geological formations.

377. **Lakhimpur.** In Lakhimpur, groundwater quality varies significantly, with EC values ranging from 50.81 µS/cm to 458.80 µS/cm. The iron concentration, spanning from 0.10 to 5.78 ppm, is influenced by the region's sedimentary deposits. Localized arsenic presence, up to 2.79 ppb, may originate from the natural leaching of arsenic-bearing minerals in the alluvial sediments.

378. **Majuli**. While specific groundwater data for Majuli is unavailable, the region's unique geomorphology as a riverine island suggests variability in groundwater quality. Iron and arsenic contamination are likely influenced by alluvial sediments deposited by the Brahmaputra River, while EC and TDS levels may exhibit localized variation based on the depth and composition of aquifers.

379. **Morigaon**. Groundwater in Morigaon displays significant iron content, with levels reaching 4.49 ppm. This is consistent with the dissolution of iron-rich minerals in the alluvial aquifers. EC values range from 82.32 to 654.40 µS/cm, reflecting moderate mineralization. Arsenic presence of up to 11.53 ppb is likely due to natural geochemical processes in the sedimentary aquifers.

380. **Nagaon**. In Nagaon, EC values range from 151.70 µS/cm to 1167.00 µS/cm, reflecting variability in groundwater mineralization. Iron concentrations (0.03–1.85 ppm) align with the natural geochemistry of the aquifers. The arsenic levels, reaching up to 4.89 ppb, suggest localized geogenic sources in the alluvial sediments.

381. **Sivasagar.** Groundwater in Sivasagar exhibits moderate mineralization, with EC values ranging from 346.80 to 975.60 µS/cm. Iron levels (0.85 ppm) are consistent with the region's sedimentary aquifers, while arsenic contamination remains minimal (up to 0.48 ppb). The groundwater composition reflects the natural interaction of water with sedimentary rocks and recharge from surface sources.

382. **Tinsukia**. District's groundwater quality is characterized by EC values ranging from 39.09 to 253.60 µS/cm, indicating low to moderate mineralization. Iron concentrations vary from 0.01 to 5.06 ppm, influenced by the region's sedimentary aquifers. The absence of significant arsenic contamination reflects the limited presence of arsenic-bearing minerals in the aquifer system.

383. **Barpeta.** The groundwater in Barpeta shows pH values ranging from 7.08 to 7.65, indicating neutral to slightly alkaline water. Electrical conductivity (EC) ranges from 149.10 µS/cm to 537.40 µS/cm, reflecting moderate mineral content. Total Dissolved Solids (TDS) levels are between 92.44 mg/L and 333.19 mg/L, well within the permissible limit of 500 mg/L. Chloride and sulfate levels are low, ranging from 5.06 mg/L to 21.27 mg/L and 1.26 mg/L to 12.64 mg/L, respectively, indicating no significant contamination. Total hardness (TH) varies between 60.00 mg/L and 245.00 mg/L, classifying the water as soft to moderately hard. Alkalinity (HCO3 and TA) and other cations, such as calcium ($Ca^{2+}$) and magnesium ($Mg^{2+}$), are within safe limits. Iron (Fe) levels range from 0.26 ppm to 5.39 ppm, with some areas exceeding the permissible limit of 1.0 ppm, indicating potential iron contamination. Arsenic (As) ranges from 0.13 ppb to 7.17 ppb, remaining within safe drinking water standards (10 ppb). Uranium (U) varies between 0.35 ppb and 0.88 ppb, significantly below the safe limit of 30 ppb. Manganese (Mn) concentrations range from 0.50 ppm to 0.60 ppm, mostly within the permissible limit of 0.3 ppm but with slight exceedance. Copper (Cu) levels (0.06–0.09 ppm) and Zinc (Zn) concentrations (0.19–0.95 ppm) are well within safe limits.

384. **Biswanth.** In Biswanath, groundwater quality is slightly more mineralized, with EC values ranging from 149.80 µS/cm to 612.00 µS/cm and TDS levels from 92.88 mg/L to 379.44 mg/L. The pH remains neutral to slightly alkaline, ranging from 6.75 to 7.65. Major ions, including chloride (14.18–74.45 mg/L) and sulfate (1.31–24.46 mg/L), are within permissible limits, with no evidence of significant contamination. Hardness levels (TH) range from 45.00 mg/L to 160.00 mg/L, making the water soft to moderately hard. Sodium (Na) and potassium (K) concentrations are also low, between 54.77 mg/L and 22.60 mg/L, respectively. Biswanath's groundwater remains safe for drinking and irrigation purposes despite its slightly higher EC and TDS values compared to other districts. Iron (Fe) levels range from 0.59 ppm to 1.56 ppm, occasionally exceeding the permissible limit. Arsenic (As) varies between 0.08 ppb and 0.43 ppb, well within the safe drinking limit. Uranium (U) concentrations range from 0.18 ppb to 0.35 ppb, far below the permissible limit. Manganese (Mn) levels (0.49–2.67 ppm) often exceed the limit of 0.3 ppm. Copper (Cu) concentrations (0.03–0.07 ppm) and Zinc (Zn) levels (0.90–1.12 ppm) remain safe

385. **Kamrup**. The groundwater quality in Kamrup district is generally good, with pH levels ranging from neutral to slightly alkaline (7.38–8.42). Most parameters, including chloride, sulfate, nitrate, and fluoride, remain well within permissible limits, ensuring safety for drinking and domestic use. TDS and EC show moderate to slightly elevated levels (93.43–665.26 mg/L and 150.70–1073.00 µS/cm, respectively), with localized areas of higher salinity. Hardness varies from soft to hard (50.00–485.00 mg/L), while calcium, magnesium, sodium, and potassium concentrations are within safe limits. In Kamrup, iron (Fe) levels range from 0.41 ppm to 10.69 ppm, with significant exceedances of the permissible limit (1.0 ppm) in many areas, indicating iron contamination. Arsenic (As) varies between 0.14 ppb and 7.81 ppb, remaining within the safe drinking water standard of 10 ppb. Uranium (U) concentrations are between 0.08 ppb and 1.63 ppb, which is far below the permissible limit of 30 ppb. Manganese (Mn) levels range from 0.04 ppm to 4.25 ppm, often exceeding the safe threshold of 0.3 ppm, signaling localized contamination. Copper (Cu) concentrations (0.01–0.06 ppm) are well within

acceptable limits, while zinc (Zn) levels range from 0.26 ppm to 0.97 ppm, also within safe limits.

386. **Golaghat.** The pH typically remains within neutral to slightly alkaline limits. TDS and EC values, along with hardness and ion concentrations, are generally within permissible limits, supporting its suitability for drinking and agricultural use.

387. **Kokrajhar.** Water quality monitoring at Kokrajhar Town indicates pH values ranging from 6.9 to 7.7, suggesting neutral to slightly alkaline conditions. Electrical conductivity varied between 342 and 348 µmho/cm, reflecting moderate mineralization of water. Biochemical Oxygen Demand (BOD) values ranged from 2.4 to 2.5 mg/L, indicating relatively low organic pollution. Nitrate-N concentrations varied from 0.8 to 1.0 mg/L, remaining well within acceptable limits. Overall, the water quality is suitable for most uses, with no significant indications of nutrient enrichment or organic contamination.

388. **Nalbari.** In Nalbari Town, pH values ranged between 7.0 and 7.2, indicating neutral water conditions. Electrical conductivity varied from 340 to 344 µmho/cm, suggesting moderate dissolved mineral content. BOD levels ranged from 2.5 to 2.6 mg/L, reflecting low organic pollution. Nitrate-N concentrations ranged from 0.9 to 2.5 mg/L, with higher values observed during the post-monsoon period. Despite this seasonal variation, nitrate levels remain within acceptable limits, indicating generally good water quality.

389. **Sonitpur.** Water quality data from Mission Charali, Tezpur and Dhekiajuli Town indicate pH values ranging from 6.8 to 7.8, reflecting neutral to slightly alkaline conditions. Electrical conductivity varied between 210 and 284 µmho/cm at Dhekiajuli and remained around 280 µmho/cm at Mission Charali, indicating low to moderate mineralization. BOD concentrations ranged from 2.1 to 2.6 mg/L, suggesting limited organic pollution. Nitrate-N levels varied between 0.7 and 1.4 mg/L, remaining within acceptable limits and indicating good overall water quality.

390. **Darrang.** Water quality monitoring at Mangaldoi Town shows pH values ranging from 6.8 to 7.0, indicating near-neutral conditions. Electrical conductivity exhibited considerable seasonal variation, ranging from 196 to 360 µmho/cm. BOD values remained low, between 2.1 and 2.2 mg/L, suggesting minimal organic contamination. Nitrate-N concentrations ranged from 0.9 to 1.2 mg/L, remaining within permissible limits. Overall, the monitored parameters indicate satisfactory water quality conditions.

## 4.3. Biological Environment

### Forest

391. Assam, a state located in the northeastern region of India, is renowned for its rich biodiversity and vast forest cover. The recorded forest area in Assam is 26,832 square kilometers, which accounts for 34.21% of its total geographical area of 78,438 square kilometers. The state’s forest landscape is diverse, comprising various types of forests that contribute significantly to the ecological balance and economy of the region.

392. The forests of Assam are categorized into different types based on their legal status. Reserved Forests make up 66.58% of the total forest area, while Unclassed Forests constitute the remaining 33.42%. These forests are a vital part of Assam's ecosystem, providing habitats for numerous species of flora and fauna, including the world-famous one-horned rhinoceros. Type of forest cover of Assam is summarized in Table 4-5.

393. Assam’s forests are classified into five major forest type groups according to the Champion and Seth Classification: Tropical Wet Evergreen, Tropical Semi-Evergreen, Tropical Moist Deciduous, Tropical Dry Deciduous, and Sub-Tropical Pine Forests. These diverse forest types are spread across

the state's three distinct topographical regions: the Brahmaputra Valley, the Surma Valley, and the Assam Ranges.

394. According to the latest assessment using satellite data from November 2017 to February 2018, Assam's forest cover is 28,326.51 square kilometers, which is 36.11% of the state's total geographical area. This includes 2,794.86 square kilometers of Very Dense Forest (VDF), 10,278.91 square kilometers of Moderately Dense Forest (MDF), and 15,252.74 square kilometers of Open Forest (OF). Additionally, there is a small area of scrubland covering 173.43 square kilometers.
The protected areas in Assam play a crucial role in conserving its rich biodiversity. The state has established seven National Parks and eighteen Wildlife Sanctuaries, covering an area of 4,938.53 square kilometers. These protected areas serve as safe havens for endangered species and are essential for the preservation of Assam's unique ecological heritage[41].

395. Forests in Assam not only provide a habitat for wildlife but also support local communities by supplying a variety of forest products, including timber, fuelwood, bamboo, and traditional medicines. However, the forests are under constant threat from biotic pressures and over-extraction, which have significant impacts on their physical and ecological integrity.

**Table 4-5. Forest Cover of the Assam**

| Class of Forests | Area (sq. km.) |
|---|---|
| **Reserved Forests** | **17864** |
| **Protected Forests** | **26832** |
| **National Parks (including proposed)** | **2865.07** |
| **Wildlife Sanctuary (including proposed)** | **1729.91** |
| **Non-Forest Land transferred to the Department and Exchanged lands** | **8972** |
| **Sub-total** | **28311.51** |

396. Details of district wise forest cover in Assam is presented in Table 4-6 which provides a comprehensive overview of forest cover across the districts of Assam, revealing both the extent and distribution of forested areas. Assam's total geographical area is 78,438 square kilometers, with a total forest cover of 28,326.51 square kilometers, which constitutes 36.11% of the state's area. Among the districts, Dima Hasao stands out with the highest proportion of its area covered by forests, at an impressive 86.07%, translating to 4,206.93 square kilometers of forested land. This is in stark contrast to Barpeta and Dhubri, which have the lowest forest cover percentages at 5.05% and 4.52%, respectively. Cachar has the largest forest area, with 2,222.34 square kilometers, reflecting a significant forest presence but a lower percentage (58.7%) compared to Dima Hasao. Other districts such as Karbi-Anglong and Hailakandi also feature extensive forest cover, with Karbi-Anglong covering 7,889.18 square kilometers (75.61% of its area) and Hailakandi 774.34 square kilometers (58.35% of its area). In contrast, districts like Darrang and Nalbari show relatively modest forest cover, covering only 5.64% and 10.18% of their areas, respectively. This distribution highlights significant regional variations in forest coverage within Assam, illustrating areas with abundant forest resources as well as those with relatively limited forest presence.

[41] *https://environmentandforest.assam.gov.in/information-services/forest-types-in-assam-0*

**Table 4-6.Details of district wise forest cover in Assam State[42.]**

| District | Geographical Area (GA) | 2019 Assessment | | | | % of GA | Change wrt 2017 assessment | Scrub |
|---|---|---|---|---|---|---|---|---|
| | | Very Dense Forest | Mod. Dense Forest | Open Forest | Total | | | |
| Baksa | 2.457 | 156.00 | 130.01 | 273.66 | 559.67 | 22.78 | 3.67 | 6.00 |
| Barpeta | 2.282 | 0.00 | 33.21 | 81.97 | 115.18 | 5.05 | 10.18 | 1.00 |
| Bongaigaon | 1.093 | 0.00 | 62.18 | 187.95 | 250.13 | 22.88 | 14.13 | 0.00 |
| Cachar | 3.786 | 93.00 | 1,077.58 | 1,051.76 | 2,222.34 | 58.70 | -0.66 | 17.45 |
| Chirang | 1.923 | 402.00 | 110.45 | 187.39 | 699.84 | 36.39 | 5.84 | 3.00 |
| Darrang | 1.585 | 0.00 | 13.89 | 75.54 | 89.43 | 5.64 | 3.43 | 1.00 |
| Dhemaji | 3.237 | 68.00 | 124.66 | 152.14 | 344.80 | 10.65 | 6.80 | 4.00 |
| Dhubri | 2.176 | 1.00 | 22.44 | 75.02 | 98.46 | 4.52 | 8.46 | 4.00 |
| Dibrugarh | 3.381 | 105.86 | 68.10 | 581.27 | 755.23 | 22.34 | -1.77 | 1.00 |
| Dima Hasao | 4.888 | 209.00 | 1,519.73 | 2,478.20 | 4,206.93 | 86.07 | -3.07 | 4.00 |
| Goalpara | 1.824 | 14.00 | 137.66 | 244.08 | 395.74 | 21.70 | 97.74 | 1.72 |
| Golaghat | 3.502 | 21.00 | 119.30 | 529.61 | 669.91 | 19.12 | 18.91 | 4.00 |
| Hailakandi | 1.327 | 13.00 | 366.04 | 395.30 | 774.34 | 58.35 | 1.34 | 1.48 |
| Jorhat | 2.851 | 12.00 | 103.00 | 445.10 | 560.10 | 19.65 | 6.10 | 4.00 |
| Kamrup | 3.105 | 50.00 | 455.95 | 457.52 | 963.47 | 31.03 | 44.47 | 3.00 |
| Kamrup Metro | 955 | 0.00 | 225.00 | 235.05 | 460.05 | 48.17 | 0.05 | 1.00 |
| Karbi-Anglong | 10.434 | 583.93 | 3,766.62 | 3,538.63 | 7,889.18 | 75.61 | -93.82 | 84.38 |
| Sribhumi | 1.809 | 3.00 | 300.23 | 548.20 | 851.43 | 47.07 | 35.43 | 0.76 |
| Kokrajhar | 3.296 | 438.00 | 270.19 | 458.38 | 1,166.57 | 35.39 | 8.57 | 1.00 |
| Lakhimpur | 2.277 | 29.00 | 85.88 | 191.69 | 306.57 | 13.46 | 11.57 | 0.96 |
| Morigaon | 1.551 | 10.00 | 42.00 | 122.11 | 174.11 | 11.23 | 0.11 | 4.00 |
| Naogaon | 3.973 | 50.00 | 363.00 | 498.26 | 911.26 | 22.94 | 1.26 | 9.00 |
| Nalbari | 1.052 | 0.00 | 30.84 | 76.27 | 107.11 | 10.18 | 13.11 | 0.00 |
| Sibsagar | 2.668 | 9.00 | 152.83 | 528.13 | 689.96 | 25.86 | 1.96 | 2.40 |
| Sonitpur | 5.204 | 108.97 | 257.53 | 703.11 | 1,069.61 | 20.55 | 14.61 | 3.38 |
| Tinsukia | 3.790 | 410.10 | 353.92 | 818.55 | 1,582.57 | 41.76 | 3.57 | 9.90 |
| Udalguri | 2.012 | 8.00 | 86.67 | 317.85 | 412.52 | 20.50 | 9.52 | 1.00 |
| **Grand Total** | **78.438** | **2,794.86** | **10,278.91** | **15,252.74** | **28,326.51** | **36.11** | **221.51** | **173.43** |

397. The table 4-6 highlights the forest distribution across Assam's districts, emphasizing significant regional variations in forest cover. The state, with a total geographical area of 78,438 square kilometers, has a forest cover of 28,326.51 square kilometers, constituting 36.11% of its area. Among the districts, Dima Hasao records the highest forest coverage at 86.07%, translating to 4,206.93 square kilometers, while Barpeta and Dhubri exhibit the lowest coverage, at 5.05% and 4.52%, respectively. Notably, Cachar has the largest forested area (2,222.34 square kilometers), contributing 58.7% of its geographical area. Districts like Karbi-Anglong and Hailakandi also display extensive forest coverage, with percentages of 75.61% and 58.35%, respectively. Conversely, regions such as Nalbari and

[42] *environmentandforest.assam.gov.in, forest.assam.gov.in*

Darrang show minimal forest presence, highlighting disparities in forest resource distribution across the state.

**Tree cover losses**

398. From 2001 to 2023, Assam lost 324 kha of tree cover, equivalent to a 12% decrease in tree cover since 2000, and 152 Mt of $CO_2e$ emissions. In Assam, the top 2 regions (Karbi Anglong and Dima Hasao) were responsible for 62% of all tree cover loss between 2001 and 2023. Karbi Anglong had the most tree cover loss at 119 kha compared to an average of 12.0 kha.[43] Without forest cover, rainfall results in more surface runoff, which carries away topsoil and nutrients. This not only depletes fertile land but also increases sedimentation in rivers and water bodies. Sedimentation can reduce the storage capacity of water bodies and disrupt the natural flow of rivers. Assam Forest Department has been working to address these challenges through various conservation and reforestation initiatives. However, the persistent loss of forest cover underscores the need for enhanced efforts to protect and restore Assam's forests. Year wide loss of tree cover is presented in Figure 4-9.




**Figure 4-9. Year wide loss of tree cover in Assam**

**Forest Types and Their Significance in Assam**

399. The Tropical Wet Evergreen Forests of Assam, located primarily in districts such as Golaghat, Jorhat, Sibsagar, Tinsukia, Dibrugarh, and parts of Lakhimpur and Dhemaji along foothills, represent some of the most biodiverse ecosystems in the region. These forests are also found in the southern state areas like the Borail Range and in reserve forests such as Loharbund, Sonai, Longai, and Dholia in Cachar and Sribhumi. The predominant species in these forests is Hollong (*Dipterocarpus macrocarpus*), which is the tallest tree in Assam and also its state tree. Hollong is accompanied by species such as Borpat, Jutuli, Sam, Dewa Sam, Nahar, Teeta Chap, Bhelu, and Mekai. In Southern Assam, species like *Dipterocarpus terbinatus* (Garjan) coexist with *Mesua ferrea* (Nahar), *Mesua floribunda* (Bolong), *Michelia glabra* (Champ), and *Palaquium polyanthum* (Kathalua).

400. The Tropical Semi-Evergreen Forests are distributed across several reserve forests, including Hallangapar, Abhoypur, Dilli, Dhansiri, Kholahat, and many others in the northern and southern parts of Assam. These forests contain medium to large-sized trees, complemented by shrubs, lianas, climbers, orchids, and ferns. Bamboo and cane species are commonly found along forest fringes. Frequently occurring species include *Actinodaphne obovata* (Petarichawa), *Aesculus* species (Ramanbih), *Artocarpus chama* (Sam), *Albizia* species (Siris, Sau, Koroi), and *Dillenia indica* (Outenga), among others.

401. Moist Deciduous Forests in Assam are categorized into Sal Forests and Mixed Deciduous Forests. Sal Forests dominate regions like Nagaon, Morigaon, Kamrup, and parts of Nalbari, Barpeta,

[43] Assam, India Deforestation Rates & Statistics | GFW

Dhubri, and Goalpara. Key species in these forests include Sal (*Shorea robusta*), *Lagerstroemia* species (Jarul, Ajar), *Schima wallichii* (Ghugra), and various *Ficus* species. Mixed Deciduous Forests, on the other hand, are located at the foothills of Lakhimpur, Dhemaji, Karbi-Anglong, and North Cachar Hills, featuring a mix of deciduous and evergreen species like *Adina cordifolia* (Haldu), *Alstonia scholaris* (Satiana), and *Dalbergia* species (Sissoo, Medelua).

402. Subtropical Broadleaf Hill Forests and Subtropical Pine Forests are confined to Karbi-Anglong and North Cachar Hills, with species like *Alseodaphne petiolaris*, *Antidesma bunius*, and *Betula alnoides*. In higher altitudes, pure stands of Khasi pine (*Pinus kesiya*) dominate, particularly in Hamren subdivision of Karbi-Anglong.

403. Assam's Grasslands and Savannahs are essential for wildlife conservation and are primarily found in protected areas like Kaziranga National Park, Pobitora, and Manas National Park. Dominant grasses include *Apluda mutica*, *Phragmatis karka*, and *Saccharum* species, which can grow up to 6 meters during the monsoon season.

404. Littoral and Swamp Forests in Assam have largely diminished due to biotic pressures, leaving behind sedges and grasses as the predominant vegetation. Key species include *Ageratum conyzoides*, *Alocasia* species, and *Bombax* species.

405. Orchids are another highlight of Assam's flora, with 293 species representing 44.39% of Northeast India's orchid diversity. Genera like *Dendrobium*, *Cymbidium*, and *Coelogyne* thrive in evergreen and semi-evergreen forests, while aquatic species like *Goodyera procera* add to the diversity. Bamboo species are equally significant, with 38 naturally occurring varieties such as *Bambusa balcooa* and *Dendrocalamus hamiltonii*. Assam also hosts 14 species of cane, and several endemic plants are used for traditional medicine.

406. The information is referenced from Assam Biodiversity Board data and iNaturalist website for the State of Assam.[44] There are many species referenced in this platform as observed in the State (see the sample photographs below). Among the floral species, Table 4-7 shows threatened plants found in the Assam. However, none of these were recorded at any of the project sites.

**Table 4-7. Some of the important threatened plant species of Assam**

| Species | IUCN Status |
|---|---|
| *Vatica lanceaefolia* | CR |
| *Aquilaria Malaccensi* | *CR* |
| *Oroxylum indicum* | *CR* |
| *Mesua assamica* | *EN* |
| *Paphiopedilium spicerianum* | *EN* |
| *Rauvolfia serpentina* | *EN* |
| *Cycas pectinate* | *VU* |
| *Diptero carpus retusus* | *VU* |

Source: Assam Biodiversity Board and other Reference data

[44] With the intention of connecting people with nature, iNaturalist defines itself as "an online social network of people sharing biodiversity information to help each other learn about nature." iNaturalist is a platform for science and conservation initiatives, providing valuable open data to land managers, research projects, other organisations, and the general public, despite not being a science project in and of itself.



a. *Mesua assamica* (EN) Kosterm., commonly known as "Sia- Nahar" in Assamese is an evergreen tree belonging to family Calophyllaceae [45]



b. *Paphiopedilum spicerianum* (EN), a flowering orchid species, is listed under Appendix I of the Convention on International Trade in Endangered Species[46]



c. *Vatica lanceaefolia* (CR) It is a critically endangered species threatened by habitat loss. Vatica species are trees or shrubs, with irregular crown, and sympodial branches [47]

**Endemic Flora**

407. Assam is home to 165 recorded plant species that are restricted in distribution to specific pockets within the state. Among these, approximately 100 species are endemic to Assam and do not naturally occur elsewhere in India. Some of these species have faced extended threats of habitat destruction in the northeastern region and other parts of India.

408. The endemic plant species of Assam include trees such as *Acacia gageana*, *Adiantum assamicum*, *Alseodaphne andersonii*, *Alseodaphne khasyana*, and *Angiopteris assamica*. Other notable species include *Cedrela febrifuga*, *Cinnamomum cacharensis*, *Coelogyne assamica*, *Combretum wallichii*, *Dinochloa indica*, *Diospyros cacharensis*, and *Dipterocarpus mannii*. Additionally, *Eugenia cyanophylla* adds to the diversity of tree species.

409. Assam's biodiversity also includes unique bamboo species such as *Bambusa cacharensis*, *Bambusa mastersii*, and *Chimonobambusa griffithiana*. These bamboos are integral to the socio-economic fabric of Assam and contribute significantly to the local ecosystems.

410. The state is also renowned for its rich orchid diversity, which includes species like *Bulbophyllum elassonotum*, *Bulbophyllum vireus*, and *Dendrobium assamicum*. These orchids are a critical part of Assam's floral richness, thriving in the state's unique climatic and ecological conditions.



*Angiopteris assamica*



*Plectomia assamica*



*Combretum wallichii*

[45] Source: https://indiabiodiversity.org/species/show/246483
[46] Source: https://indiabiodiversity.org/species/show/244276/
[47] Source: *Vatica lanceifolia (Roxb.) Blume | Species*



*Cycas pectinata*



*Paphiopedilium spicerianum*



*Vatica lanceaefolia*

**Figure 4-10.Sample photographs of endemic plants found in the State[48]**

**Fauna**

411. Assam occupies a unique transitional zone connecting the Indian, Indo-Malayan, and Indo-Chinese biogeographical regions. This strategic position, coupled with a favorable climate, diverse topography, and fertile soils, supports a rich variety of plant and animal communities. Dense Wet Evergreen and Semi-Evergreen forests, Moist Deciduous woodlands, Wet Savannahs, and an extensive network of rivers, swamps, and wetlands create a wide range of habitats. These ecosystems are home to mammals, primates, reptiles, amphibians, fish, mollusks, birds, butterflies, and moths, making Assam a crucial gateway for the spread of both Oriental and Palaearctic fauna across India.

412. Assam boasts over 180 species of mammals, including globally significant species such as the one-horned rhinoceros (*Rhinoceros unicornis*), royal Bengal tiger (*Panthera tigris tigris*), golden langur (*Trachypithecus geei*), and hoolock gibbon (*Hoolock hoolock*), India's only ape. Some species, like the clawless otter (*Aonyx cinereus*), spotted deer (*Axis axis*), swamp deer (*Rucervus duvaucelii*), and hispid hare (*Caprolagus hispidus*), find the northernmost extent of their range in Assam's plains. The state also supports Indo-Chinese species such as the clouded leopard (*Neofelis nebulosa*), marbled cat (*Pardofelis marmorata*), and Asiatic golden cat (*Catopuma temminckii*).

413. The state is a haven for primates, with all species native to the Northeast present, including 9 of India's 15 primate species. Notable primates include the golden langur (locally called "Sonali Bandar"), capped monkey (*Macaca arctoides*), rhesus macaque (*Macaca mulatta*), and pig-tailed macaque (*Macaca nemestrina*). The golden langur is geographically restricted to a specific area bounded by the Sankosh River to the west, Manas River to the east, the Brahmaputra River to the south, and the Bhutan mountains to the north. Other species, like the Assamese macaque (*Macaca assamensis*) and rhesus macaque, are widespread and even adapt to urban areas.

414. Recognized as one of the world's "endemic bird areas," Assam is home to 950 bird species, accounting for over half of the species found in the Indian subcontinent. Endemic birds include the Manipur Bush Quail, Marsh Babbler, and Blyth's Tragopan. Reptiles are equally diverse, with 19 species of tortoises, 77 species of snakes and lizards, and the endangered Gangetic gharial (*Gavialis gangeticus*). Amphibians are also well-represented, with 70 species, including two endemic ones: *Gangenophis fulleri* and *Ichthyphis garoensis*.

415. The Brahmaputra and B. River systems, with their extensive floodplain wetlands known as beels, make Assam one of the world's hotspots for freshwater fish biodiversity. Of the 197 food, sport, and ornamental fish species reported from the region, 185 are found in Assam. These include ornamental species like *Colisa*, *Danio*, and *Botia*, as well as commercially valuable fish such as Rohu, Katla, and Chital. Overexploitation, however, has endangered 25 fish species. The river systems also support 39 species of freshwater mollusks, 10 of which are consumed as food.

[48] India Biodiversity Portal

416. Sample visuals of Assam's threatened fauna is depicted in below. This highlights the ecological significance of Assam's biodiversity and underscores the need for conservation efforts.



a. Indian rhinoceros (*Rhinoceros unicornis*), also called the greater one-horned rhinoceros is second in size, among Asian land mammals, only to the Asian elephant. They are solitary creatures and has no natural enemies, except for tigers. Poaching is the number one cause for their decline.[49]



b. Golden Langurs (*Trachypithecus geei*) is endangered species found in assam that are named after the colour of their fur. The fur colour ranges from dark golden to creamy buff. [50]



The clouded leopard *(Neofelis nebulosa)* is a wild cat inhabiting dense forests from the foothills of the Himalayas through mainland Southeast Asia.[51]



The Gangetic dolphin *(Platanista gangetica gangetica)* is an endangered small sized aquatic mammal that is about 2.6 m in length and pale blue to dark grey in colour found in the rivers Brahmaputra, Ganges, Hoogley Karnaphuli, Meghna and their tributaries. [52]

**Figure 4-11. Threatened Faunal species of Assam State**

417. The species found in Assam hold immense ecological importance and play vital roles in maintaining the state's rich biodiversity. For example, Critically Endangered species such as the White-bellied Heron (*Ardea insignis*) are key indicators of wetland health, underscoring the need for the conservation of Assam's wetlands. Similarly, the Marsh Babbler (*Pellorneum palustre*) and Pink-headed Duck (*Rhodonesa caryophylacea*) inhabit wetlands and grasslands, reflecting the ecological diversity of these habitats. The Indian Vulture (*Gyps indicus*) plays a critical role as a scavenger, preventing the spread of diseases by feeding on carcasses, while the Bengal Florican (*Houbaropsis bengalensis*) contributes to the maintenance of grassland ecosystems by dispersing seeds and controlling insect populations.

[49] Source: https://assambiodiversity.indiabiodiversity.org/species/show/257370
[50] Source: https://www.thainationalparks.com/species/wild-water-buffalo
[51] Source: https://www.thainationalparks.com/species/clouded-leopard
[52] Platanista gangetica (Roxburgh, 1801) | Species

418. Endangered species such as the Leopard Cat (*Panthera bengalensis*) regulate rodent populations, contributing to forest ecosystem stability. The Asian Elephant (*Elephas maximus*), a keystone species, is essential for seed dispersal and modifying forest habitats, which supports biodiversity. Grassland ecosystems are shaped by species like the Hispid Hare (*Caprolagus hispidus*), while the Hoolock Gibbon (*Hoolock hoolock*), India's only ape, helps sustain forest canopies through seed dispersal. Wetland habitats support species such as the Fishing Cat (*Prionailurus viverrinus*) and Ganges River Dolphin (*Platanista gangetica*), which serve as indicators of aquatic ecosystem health. Additionally, species like the Hog Deer (*Axis porcinus*) and Wild Water Buffalo (*Bubalus arnee*) maintain the ecological balance of grasslands and floodplains through their grazing behaviors.

419. Amphibians such as Bufoides meghalayanus, along with turtles like the Asian Box Turtle (*Cuora mouhotii*) and Sylhet Roofed Turtle (*Pangshura sylhetensis*), play significant roles in nutrient cycling and aquatic ecosystem maintenance. Pangolins (*Manis pentadactyla*) contribute to soil health through their burrowing and insect control activities, while the Asian Giant Tortoise (*Manouria emys*) supports seed dispersal. Freshwater fish species, including the Queen Loach (*Botia dario-Hamilton*) and Golden Mahseer (*Tor putitora*), are essential for sustaining aquatic food webs. Reptiles such as the Gharial (*Gavialis gangeticus*) help maintain fish population balance in river ecosystems.

420. Assam's Vulnerable species also hold ecological importance. The Indian Bison (*Bos gaurus*) influences vegetation patterns through grazing, while the Mugger Crocodile (*Crocodylus palustris*) serves as a top predator, ensuring the stability of aquatic food chains. The Indian Flapshell Turtle (*Lissemys punctata*) contributes to aquatic habitat health by managing vegetation and insect populations. Amphibians like the Garo Forest Frog (*Philautus garo*) and primates such as the Northern Pig-tailed Macaque (*Macaca leonina*) aid in pest control and seed dispersal, respectively. Species like the Asiatic Black Bear (*Ursus thibetanus*) and Binturong (*Arctictis binturong*) are crucial for seed dispersal, while the King Cobra (*Ophiophagus hannah*) maintains balance by preying on other snakes. Each of these species contributes uniquely to Assam's ecological stability. Their roles in processes such as nutrient cycling, habitat maintenance, and food web balance are critical for sustaining the region's biodiversity. Protecting these species is essential not only for preserving Assam's natural heritage but also for ensuring the long-term health of its ecosystems, which provide invaluable services to local communities and the broader environment.

**Protected Areas (PA)**

421. Assam is an integral part of the Eastern Himalayan Biodiversity Region, one of the two biodiversity "Hotspots" in India. The state's favorable climatic conditions, combined with its diverse physical features, have fostered a range of ecological habitats, including forests, grasslands, and wetlands. These habitats support a wide variety of floral and faunal species, highlighting Assam's crucial role in sustaining and conserving biodiversity. The ecological diversity further underscores the importance of Assam in global biodiversity conservation efforts.

422. As shown in Table 4-8 and depicted in Figure 4-12, Assam state is home to five National Parks, seventeen Wildlife Sanctuaries, and one Ramsar-designated wetland site, which also functions as a Wildlife Sanctuary. These protected areas provide safe havens for numerous threatened and endemic species, emphasizing their ecological significance. In addition, Assam hosts 21 Key Biodiversity Areas (KBA) and Important Bird Areas (IBA), reflecting its status as a critical region for bird conservation and

biodiversity preservation.[53,54] These KBAs and IBAs play a vital role in maintaining ecological balance and serve as key focus areas for conservation initiatives.

**Table 4-8. Summary of Protected Areas in Assam**

| Name | National Status[55] | IUCN Protected Area Level/Ramsar Criteria | IBA Criteria[56] | KBA | Critical Habitat as a PA |
|---|---|---|---|---|---|
| Dibru- Saikhowa NP | NP | Not categorized yet but considered as Category II as per IUCN criteria | A1, A2 | Yes | Supports CR/EN species |
| Kaziranga NP | NP | Category II (NP) and X (World Heritage Site) as per IUCN criteria | A1, A2, A4i, A4iii | Yes | Fulfils IUCN category II PA criterion |
| Manas NP | NP | Category IV (habitat or species management area) as per IUCN | A1, A2 | Yes | Supports CR/EN species |
| Nameri NP | NP | Category IV as per IUCN | A1, A2 | Yes | Supports CR/EN and endemic species |
| Orang NP | NP | Category IV as per IUCN | A1, A4ii | Yes | Supports CR/EN and migratory species |
| Amchang WLS | WLS | Not categorized yet but considered as Category IV as per IUCN | A1 | Yes | Supports CR/EN species |
| Barail WLS | WLS | Not categorized yet but considered as Category IV as per IUCN | A1, A2, A3 | Yes, as part of Barail Range | Supports CR/EN and endemic species |
| Barnadi WLS | WLS | Category IV as per IUCN | A1 | Yes | - |
| Bherjan- Borajan-Podumoni WLS | WLS | Not categorized yet but considered as Category IV as per IUCN | A1 | Yes | - |
| Burachapori WLS | WLS | Not categorized yet but considered as Category IV as per IUCN | A1, A2 | Yes | - |
| Chakrashila WLS | WLS | Not categorized yet but considered as Category IV as per IUCN | A1, A4i, A4iii | Yes | - |
| Deepor Beel | Ramsar Site | Ramsar Site per criterion 1, 2, 4, 7 and 8. Category IV as per IUCN | A1, A4iii | Yes | Ramsar site. it is a wetland that provides key |

[53] Key Biodiversity Areas (KBA) are sites contributing significantly to the global persistence of biodiversity in terrestrial, freshwater and marine ecosystems. Sites qualify as global KBAs if they meet one or more of 11 criteria, clustered into five categories: threatened biodiversity; geographically restricted biodiversity; ecological integrity; biological processes; and, irreplaceability. KBAs comprise an "umbrella" set of internationally recognized priority sites for biodiversity that includes Important Bird Areas (IBAs) and Alliance for Zero Extinction (AZE) sites. IBAs are priority sites for bird conservation because they regularly hold significant populations of one or more globally or regionally threatened, endemic or congregatory bird species, or highly representative bird assemblages.

[54]WII ENVIS, Govt. of India. 2017. http://wiienvis.nic.in/Database/Key_Biodiversity_Areas_8647.aspx

[55] WII ENVIS, Govt. of India. 2023. http://wiienvis.nic.in/Database/wls_8230.aspx and Assam State Biodiversity Board, Govt. of Assam. https://asbb.assam.gov.in/information-services/protected-area- network

[56] BirdLife International (2022) Country profile: India (http://datazone.birdlife.org/country/india and Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016) Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated). Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and BirdLife International (U.K.). Pp. 1992 + xii

| Name | National Status[55] | IUCN Protected Area Level/Ramsar Criteria | IBA Criteria[56] | KBA | Critical Habitat as a PA |
|---|---|---|---|---|---|
| | | | | | ecosystem services/fish breeding ground |
| East Karbi Anglong WLS | WLS | Not categorized yet but considered as Category IV as per IUCN | A1 | Yes | - |
| Garampani WLS | WLS | Category IV as per IUCN | A1 | Yes | - |
| Hollongapar-Gibbon WLS | WLS | Not categorized yet but considered as Category IV as per IUCN | A1 | Yes | Supports CR/EN and endemic species |
| Laokhowa WLS | WLS | Category IV as per IUCN | A1, A2 | Yes | Supports CR/EN and endemic species |
| Marat Longri WLS | WLS | Not categorized yet but considered as Category IV as per IUCN | A1 | Yes | - |
| Nambor Doigrung WLS | WLS | Not categorized yet but considered as Category IV as per IUCN | A1 | Yes | - |
| Nambor WLS | WLS | Not categorized yet but considered as Category IV as per IUCN | A1 | Yes | - |
| Pobitora WLS | WLS | Category IV as per IUCN | A1, A2, A4iii | Yes | Supports CR/EN and migratory species |
| Pani-Dihing WLS | WLS | Not categorized yet but considered as Category IV as per IUCN | A1, A4iii | Yes | - |
| Sonai-Rupai WLS | WLS | Category IV as per IUCN | A1 | Yes | Supports CR/EN species |

CR = Critically Endangered, EN = Endangered, IBA = important bird area, KBA = Key Biodiversity Areas, IUCN = International Union for Conservation of Nature

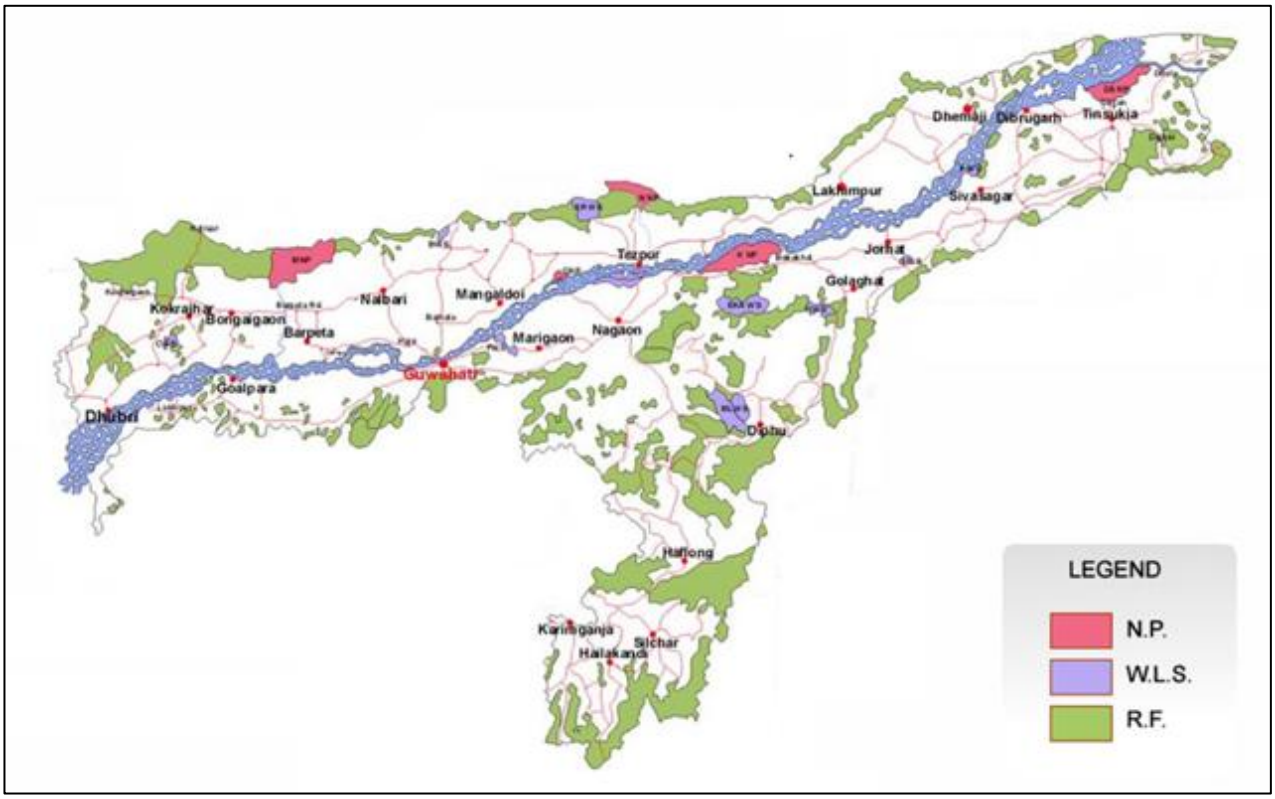



**Figure 4-12. Map of Reserved Forests and Protected Areas on Assam[57]**

**Flora and Fauna in and Around Beels**

423. A biodiversity survey was conducted by a MOEFCC-accredited lab to assess the flora and fauna found in and around 15 beels, utilizing a combination of primary site surveys and analysis of secondary information from various research articles and reports. The findings indicate that no threatened species were recorded within the examined village beels during the survey period, suggesting that the current biodiversity status in these areas does not include any species classified as threatened.

424. Chalantapara Beel, Bongaigaon District. The flora around Chalantapara Beel in Bongaigaon District is diverse, featuring a mix of 12 tree species, such as *Mangifera indica* (Mango) and *Shorea robusta* (Sal), 9 medicinal plants like *Centella asiatica* (Indian Pennywort), and 8 grasses, including *Bambusa balcooa* (Bamboo). Additionally, the beel hosts 9 macrophytes like *Eichhornia crassipes* (Water Hyacinth) and *Nelumbo nucifera* (Indian Lotus), which support aquatic life and contribute to nutrient cycling. This varied vegetation structure provides essential habitat, shade, and food for the ecosystem's wildlife.

425. The fauna of Chalantapara Beel is equally rich, consisting of 8 mammal species. *Macaca mulatta* (Rhesus Macaque), 6 reptiles like *Varanus bengalensis* (Bengal Monitor), and 11 bird species, including *Pavo cristatus* (Indian Peafowl) and *Ardea cinerea* (Grey Heron). The wetland also harbors seven amphibian species, including *Hoplobatrachus tigerinus* (Indian Bullfrog), and 6 fish species like *Labeo rohita* (Rohu), which are integral to the local food web. Together, these species illustrate a vibrant, interconnected ecosystem dependent on the beel's resources.

[57] **Source:** https://environmentandforest.assam.gov.in/information-services/reserve-forests-0

426. Purani Beel, Dhubri District. Purani Beel in Dhubri District is home to a diverse range of plant life, including eight different types of trees.*Bombax ceiba* (Red Silk Cotton Tree), *Ficus benghalensis* (Banyan Tree), and *Mangifera indica* (Mango Tree), all classified as Least Concern by the IUCN. These trees provide essential shade, nesting sites, and food for local wildlife. The area also supports several plant species like *Cyperus papyrus* (Paper Reed) and *Saccharum spontaneum* (Wild Sugarcane), which help stabilize the wetland soil. The presence of 6 grass species, including *Bambusa balcooa* (Bhaluka Bamboo) and *Vetiveria zizanioides* (Vetiver Grass), aids in erosion control, while aquatic macrophytes like *Eichhornia crassipes* (Water Hyacinth) and *Nymphaea stellata* (Blue Lotus) contribute to nutrient cycling and provide habitat for aquatic species.

427. Purani Beel's fauna is equally diverse, with 10 mammal species, including domestic animals like*Bos indicus* (Domestic Cow) and *Capra aegagrus hircus* (Domestic Goat), alongside wild species like *Herpestes edwardsii* (Indian Grey Mongoose) and *Pteropus giganteus* (Indian Flying Fox). Reptiles, such as *Naja naja* (Indian Cobra) and *Bungarus caeruleus* (Common Krait), help regulate prey populations. The beel is home to a variety of birdlife, with 13 recorded species.*Pavo cristatus* (Indian Peafowl) and migratory birds like *Tadorna ferruginea* (Ruddy Shelduck). Amphibians like *Hoplobatrachus tigerinus* (Indian Bullfrog) and fish species such as *Labeo rohita* (Rohu) are integral to the food web, contributing to insect control, nutrient cycling, and providing prey for larger species, showcasing Purani Beel's ecological richness.

428. Udmari Chora, Dhubri District. The flora in and around Udmari Chora, Dhubri District, includes 8 species of trees, 4 species of plants, 6 species of grasses, and 6 species of macrophytes. Notable trees include Bombax ceiba (Red Silk Cotton Tree), Ficus benghalensis (Banyan Tree), and Mangifera indica (Mango Tree), all categorized as Least Concern by the IUCN. Common plants include Cyperus papyrus (Paper Reed) and Hibiscus spontaneum (Hibiscus), while grasses like Bambusa balcooa (Bhaluka Bamboo) and Phragmites australis (Common Reed) are also present. Macrophytes such as Eichhornia crassipes (Water Hyacinth) and Nymphaea stellata (Blue Lotus) thrive in the region.

429. The fauna around Udmari Chora consists of 6 species of mammals, 4 species of reptiles, 14 species of birds, 7 species of fish, and 4 species of amphibians. Domesticated mammals like Bos indicus (Domestic Cow) and Canis lupus familiaris (Domestic Dog) are common, along with wild species such as Herpestes edwardsii (Indian Grey Mongoose) and Pteropus giganteus (Indian Flying Fox). Reptiles like Naja naja (Indian Cobra) and Bungarus caeruleus (Common Krait) are found, while birds such as Ardea cinerea (Grey Heron) and Pavo cristatus (Indian Peafowl) contribute to the region's avian diversity. Fish species like Labeo rohita (Rohu) and Catla catla (Catla), along with amphibians like Hoplobatrachus tigerinus (Indian Bullfrog), add to the biodiversity of the area. The IUCN has classified all these species as Least Concern.

430. Moridesoi Beel, Jorhat District. The flora in and around Moridesoi Beel, Jorhat District, consists of 10 tree species, including Azadirachta indica (Neem), Mangifera indica (Mango Tree), and Tectona grandis (Teak), all listed as Least Concern by the IUCN. It also includes 10 plant species such as Curcuma longa (Turmeric), Zingiber officinale (Ginger), and Ocimum sanctum (Holy Basil), along with 6 species of grasses like Bambusa balcooa (Bhaluka Bamboo) and Cynodon dactylon (Bermuda Grass). The area is rich in macrophytes, containing 10 species.Eichhornia crassipes (Water Hyacinth) and Nelumbo nucifera (Indian Lotus), all categorized under Least Concern.

431. The Moridesoi Beel area is home to eight different species of mammals.Bos taurus (Domestic Cow), Bubalus bubalis (Water Buffalo), and Pteropus giganteus (Indian Flying Fox), with the latter two categorized as Least Concern. There are seven species of reptiles.Naja naja (Indian Cobra) and Calotes versicolor (Oriental Garden Lizard), all of which are also listed as Least Concern. The bird population consists of 10 species such as Gallus gallus domesticus (Domestic Chicken) and Ardea cinerea (Grey Heron), while the fish species include Labeo rohita (Rohu) and Channa punctata (Spotted Snakehead), among others. Additionally, amphibians like Hoplobatrachus tigerinus (Indian

Bullfrog) and Duttaphrynus melanostictus (Asian Common Toad) add to the biodiversity, with all species listed as Least Concern.

432. Sawaguri Beel, Jorhat District. The flora in and around Sawaguri Beel, Jorhat District, comprises nine tree species, includingAzadirachta indica (Neem), Mangifera indica (Mango Tree), and Tectona grandis (Teak), all categorized as Least Concern. Additionally, there are 10 different plant species.Curcuma longa (Turmeric), Zingiber officinale (Ginger), and Ocimum sanctum (Holy Basil), alongside 6 grass species like Bambusa balcooa (Bhaluka Bamboo) and Cynodon dactylon (Bermuda Grass). The area supports 10 macrophytes, including Eichhornia crassipes (Water Hyacinth) and Nelumbo nucifera (Indian Lotus), all of which are listed as Least Concern.

433. Fauna around Sawaguri Beel consists of 8 mammal species, including Bos taurus (Domestic Cow), Bubalus bubalis (Water Buffalo), and Pteropus giganteus (Indian Flying Fox), the latter two classified as Least Concern. The reptiles in the area include Naja naja (Indian Cobra) and Calotes versicolor (Oriental Garden Lizard), both of which are listed as Least Concern. There are 10 different bird species.Gallus gallus domesticus (Domestic Chicken) and Ardea cinerea (Grey Heron), while the fish species include Labeo rohita (Rohu) and Channa punctata (Spotted Snakehead). The amphibians present include Hoplobatrachus tigerinus (Indian Bullfrog) and Duttaphrynus melanostictus (Asian Common Toad), all categorized under Least Concern.

434. Tiayakuri Beel, Sribhumi District. The flora in and around Tiayakuri Beel, Sribhumi District, includes 10 different tree species.Azadirachta indica (Neem), Mangifera indica (Mango Tree), and Ficus benghalensis (Banyan Tree), all listed as Least Concern. The area also harbors nine plant species, includingOcimum sanctum (Holy Basil) and Zingiber officinale (Ginger), as well as 7 grass species like Bambusa balcooa (Bhaluka Bamboo) and Cynodon dactylon (Bermuda Grass). The area houses five macrophytes, includingEichhornia crassipes (Water Hyacinth) and Nymphaea nouchali (Red Water Lily), all categorized as Least Concern.

435. The fauna in the vicinity of Tiayakuri Beel comprises 10 mammal species, including Bos taurus (Domestic Cow), Bubalus bubalis (Water Buffalo), and Macaca mulatta (Rhesus Macaque), with Pteropus giganteus (Indian Flying Fox) also listed as Least Concern. Reptiles include Naja naja (Indian Cobra) and Calotes versicolor (Oriental Garden Lizard), both listed as Least Concern. There are ten different bird species.Gallus gallus domesticus (Domestic Chicken) and Ardea cinerea (Grey Heron). The fish species found include Labeo rohita (Rohu), Catla catla (Catla), and Wallago attu (Wallago Catfish). Amphibians such as Hoplobatrachus tigerinus (Indian Bullfrog) and Euphlyctis cyanophlyctis (Indian Skittering Frog) are also present, all categorized as Least Concern.

436. Gojarala Beel, Sribhumi District. The flora in and around Gojarala Beel, Sribhumi District, includes 10 tree species.Azadirachta indica (Neem), Mangifera indica (Mango Tree), and Ficus benghalensis (Banyan Tree), all categorized as Least Concern. The plant species comprise nine different types.Ocimum sanctum (Holy Basil) and Zingiber officinale (Ginger), and 7 grass species such as Bambusa balcooa (Bhaluka Bamboo) and Cynodon dactylon (Bermuda Grass). The area hosts 4 macrophytes, including Nelumbo nucifera (Indian Lotus) and Eichhornia crassipes (Water Hyacinth), all listed as Least Concern.

437. Fauna in the area includes 10 mammal species, including Bos taurus (Domestic Cow), Bubalus bubalis (Water Buffalo), and Macaca mulatta (Rhesus Macaque), with Pteropus giganteus (Indian Flying Fox) listed as Least Concern. Reptiles include Naja naja (Indian Cobra) and Calotes versicolor (Oriental Garden Lizard), both Least Concern. There are ten different species of birds.Gallus gallus domesticus (Domestic Chicken) and Ardea cinerea (Grey Heron). The fish species include Labeo rohita (Rohu), Catla catla (Catla), and Wallago attu (Wallago Catfish). Amphibians like Hoplobatrachus tigerinus (Indian Bullfrog) and Euphlyctis cyanophlyctis (Indian Skittering Frog) are also present, all categorized as Least Concern.

438. Mahara Anchilik Beel, Lakhimpur District. In and around Mahara Anchilik Beel, Lakhimpur District, the recorded flora includes 10 tree species.Azadirachta indica (Neem), Mangifera indica (Mango Tree), and Ficus benghalensis (Banyan Tree), all categorized as Least Concern. The plant species include Curcuma longa (Turmeric), Zingiber officinale (Ginger), and Ocimum sanctum (Holy Basil). The area hosts 9 grass species like Bambusa balcooa (Bhaluka Bamboo) and Cynodon dactylon (Bermuda Grass), and 9 macrophytes, including Eichhornia crassipes (Water Hyacinth) and Nelumbo nucifera (Indian Lotus), all listed as Least Concern.

439. Fauna in the area includes 10 mammal species, such as Bos taurus (Domestic Cow), Bubalus bubalis (Water Buffalo), and Macaca mulatta (Rhesus Macaque), with Pteropus giganteus (Indian Flying Fox) and Rattus rattus (Black Rat) listed as Least Concern. Reptiles include Naja naja (Indian Cobra), Calotes versicolor (Oriental Garden Lizard), and Varanus bengalensis (Bengal Monitor Lizard). Bird species include Gallus gallus domesticus (Domestic Chicken), Anas platyrhynchos domesticus (Domestic Duck), and Ardea cinerea (Grey Heron). The fish species recorded include Labeo rohita (Rohu), Catla catla (Catla), and Channa punctata (Spotted Snakehead). Amphibians like Hoplobatrachus tigerinus (Indian Bullfrog) and Duttaphrynus melanostictus (Asian Common Toad) are also present, all categorized as Least Concern.

440. Tekidubi Beel, Lakhimpur District. In and around Tekidubi Beel, Lakhimpur District, the recorded flora includes 10 tree species such as Azadirachta indica (Neem), Mangifera indica (Mango Tree), and Ficus benghalensis (Banyan Tree), all categorized as Least Concern. The plant species include Curcuma longa (Turmeric), Zingiber officinale (Ginger), and Ocimum sanctum (Holy Basil). The area hosts 9 grass species like Bambusa balcooa (Bhaluka Bamboo) and Cynodon dactylon (Bermuda Grass), and 9 macrophytes, including Eichhornia crassipes (Water Hyacinth) and Nymphaea nouchali (Red Water Lily), all listed as Least Concern.

441. Fauna in the area includes 10 mammal species such as Bos taurus (Domestic Cow), Bubalus bubalis (Water Buffalo), and Macaca mulatta (Rhesus Macaque), with Pteropus giganteus (Indian Flying Fox) and Rattus rattus (Black Rat) listed as Least Concern. Reptiles include Naja naja (Indian Cobra), Calotes versicolor (Oriental Garden Lizard), and Hemidactylus frenatus (Common House Gecko). Bird species include Gallus gallus domesticus (Domestic Chicken), Anas platyrhynchos domesticus (Domestic Duck), and Ardea cinerea (Grey Heron). The fish species recorded include Labeo rohita (Rohu), Catla catla (Catla), and Channa punctata (Spotted Snakehead). Amphibians like Hoplobatrachus tigerinus (Indian Bullfrog) and Duttaphrynus melanostictus (Asian Common Toad) are also present, all categorized as Least Concern.

442. Bechamari Beel, Morigaon District. In and around Bechamari Beel, Morigaon District, the recorded flora includes 10 tree species such as Mangifera indica (Mango Tree), Azadirachta indica (Neem Tree), and Ficus religiosa (Peepal Tree), all listed as Least Concern. The plant species include Solanum torvum (Turkey Berry), Centella asiatica (Indian Pennywort), and Calotropis gigantea (Crown Flower). The area has 10 grass species, including Bambusa balcooa (Bhaluka Bamboo) and Saccharum spontaneum (Wild Sugarcane), and 5 macrophytes, including Eichhornia crassipes (Water Hyacinth) and Nelumbo nucifera (Indian Lotus), with some species not evaluated for conservation status.

443. Fauna in the area includes 10 mammal species such as Bos taurus (Domestic Cow), Capra hircus (Domestic Goat), and Macaca mulatta (Rhesus Macaque). Reptiles recorded include Varanus bengalensis (Bengal Monitor Lizard), Naja kaouthia (Monocled Cobra), and Eutropis multifasciata (Common Sun Skink). Bird species include Gallus gallus domesticus (Domestic Chicken), Anas platyrhynchos (Mallard), and Milvus migrans (Black Kite). Fish species include Labeo rohita (Rohu), Catla catla (Catla), and Channa punctata (Spotted Snakehead). Amphibians such as Hoplobatrachus tigerinus (Indian Bullfrog) and Duttaphrynus melanostictus (Asian Common Toad) are also present,

with all amphibians listed as Least Concern.

444. Morikolong Beel, Morigaon District. In and around Morikolong Beel, Morigaon District, the recorded flora includes trees such as Mangifera indica (Mango Tree), Azadirachta indica (Neem Tree), and Ficus religiosa (Peepal Tree), all categorized as Least Concern. The plant species include Solanum torvum (Turkey Berry), Centella asiatica (Indian Pennywort), and Calotropis gigantea (Crown Flower). The area also contains grasses like Bambusa balcooa (Bhaluka Bamboo), Saccharum spontaneum (Wild Sugarcane), and Cynodon dactylon (Bermuda Grass). Macrophytes such as Eichhornia crassipes (Water Hyacinth), Nelumbo nucifera (Indian Lotus), and Hydrilla verticillata (Hydrilla) are present, with some species not evaluated for conservation status.

445. The fauna includes mammals such as Bos taurus (Domestic Cow), Macaca mulatta (Rhesus Macaque), and Canis aureus (Golden Jackal). Reptiles like Varanus bengalensis (Bengal Monitor Lizard), Naja kaouthia (Monocled Cobra), and Eutropis multifasciata (Common Sun Skink) are present. Bird species include Gallus gallus domesticus (Domestic Chicken), Pavo cristatus (Indian Peafowl), and Milvus migrans (Black Kite). Fish species recorded include Labeo rohita (Rohu), Catla catla (Catla), and Channa punctata (Spotted Snakehead). Amphibians such as Hoplobatrachus tigerinus (Indian Bullfrog) and Duttaphrynus melanostictus (Asian Common Toad) are also found in the area, with all amphibians listed as Least Concern.

446. In and around Bhagampur, Nagaon District, the recorded flora includes trees such as Ficus benghalensis (Banyan Tree), Shorea robusta (Sal Tree), and Mangifera indica (Mango), all listed as Least Concern. Other trees include Acacia auriculiformis (Acacia), Terminalia bellirica (Baheda), and Diospyros lotus (Black Sapote). Plants like Nymphaea nouchali (Blue Water Lily), Nelumbo nucifera (Lotus), and Azolla pinnata (Water Fern) are present. Grasses include Bambusa balcooa (Bhaluka Bamboo), Phragmites karka (Common Reed), and Typha angustifolia (Bulrush), all of which are Least Concern. Macrophytes like Eichhornia crassipes (Water Hyacinth), Salvinia molesta (Giant Salvinia), and Lemna minor (Lesser Duckweed) are found in the area.

447. The fauna includes mammals like Canis lupus familiaris (Domestic Dog), Bos taurus (Domestic Cow), and Bubalus bubalis (Water Buffalo). Reptiles include Calotes versicolor (Oriental Garden Lizard), Naja naja (Indian Cobra), and Eutropis carinata (Keeled Indian Mabuya). Birds such as Gallus gallus domesticus (Domestic Chicken), Corvus splendens (House Crow), and Pycnonotus cafer (Red-vented Bulbul) are also recorded. Fish species include Labeo rohita (Rohu), Catla catla (Catla), and Channa punctata (Spotted Snakehead). Amphibians such as Hoplobatrachus tigerinus (Indian Bullfrog), Duttaphrynus melanostictus (Asian Common Toad), and Euphlyctis cyanophlyctis (Indian Skittering Frog) are present, all categorized as Least Concern.

448. Sapekhality Beel, Nagaon District. In and around Sapekhality Beel, Nagaon District, the recorded flora includes trees such as Ficus benghalensis (Banyan Tree), Shorea robusta (Sal Tree), Mangifera indica (Mango), and Acacia auriculiformis (Acacia), all categorized as Least Concern. Other trees include Terminalia bellirica (Baheda) and Diospyros lotus (Black Sapote). The plant species in the area include Nymphaea nouchali (Blue Water Lily), Nelumbo nucifera (Lotus), Azolla pinnata (Water Fern), and Eclipta prostrata (False Daisy), all listed as Least Concern. Grasses present include Bambusa balcooa (Bhaluka Bamboo), Phragmites karka (Common Reed), and Typha angustifolia (Bulrush). Macrophytes such as Eichhornia crassipes (Water Hyacinth), Salvinia molesta (Giant Salvinia), and Lemna minor (Lesser Duckweed) are recorded.

449. The fauna includes mammals like Canis lupus familiaris (Domestic Dog), Bos taurus (Domestic Cow), Bubalus bubalis (Water Buffalo), and Felis catus (Domestic Cat). Reptiles found include Calotes versicolor (Oriental Garden Lizard), Naja naja (Indian Cobra), and Gekko gecko (Tokay Gecko). Birds like Gallus gallus domesticus (Domestic Chicken), Corvus splendens (House Crow), and Pycnonotus cafer (Red-vented Bulbul) are present, while fish species include Labeo rohita (Rohu), Catla catla

(Catla), and Channa punctata (Spotted Snakehead). Amphibians such as Hoplobatrachus tigerinus (Indian Bullfrog), Duttaphrynus melanostictus (Asian Common Toad), and Euphlyctis cyanophlyctis (Indian Skittering Frog) are also recorded, all classified as Least Concern.

450. No Borhullung, Lonkadeep, Tinsukia District. In and around 3 No Borhullung, Lonkadeep, Tinsukia District, the recorded flora includes trees such as Azadirachta indica (Neem), Mangifera indica (Mango Tree), and Ficus benghalensis (Banyan Tree), all of which are categorized as Least Concern. Other notable trees include Syzygium cumini (Jamun/Java Plum), Artocarpus heterophyllus (Jackfruit Tree), and Tectona grandis (Teak). Plants such as Ocimum sanctum (Holy Basil), Zingiber officinale (Ginger), and Curcuma longa (Turmeric) are also present. Common grasses include Bambusa balcooa (Bhaluka Bamboo), Cynodon dactylon (Bermuda Grass), and Eleusine indica (Indian Goosegrass). Macrophytes such as Eichhornia crassipes (Water Hyacinth), Nymphaea nouchali (Red Water Lily), and Trapa natans (Water Chestnut) are found in the area.

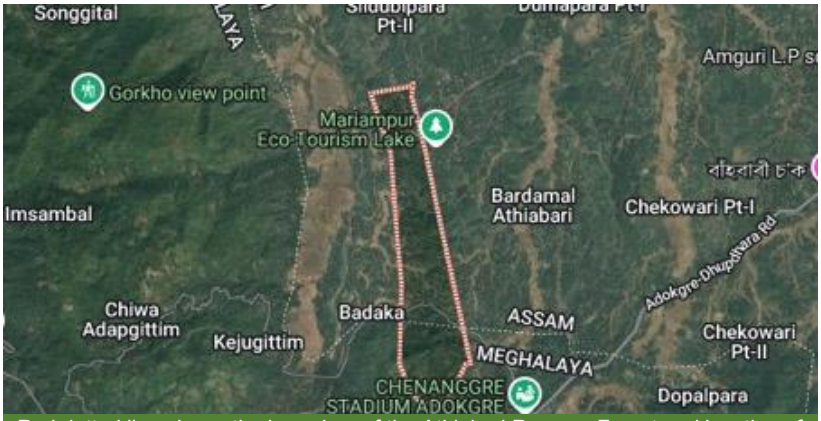
451. The fauna includes mammals such as Bos taurus (Domestic Cow), Bubalus bubalis (Water Buffalo), and Canis lupus familiaris (Domestic Dog). Reptiles recorded in the area include Naja naja (Indian Cobra), Calotes versicolor (Oriental Garden Lizard), and Varanus bengalensis (Bengal Monitor Lizard). Birds like Gallus gallus domesticus (Domestic Chicken), Columba livia (Rock Pigeon), and Acridotheres tristis (Common Myna) are present. Fish species include Labeo rohita (Rohu), Catla catla (Catla), and Channa punctata (Spotted Snakehead). Amphibians such as Hoplobatrachus tigerinus (Indian Bullfrog), Euphlyctis cyanophlyctis (Indian Skittering Frog), and Duttaphrynus melanostictus (Asian Common Toad) are found in the area, with all species listed as Least Concern.

452. Dalpung Beel, Dhemaji District. In and around Dalpung Beel, Dhemaji District, the recorded flora includes trees such as Azadirachta indica (Neem), Mangifera indica (Mango Tree), Tectona grandis (Teak), Ficus benghalensis (Banyan Tree), and Syzygium cumini (Jamun/Java Plum), all classified as Least Concern. Other notable trees include Artocarpus heterophyllus (Jackfruit Tree), Terminalia arjuna (Arjun Tree), and Dalbergia sissoo (Indian Rosewood). Common plants include Curcuma longa (Turmeric), Zingiber officinale (Ginger), and Ocimum sanctum (Holy Basil). Grasses such as Bambusa balcooa (Bhaluka Bamboo), Cynodon dactylon (Bermuda Grass), and Saccharum spontaneum (Wild Sugarcane) are also found in the area. Macrophytes like Eichhornia crassipes (Water Hyacinth), Nelumbo nucifera (Indian Lotus), and Nymphaea nouchali (Red Water Lily) are present in the wetlands.

453. The fauna includes mammals such as Bos taurus (Domestic Cow), Bubalus bubalis (Water Buffalo), and Canis lupus familiaris (Domestic Dog). Reptiles recorded include Naja naja (Indian Cobra), Calotes versicolor (Oriental Garden Lizard), and Varanus bengalensis (Bengal Monitor Lizard). Birds such as Gallus gallus domesticus (Domestic Chicken), Columba livia (Rock Pigeon), and Acridotheres tristis (Common Myna) are also observed. Fish species like Labeo rohita (Rohu), Catla catla (Catla), and Channa punctata (Spotted Snakehead) are found in the area. Amphibians such as Hoplobatrachus tigerinus (Indian Bullfrog), Duttaphrynus melanostictus (Asian Common Toad), and Fejervarya limnocharis (Cricket Frog) are also present. All species listed are categorized as Least Concern.

454. In addition to the documented flora and fauna of the surveyed wetlands, the ARIAS Society, in coordination with the Department of Fisheries (DoF), conducted a site visit to the Mariampur Eco-

Tourism Lake, which is located within Dag No. 71 of Bardamal Athiabari revenue village under the Rangjuli Revenue Circle. According to the Divisional Forest Officer, Goalpara district, the lake falls within the Reserved Forest Area (Athiabari Reserved Forest). Although situated within the boundary of a Reserved Forest, the lake lies along the fringe of a semi-degraded forest patch and a modified habitat zone.



Red dotted line shows the boundary of the Athiabari Reserve Forest and location of Mariampur Eco Tourism Lake

455. The site was also visited by the ADB team during the pre-fact finding mission. Based on consultations carried out by ARIAS Society and the DoF with local villagers along with observations and secondary data collected during the site visit the presence of common flora and floara was reported. Domesticated animals in the vicinity include Bos taurus (Cow) and Bubalus bubalis (Water Buffalo). Reptilian fauna includes Calotes versicolor (Oriental Garden Lizard), Naja naja (Indian Cobra), and Eutropis carinata (Keeled Indian Mabuya), with monkeys frequently observed along the forest edge. The bird species recorded include Gallus gallus domesticus (Domestic Chicken), Corvus splendens (House Crow), Pycnonotus cafer (Red-vented Bulbul), and various local duck species that frequent the lake.

456. The lake supports freshwater fish such as *Labeo rohita* (Rohu), *Catla catla* (Catla), and *Channa punctata* (Spotted Snakehead). Amphibians reported in the area include *Hoplobatrachus tigerinus* (Indian Bullfrog), *Duttaphrynus melanostictus* (Asian Common Toad), and *Euphlyctis cyanophlyctis* (Indian Skittering Frog), all of which are listed as Least Concern on the IUCN Red List.

457. Occasional sightings of wild elephants have been reported near the village outskirts, and additional avian species are observed during the winter season. Given the lake's location at the interface of reserved forest area and modified habitat, the diversity of wild species is very limited.

**Critical Habitat Assessment (CHA)**

458. The CHA for the threatened flora and fauna in Assam focused on species associated with the beels (wetlands), the Brahmaputra River, and its floodplain. Emphasis was placed on species found in Key Biodiversity Areas (KBAs) and protected areas. The assessment involved an initial review of over 100 species, followed by a screening process to identify those most likely to be impacted by project activities. This process highlighted 32 species (primarily birds, reptiles, and fish) that are potentially vulnerable and could be affected by the project. These species were then assessed against CHA thresholds to determine their conservation significance.

**Data Collection and Area of Analysis**

459. Data for the CHA was sourced from diverse and reliable platforms, including the Department of Fisheries (DoF), a laboratory recognized by the Ministry of Environment, Forest and Climate Change (MoEFCC), government websites, iNaturalist, and the Key Biodiversity Area (KBA) databank. Additionally, the Integrated Biodiversity Assessment Tool (IBAT) was used to analyze sensitive locations, as outlined in Annexure 6.

460. The Area of Analysis (AoA) focused on the beels and their surrounding areas, particularly within the boundaries of the wetlands. While the impacts of the project are expected to be localized within the beel boundaries, it is important to note that no National Parks or Wildlife Sanctuaries are situated near

the project sites. However, two of the subproject beels Paranm Beel and Tatinga Mekheli Barbeel, located on Majuli Island-are identified as KBAs. Majuli Island, a designated KBA, supports a rich diversity of threatened flora and fauna, which were included in the assessment to ensure a thorough understanding of the project's potential impacts.

**Findings and Mitigation Measures**

461. Majuli Island's ecological importance, combined with its threatened species, underscores the need for targeted mitigation strategies to minimize the impact of project activities. The CHA findings will guide the development of conservation measures, ensuring that biodiversity in sensitive ecosystems is preserved. The inclusion of threatened species and their habitats in the assessment enables informed decision-making, promoting the integration of biodiversity conservation into project planning.

462. By aligning the CHA with international standards, such as those outlined in ADB SPS 2009 and IFC Guidance Note 6, the assessment ensures that development projects are sustainable, environmentally responsible, and sensitive to the unique biodiversity of Assam's wetlands and floodplains.

463. Critical habitat refers to areas of high biodiversity value in which development would be particularly sensitive and require special attention. The purpose of a critical habitat assessment is to identify the level of high biodiversity value within the subproject areas. Critical habitat is defined in ADB SPS 2009 as areas or sites:

1. with high biodiversity value, including habitat required for the survival of critically endangered or endangered species;
2. having special significance for endemic or restricted-range species;
3. that are critical for the survival of migratory species;
4. supporting globally significant concentrations or numbers of individuals of congregatory species;
5. with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services;
6. having biodiversity of significant social, economic, or cultural importance to local communities

464. Moreover, based on ADB SPS 2009, critical habitats can be either natural or modified or a combination of both. These include legally protected areas or those officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's world natural heritage sites.

465. To support the critical habitat assessment in subproject sites, International Finance Corporation's (IFC) Guidance Note 6[58] on Biodiversity Conservation and Sustainable Management of Living Natural Resources is used to determine any trigger as per SPS 2009. The guidance note defines critical habitat as areas of high biodiversity value that include or meet at least one of the following:

- Criterion 1: Critically Endangered (CR) and/or Endangered (EN) species
- Criterion 2: Endemic or restricted-range species
- Criterion 3: Migratory or congregatory species
- Criterion 4: Key evolutionary processes

466. The data used for the CHA was collected from various sources, including the Department of Fisheries (DoF), a MoEFCC-recognized laboratory, government websites, iNaturalist, and the KBA

[58] *International Finance Corporation's Guidance Note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (ifc.org)*

PUBLIC. This information is being disclosed to the public in accordance with ADB's Access to Information Policy.

databank. Additionally, an IBAT (Integrated Biodiversity Assessment Tool) report was used for sensitive locations, as outlined in **Annexure 6**. The Area of Analysis (AoA) for the critical habitat assessment focused on the beels and their surrounding areas. Although the impacts of the project are expected to be confined to these areas particularly within the beel boundary, it is important to note that no National Parks or Wildlife Sanctuaries are located in close proximity to the beels. However, two of the subproject beels, Paranm Beel and Tatinga Mekheli Barbeel, situated on Majuli Island, are identified as KBA. Majuli Island, being a KBA, is home to a variety of threatened flora and fauna. Apart from the two beels, Borthol Beel in Nagaon District, Assam, lies adjacent to Deobali Jalah, Sialmari, Haibargaon, and Khutikatia (Nagaon), which are identified as a KBA. This wetland landscape supports important habitats and serves as a refuge for threatened avifauna species, including the Greater Adjutant, Bengal Florican Lesser Adjutant, Swamp Francolin (Francolinus gularis) and Bristled Grassbird. The threatened species found in these areas were also considered for the assessment to ensure the project's potential impacts on biodiversity are well-understood and mitigated.

**Wildlife Screening**

467. The CHA for threatened flora and fauna in Assam has been carried out, focusing on species associated with the beels, the Brahmaputra River, and its floodplain. Specific attention was given to species found in KBA and protected areas, as listed in Table 4-7. The selection of species for the CHA assessment was based on their presence in these sensitive ecosystems. Following an initial review of over 100 species, a further screening process was applied to identify those most likely to be impacted by the project activities. This screening resulted in 32 species (mostly aves, reptiles and fishes listed in Table 4-9) that could possibly affected by the project activities and identified as potentially vulnerable. These species were further assessed against CHA thresholds.

**Table 4-9. Flora and fauna selected under critical habitat screening**

| Species Name | IUCN Category | Biome | Taxonomic Group | Affected By Project |
|---|---|---|---|---|
| *Pangshura sylhetensis* | CR | Freshwater and Terrestrial | Reptile | Possible |
| *Ardea insignis* | CR | Terrestrial and Freshwater | Aves | Unlikely |
| *Asarcornis scutulata* | CR | Freshwater and Terrestrial | Aves | Unlikely |
| *Aythya baeri* | CR | Freshwater | Aves | Possible |
| *Cinnamomum champokianum* | CR | Terrestrial | Plant | Unlikely |
| *Emberiza aureola* | CR | Terrestrial and Freshwater | Aves | Unlikely |
| *Gavialis gangeticus* | CR | Freshwater and Terrestrial | Reptile | Unlikely |
| *Gyps bengalensis* | CR | Terrestrial | Aves | Unlikely |
| *Gyps indicus* | CR | Terrestrial | Aves | Unlikely |
| *Gyps tenuirostris* | CR | Terrestrial | Aves | Unlikely |
| *Magnolia gustavii* | CR | Terrestrial | Plant | Unlikely |
| *Manis pentadactyla* | CR | Terrestrial | Mammal | Unlikely |
| *Manouria emys* | CR | Freshwater and Terrestrial | Reptile | Unlikely |
| *Nardostachys jatamansi* | CR | Terrestrial | Plant | Unlikely |
| *Nilssonia nigricans* | CR | Freshwater and Terrestrial | Reptile | Unlikely |
| *Perdicula manipurensis* | CR | Terrestrial | Aves | Unlikely |
| *Rhodonesa caryophylacea* | CR | Terrestrial | Plant | Unlikely |
| *Sarcogyps calvus* | CR | Terrestrial and Freshwater | Aves | Unlikely |
| *Vatica lanceaefolia* | CR | Terrestrial | Plant | Unlikely |
| *Aquilaria Malaccensis* | *CR* | Terrestrial | Plant | Unlikely |
| *Oroxylum indicum* | CR | Terrestrial | Plant | Unlikely |
| *Cairina scutulata* | CR | Terrestrial and Freshwater | Aves | Possible |
| *Houbaropsis bengalensis* | CR | Terrestrial | Aves | Possible |
| *Sterna acuticauda* | CR | Freshwater | Aves | Possible |
| *Heliopais personatus* | CR | Terrestrial and Freshwater | Aves | Possible |
| *Chitra indica* | EN | Freshwater and Terrestrial | Reptile | Possible |

| Species Name | IUCN Category | Biome | Taxonomic Group | Affected By Project |
|---|---|---|---|---|
| *Geoclemys hamiltonii* | EN | Freshwater and Terrestrial | Reptile | Possible |
| *Hardella thurjii* | EN | Freshwater and Terrestrial | Reptile | Possible |
| *Laticilla cinerascens* | EN | Terrestrial and Freshwater | Aves | Possible |
| *Leptoptilos dubius* | EN | Terrestrial and Freshwater | Aves | Possible |
| *Morenia petersi* | EN | Freshwater and Terrestrial | Reptile | Possible |
| *Rynchops albicollis* | EN | Freshwater | Aves | Possible |
| *Tringa guttifer* | EN | Freshwater | Aves | Possible |
| *Amblyceps arunchalensis* | EN | Freshwater | Fish | Unlikely |
| *Anas scutulata* | EN | Terrestrial and Freshwater | Aves | Unlikely |
| *Aquila nipalensis* | EN | Terrestrial | Aves | Unlikely |
| *Axis porcinus* | EN | Terrestrial | Mammal | Unlikely |
| *Botia Dario-Hamilton* | EN | Freshwater | Fish | Unlikely |
| *Bubalus arnee* | EN | Terrestrial | Mammal | Unlikely |
| *Bufoides meghalayanus* | EN | Terrestrial and Freshwater | Amphibian | Unlikely |
| *Caprolagus hispidus* | EN | Terrestrial | Mammal | Unlikely |
| *Cuon alpinus* | EN | Terrestrial | Mammal | Unlikely |
| *Cuora mouhotii* | EN | Freshwater and Terrestrial | Reptile | Unlikely |
| *Elephas maximus* | EN | Terrestrial | Mammal | Unlikely |
| *Hoolock hoolock* | EN | Terrestrial | Mammal | Unlikely |
| *Indotestudo elongata* | EN | Freshwater and Terrestrial | Reptile | Unlikely |
| *Magnolia pealiana* | EN | Terrestrial | Plant | Unlikely |
| *Manis pentadactyla* | EN | Terrestrial | Mammal | Unlikely |
| *Manouria impressa* | EN | Terrestrial | Reptile | Unlikely |
| *Nycticebus bengalensis* | EN | Terrestrial | Mammal | Unlikely |
| *Nycticebus coucang* | EN | Terrestrial | Mammal | Unlikely |
| *Panthera bengalensis* | EN | Terrestrial | Mammal | Unlikely |
| *Panthera tigris* | EN | Terrestrial | Mammal | Unlikely |
| *Platanista gangetica* | EN | Freshwater | Mammal | Unlikely |
| *Ploceus megarhynchus* | EN | Terrestrial | Aves | Unlikely |
| *Prinia cinerasens* | EN | Terrestrial | Aves | Unlikely |
| *Prionailurus viverrinus* | EN | Terrestrial and Freshwater | Mammal | Unlikely |
| *Sloanea tomentosa* | EN | Terrestrial | Plant | Unlikely |
| *Tor putitora* | EN | Terrestrial and Freshwater | Fish | Unlikely |
| *Trachypithecus pileatus brahma* | EN | Terrestrial | Mammal | Unlikely |
| *Trachypithecus pileatus* | EN | Terrestrial | Mammal | Unlikely |
| *Trillium tschonoskii* | EN | Terrestrial | Plant | Unlikely |
| *Mesua assamica* | EN | Terrestrial | Plant | Unlikely |
| *Paphiopedilium spicerianum* | EN | Terrestrial | Plant | Unlikely |
| *Rauvolfia serpentina* | EN | Terrestrial | Plant | Unlikely |
| *Trachypithecus geei* | EN | Terrestrial | Mammal | Unlikely |
| *Nepenthes khasiana* | EN | Terrestrial | Plant | Unlikely |
| *Ilex venulose,* | EN | Terrestrial | Plant | Unlikely |
| *Aborichthys garoensis* | VU | Freshwater | Fish | Possible |
| *Chrysomma altirostre* | VU | Terrestrial and Freshwater | Aves | Possible |
| *Clanga clanga* | VU | Terrestrial and Freshwater | Aves | Possible |
| *Cuora amboinensis* | VU | Freshwater and Terrestrial | Reptile | Possible |
| *Devario assamensis* | VU | Freshwater | Fish | Possible |
| *Francolinus gularis* | VU | Terrestrial and Freshwater | Aves | Possible |
| *Geoclemys hamiltonii* | VU | Freshwater and Terrestrial | Reptile | Possible |
| *Leptoptilos javanicus* | VU | Freshwater | Aves | Possible |
| *Lissemys punctata* | VU | Freshwater and Terrestrial | Reptile | Possible |
| *Melanochelys tricarinata* | VU | Terrestrial | Reptile | Possible |
| *Nilssonia gangetica* | VU | Freshwater and Terrestrial | Reptile | Possible |
| *Nilssonia hurum* | VU | Freshwater and Terrestrial | Reptile | Possible |

| Species Name | IUCN Category | Biome | Taxonomic Group | Affected By Project |
|---|---|---|---|---|
| *Ophiophagus hannah* | VU | Terrestrial | Reptile | Possible |
| *Paradoxornis flavirostris* | VU | Terrestrial and Freshwater | Aves | Possible |
| *Pelecanus philippensis* | VU | Freshwater | Aves | Possible |
| *Pellorneum palustre* | VU | Terrestrial and Freshwater | Aves | Possible |
| *Arctictis binturong* | VU | Terrestrial | Mammal | Unlikely |
| *Bos gaurus* | VU | Terrestrial | Mammal | Unlikely |
| *Crocodilus pelsutris* | VU | Freshwater and Terrestrial | Reptile | Unlikely |
| *Haliaeetus leucoryphus* | VU | Terrestrial and Freshwater | Aves | Unlikely |
| *Macaca arctoides* | VU | Terrestrial | Mammal | Unlikely |
| *Macaca leonina* | VU | Terrestrial | Mammal | Unlikely |
| *Oligodon erythrorhachis* | VU | Terrestrial | Reptile | Unlikely |
| *Philautus garo* | VU | Terrestrial | Amphibian | Unlikely |
| *Spelaeornis chocolatinus* | VU | Terrestrial and Freshwater | Aves | Unlikely |
| *Ursus thibetanus* | VU | Terrestrial | Mammal | Unlikely |
| *Cycas pectinate* | VU | Terrestrial | Plant | Unlikely |
| *Diptero carpus retusus* | VU | Terrestrial | Plant | Unlikely |
| *Rhinoceros unicornis* | VU | Terrestrial | Mammal | Unlikely |
| *Neofelis nebulosa* | VU | Terrestrial | Mammal | Unlikely |
| *Channa bleheri* | NT | Freshwater | Fish | Possible |
| *Ctenops nobilis* | NT | Freshwater | Fish | Possible |

CR = critically endangered, EN = endangered, VU = vulnerable, NT = not threatened

468. The overall assessment and findings of CHA are presented in the following sections and summarized in Table 4-10.

**Critical Habitat Assessment Criterion**

469. ***Criterion 1*: *Critically Endangered (CR) and/or Endangered (EN) species***. Species threatened with global extinction and listed as CR and EN on the IUCN Red List of Threatened Species shall be considered as part of Criterion 1. Critically Endangered species face an extremely high risk of extinction in the wild. Endangered species face a very high risk of extinction in the wild. Thresholds and analysis for Criterion 1 are the following:

- ***(a)*** *Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species).*
- ***(b)*** Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in (a).
- ***(c)*** As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

470. The species listed below are classified as Critically Endangered (CR), Endangered (EN), and Vulnerable (VU) under the International Union for Conservation of Nature (IUCN) Red List. While no firsthand sightings of these species have been recorded within the immediate subproject areas, secondary information indicates their presence within the broader district. This highlights the need to incorporate biodiversity considerations into the environmental management framework for the subproject. The reliance on secondary information underscores the potential ecological importance of the subproject area and its surroundings. These species, though not directly observed, may utilize habitats near the subproject for feeding, breeding, or migration.

471. ***Pangshura sylhetensis*[59] (Assam Roofed Turtle), CR.** *Pangshura sylhetensis* is a freshwater

[59] Pangshura sylhetensis (Assam Roofed Turtle)

species found in the Brahmaputra valley in northeastern India and parts of Bangladesh, with potential occurrences in Bhutan and Myanmar. It inhabits clear, fast-flowing streams at elevations below 200 meters. Over recent decades, the species has experienced an estimated 80% population decline due to habitat loss, exploitation for meat and eggs, and collection for the pet trade. Its current distribution is limited to fragmented, protected areas covering less than 500 km².

472. Conservation efforts for the Assam roofed turtle include legal protections under Schedule I of the Indian Wildlife (Protection) Act of 1972, which prohibits hunting and trade of the species. In-situ conservation initiatives are underway in protected areas such as Kaziranga and Manas National Parks, which provide critical habitats for the species. Additionally, the species is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), regulating its international trade to prevent further exploitation.

473. Despite these measures, the Assam roofed turtle remains critically endangered, highlighting the need for continued conservation actions, habitat protection, and enforcement of wildlife trade regulations to ensure its survival.



*The Assam roofed turtle is a Critically endangered turtle species of the family Geoemydidae found in the Brahmaputra-Meghna drainage in India (Assam) and parts of eastern* Bangladesh[60]



*Asarcornis scutulata is a large species of duck, occurs in dense tropical evergreen forests, near rivers and swamps. In India, the key protected areas for the white-winged duck are Dibru-Saikhowa National Park, Dihing-Patkai Wildlife Sanctuary etc.*[61]

474. ***Cairina scutulata*[62] (White-winged Duck), CR.** The *Asarcornis scutulata*, previously classified under the genus *Cairina*, is a critically endangered species native to the wetlands of Southeast Asia. Over the past few decades, its population has suffered a dramatic decline exceeding 80%, primarily due to habitat loss, hunting, and human disturbance. Current estimates indicate that only 150 to 400 mature individuals remain, with populations scattered across India, Myanmar, Thailand, Cambodia, and Indonesia.

475. In India, the white-winged duck is predominantly found in the northeastern states, particularly Assam. The species inhabits dense tropical evergreen forests, swamps, and wetlands, often favoring secluded, undisturbed areas near rivers and streams. However, extensive deforestation and wetland drainage for agriculture and development have severely reduced its habitat. In Myanmar, which may host the largest remaining population, the duck faces similar threats, including habitat degradation and hunting pressures.

476. The white-winged duck's presence in Thailand, Cambodia, and Indonesia is now limited to small, fragmented populations. In these regions, the species has been extirpated from many former

[60] Assam Roofed Turtle in January 2019 by Subhadra Devi · iNaturalist
[61] White-winged Duck - eBird
[62] Asarcornis scutulata (White-winged Duck)

habitats, including almost all of Vietnam, Laos, and much of Sumatra. The loss of suitable habitat, coupled with hunting and disturbance, has led to its disappearance from these areas.

477. Conservation efforts are underway to protect and restore the white-winged duck's habitat. These initiatives include establishing and managing protected areas, implementing community-based conservation programs, and conducting research to better understand the species' ecology and needs. Additionally, the white-winged duck is listed on Appendix I of the CITES, which prohibits international trade of the species.

478. Despite these efforts, the white-winged duck remains on the brink of extinction. Ongoing habitat destruction, hunting, and human disturbance continue to pose significant threats to its survival. Conservationists emphasize the urgent need for increased protection of remaining habitats, stricter enforcement of hunting regulations, and greater awareness and engagement among local communities to ensure the species' long-term survival.

479. ***Aythya baeri***[63] **(Baer's Pochard), CR.** A freshwater diving duck is native to Asia and is listed as CR on the IUCN Red List. With fewer than 1,000 individuals remaining globally, the species is perilously close to extinction. Historically, Baer's Pochard was widely distributed across southeastern Russia, and parts of South and Southeast Asia. However, its population has undergone a dramatic decline in recent decades, driven by habitat destruction, hunting, and human disturbances. These mounting threats have underscored the urgent need for targeted conservation efforts to prevent the species' extinction.

480. Baer's Pochard primarily breeds in the freshwater wetlands, shallow lakes, and marshes of southeastern Russia. These habitats provide essential nesting sites and abundant food sources, such as aquatic vegetation and invertebrates, which sustain the species during its breeding season. During winter, the species observed in countries such as Bangladesh, Myanmar, and northeastern India. Despite its migratory nature, the species has seen a drastic reduction in the availability of suitable habitats throughout its range. Wetlands essential for breeding and wintering have been drained or converted for agriculture and urban development, leaving fragmented and isolated populations that struggle to sustain themselves. The loss of connectivity between breeding and wintering sites further exacerbates the challenges facing this species, reducing its ability to recover from population declines.

481. The large-scale destruction and conversion of wetlands into agricultural fields and urban landscapes is the most significant threat to Baer's Pochard. Wetland drainage, where the species primarily winters, has eliminated critical habitats that once supported large populations. The transformation of wetlands into rice paddies and other croplands has left the species with limited space to breed, feed, and rest. This habitat loss has significantly impacted the species' ability to maintain stable populations.

482. Despite legal protections in many of its range countries, Baer's Pochard continues to face significant threats from hunting and poaching. The species is hunted for both food and sport, particularly in areas where enforcement of anti-poaching laws is weak or nonexistent. Given the already small global population of Baer's Pochard, even low levels of hunting have devastating effects on its survival prospects. Illegal hunting remains a pervasive issue, highlighting the need for stronger enforcement and community-based conservation measures.

483. The species' reliance on seasonal wetlands makes it particularly vulnerable to the impacts of climate change. Erratic rainfall patterns, prolonged droughts, and altered hydrological cycles have led to the drying up of critical wetlands, exacerbating the challenges faced by Baer's Pochard. As climate change intensifies, the availability and quality of the species' habitats are likely to decline further,

[63] Aythya baeri (Baer's Pochard)

compounding the existing threats.

484. Baer's Pochard is listed under Appendix I of the Convention on Migratory Species (CMS) and Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), providing it with international legal protection. These agreements promote transboundary cooperation among the species' range countries, fostering collaborative conservation strategies.

485. Captive breeding programs have emerged as a key component of the species' conservation efforts. Organizations such as the Wildfowl and Wetlands Trust (WWT) are working to establish a genetically diverse captive population that can serve as a source for future reintroductions into the wild. Additionally, research and monitoring programs, including satellite tracking and field surveys, have improved our understanding of the species' ecology, migration patterns, and habitat requirements, informing conservation planning.

486. ***Houbaropsis bengalensis***[64] **(Bengal Florican), CR.** It is a critically endangered bird species facing severe population declines across its range in India, Nepal, and Cambodia. This decline is primarily attributed to extensive loss and degradation of grassland habitats, largely due to agricultural expansion and human encroachment.

487. In India and Nepal, the Bengal Florican's populations are fragmented and primarily located around the Brahmaputra River and the Terai grasslands. Even within protected areas, numbers are dwindling. In Cambodia, which once harbored a significant portion of the global population, the species has experienced a sharp decline. Recent surveys indicate that fewer than 500 individuals remain, predominantly in Kompong Thom province. Globally, the Bengal Florican's population is estimated to be between 350 and 1,500 individuals. Projections suggest declines exceeding 80% over three generations, underscoring the urgent need for conservation interventions. The primary threat to the Bengal Florican is habitat loss due to the conversion of grasslands into agricultural lands. In Cambodia, for instance, the expansion of dry-season rice cultivation has led to significant habitat destruction. Additionally, infrastructure development, such as irrigation projects, has fragmented remaining habitats, further isolating populations. Human disturbances, including hunting and land-use changes, exacerbate the species' decline.

488. Conservation initiatives are underway to address these challenges. In Cambodia, approximately 350 km² of grassland have been designated as protected areas to support biodiversity and local livelihoods. Activities in these areas include participatory land-use zoning, patrols to report new developments, awareness-raising, and incentive-led nest protection schemes. In Nepal, a 10-year conservation action plan has been launched to recover and restore the Bengal Florican population, focusing on habitat expansion, captive breeding, and community awareness.

489. ***Sterna acuticauda***[65] **(Black-bellied Tern), CR.** It is a freshwater bird species that has become critically endangered due to widespread habitat destruction and human-induced pressures. Historically found across South and Southeast Asia, its range has significantly contracted, with its primary population now confined to India and small, fragmented populations surviving in Nepal, Bangladesh, and Myanmar. Once a common sight along rivers and wetlands, the species has disappeared from many parts of its historical range, including Thailand, and Vietnam. Global estimates indicate that only 800 to 1,600 mature individuals remain, underscoring the urgent need for focused conservation efforts to ensure its survival.

490. The Black-bellied Tern is highly dependent on freshwater ecosystems, primarily large rivers, lakes, and wetlands. It prefers nesting on sandbars, river islands, and shorelines, which provide the

[64] Houbaropsis bengalensis (Bengal Florican)

[65] Sterna acuticauda (Black-bellied Tern)

undisturbed environments necessary for successful breeding and chick-rearing. These habitats are formed and maintained by natural hydrological processes such as river flooding and sediment deposition, making the species highly vulnerable to changes in river dynamics. Its diet consists mainly of small fish, insects, and crustaceans, highlighting its role as a predator that helps maintain the ecological balance of freshwater systems. As an indicator species, the presence of Black-bellied Terns reflects the overall health of river ecosystems, making its conservation critical not just for the species itself but for the broader biodiversity of these habitats.

491. Habitat Destruction is the most significant threat, with rampant sand mining, river damming, and water diversion projects altering or destroying the sandbars and islands that the species relies on for nesting. Sand mining, in particular, directly removes nesting sites and disrupts the natural deposition of sediment necessary for their formation. Similarly, dams and reservoirs alter river flows, flooding some areas while leaving others dry, making them unsuitable for nesting.

492. Human Disturbance further exacerbates the problem. Illegal fishing, egg collection, and the recreational use of riverbanks disrupt the tern's breeding and feeding behaviors. Nesting sandbars are often trampled by livestock or damaged by human activity, leading to significant reductions in reproductive success. Despite legal protections, egg collection for food and sale remains a persistent issue in some regions, particularly in areas where awareness of the species' critical status is low.

493. Pollution in rivers and wetlands is another growing concern. Agricultural runoff, industrial effluents, and plastic waste degrade water quality and reduce the availability of prey species, impacting the tern's ability to feed and sustain its populations. This threat is compounded by climate change, which has introduced new challenges in the form of erratic rainfall patterns, prolonged droughts, and extreme weather events. These changes disrupt the hydrological processes that maintain the tern's nesting habitats, further reducing the availability of suitable sites.

494. Efforts to conserve the Black-bellied Tern focus on habitat protection, legislation, community involvement, and research. Protecting critical habitats along river systems is a priority, with some nesting areas designated as conservation zones. These efforts aim to regulate destructive activities such as sand mining and promote sustainable practices that minimize habitat degradation.

495. Community engagement is another critical aspect of conservation. Local communities are being involved in monitoring nesting sites and reporting illegal activities like egg collection. Awareness campaigns emphasize the ecological importance of the species and its role in maintaining healthy river systems. Incentive-based programs have also been introduced, rewarding communities for protecting sandbars and assisting in conservation efforts.

496. Legally, the Black-bellied Tern is protected under the Wildlife Protection Act of 1972 in India, which prohibits hunting and egg collection. However, enforcement of these laws remains inconsistent, particularly in remote areas. Strengthening legal frameworks and increasing patrolling efforts in key habitats are essential to ensure the species' survival.

497. Research and monitoring are vital components of conservation initiatives. Organizations and researchers are conducting population surveys, studying breeding behaviors, and mapping key habitats to better understand the species' needs. These efforts provide valuable data that inform conservation strategies and help prioritize areas for protection.

498. ***Heliopais personatus***[66] **(Masked Finfoot), CR.** It is a species of waterbird endemic to Southeast Asia, with a rapidly declining population due to habitat destruction and degradation. Known for its unique appearance, featuring lobed feet and distinct facial markings, the species relies heavily

[66] Heliopais personatus (Masked Finfoot)

on undisturbed wetlands and riverine forests for its survival. Once distributed more widely, the species is now confined to small, fragmented populations in Bangladesh, Cambodia, Myanmar, Laos, Vietnam, and potentially northeastern India. With recent records scarce, the global population is estimated to be between 108 and 304 mature individuals. The largest known population exists in the Sundarbans mangrove forest of Bangladesh, which is considered its stronghold. However, even within these critical habitats, populations are dwindling, highlighting the urgent need for conservation efforts.

499. The Masked Finfoot inhabits a range of freshwater and brackish wetlands, including mangroves, oxbow lakes, rivers, and swamp forests. These habitats provide essential resources for foraging, nesting, and breeding, making them critical for the species' survival. The bird's distribution is patchy and fragmented, with the largest population found in the Sundarbans, estimated at 80–160 individuals. Cambodia also supports a small population of 12–64 individuals, where breeding has been documented. Other countries, including Myanmar, Laos, Vietnam, and India, harbor alarmingly small populations, often fewer than 30 individuals. Historical records indicate the species was once more widely distributed, but habitat loss and degradation have led to its disappearance from many areas, particularly in Vietnam and Laos. Today, the bird is found at low densities and is increasingly rare even within its remaining range.

500. The Masked Finfoot faces numerous threats, the most significant of which is habitat loss and degradation. Wetlands and riverine forests across Southeast Asia are being destroyed at an alarming rate due to agricultural expansion, aquaculture, logging, and infrastructure development. In the Sundarbans, for example, shrimp farming, increasing salinity, and embankment construction have significantly reduced the availability of suitable habitats. Similarly, in Cambodia and Myanmar, wetlands are being converted into farmland, depriving the bird of essential breeding and feeding sites.

501. Human disturbance is another critical factor contributing to the species’ decline. Activities such as fishing, logging, and boat traffic disturb the Masked Finfoot’s nesting and foraging behaviors, often forcing it to abandon otherwise suitable habitats. During the breeding season, human presence near nesting sites can lead to direct loss of eggs and chicks. Additionally, pollution from agricultural runoff, industrial waste, and plastic debris degrades water quality and reduces the availability of prey, further compounding the challenges faced by the species.

502. Climate change poses an emerging threat, particularly in low-lying coastal regions like the Sundarbans. Rising sea levels, increased salinity, and more frequent extreme weather events threaten to submerge or alter critical habitats. These changes not only reduce the amount of available habitat but also disrupt the delicate ecological balance of wetland ecosystems. Hunting and egg collection, though less widespread, also pose localized threats, especially in areas where the species is poorly monitored.

503. Efforts to conserve the Masked Finfoot have focused primarily on protecting its remaining habitats and raising awareness about its critical status. Protected areas, such as the Sundarbans Reserve Forest in Bangladesh and wetlands in Cambodia, play an important role in providing safe havens for the species. In Cambodia, specific breeding sites are monitored to minimize disturbances during the nesting season. Awareness campaigns have been conducted to engage local communities and reduce activities that threaten the species. International agreements such as the Ramsar Convention on Wetlands and the Convention on Migratory Species (CMS) have highlighted the Masked Finfoot as a priority species, encouraging transboundary conservation efforts.

504. However, despite these efforts, challenges remain. Inadequate enforcement of conservation laws and ongoing habitat degradation continue to undermine progress. In addition, the bird’s elusive nature and low population densities make it difficult to monitor effectively, complicating efforts to track its status and design targeted interventions.

505. To ensure the survival of the Masked Finfoot, conservation efforts must expand and intensify. Strengthening habitat protection is essential, particularly in key areas such as the Sundarbans and Cambodian wetlands. This includes regulating activities like shrimp farming and logging that directly impact wetland ecosystems. Expanding the network of protected areas and improving their management will also be critical. Community engagement should remain a central focus, with incentive-based programs to encourage sustainable land use practices and reduce human-wildlife conflict. Educating local populations about the ecological importance of the Masked Finfoot and its role in maintaining wetland biodiversity can foster greater support for conservation initiatives.

506. Addressing the impacts of climate change will require innovative and adaptive strategies, such as restoring degraded mangroves and implementing water management systems to counter increasing salinity and rising sea levels. Research and monitoring must be enhanced to better understand the species' ecology, migration patterns, and habitat requirements. Collaboration among governments, NGOs, and local stakeholders is also crucial, as the Masked Finfoot's range spans multiple countries. Joint efforts to share data, coordinate conservation actions, and secure funding for large-scale projects can significantly improve the effectiveness of conservation measures.

507. ***Laticilla cinerascens***[67] **(Swamp Grass-babbler), EN.** Listed as on the IUCN Red List, is a grassland bird primarily found along the floodplains of the Brahmaputra River in Assam, India, and parts of Bangladesh. This small, inconspicuous bird inhabits dense, wet grasslands and is highly specialized in its habitat preferences, which makes it particularly vulnerable to environmental changes. The global population of the Swamp Grass-babbler is estimated to be between 250 and 2,499 mature individuals, and the population is declining due to a combination of habitat loss, degradation, and human activities.

508. The Swamp Grass-babbler is endemic to grasslands, particularly in areas with dense, tall grasses that remain moist year-round. These grasslands are typically associated with river floodplains, making the bird dependent on the dynamic processes of sediment deposition and flooding that sustain these ecosystems. It is found primarily in northeastern India, with key populations near Dibru-Saikhowa National Park, Kaziranga National Park, and other floodplain grasslands along the Brahmaputra River. A smaller, scattered population exists in Bangladesh, although it is largely restricted to remnant grasslands that are increasingly fragmented.

509. This bird's reliance on undisturbed grasslands makes it highly vulnerable to habitat loss and degradation. In particular, the seasonal inundation of floodplains, which plays a vital role in maintaining grassland ecosystems, is being altered by human activities, threatening the availability of suitable habitats.

510. The primary threat to the Swamp Grass-babbler is the widespread destruction of its grassland habitat due to agricultural expansion and conversion of floodplains into croplands. Wet grasslands are increasingly being drained and cleared for farming, depriving the bird of its critical habitat. Livestock grazing further exacerbates the problem, as heavy grazing reduces the density of grasses and disrupts the bird's nesting and foraging behaviors. Grassland burning is another significant threat, particularly near protected areas like Dibru-Saikhowa National Park. While traditional burning practices are sometimes used to regenerate grasslands, unmanaged or excessive burning destroys nesting sites and reduces the availability of food for the species. The increasing human presence in grassland areas, including activities like fishing, wood collection, and tourism, poses a direct threat to the Swamp Grass-babbler. Disturbances during the breeding season can lead to nest abandonment and reduced reproductive success. The impacts of climate change, such as altered rainfall patterns and rising temperatures, are expected to affect the floodplain ecosystems that the bird depends on. Reduced flooding or prolonged droughts can degrade grasslands, making them unsuitable for the species.

[67] Laticilla cinerascens (Swamp Grass-babbler)

511. Efforts to protect and restore grasslands are critical for the conservation of the Swamp Grass-babbler. While areas like Dibru-Saikhowa National Park provide some refuge, additional grasslands along the Brahmaputra River should be identified and designated as protected areas. Expanding the network of protected habitats will help ensure the survival of the species, especially in regions where grasslands are rapidly disappearing.



*The swamp grass babbler occurs in the plains of the Brahmaputra and the Cachar district in the state of Assam, India, and in nearby parts of northern Bangladesh.*[68]



*Black-bellied tern (Sterna acuticauda) occurs mostly in Pakistan, Nepal, India and Bangladesh, with a separate range in Myanmar. Its typical habitat is lowland rivers and marshes, and sometimes ditches and pools.*[69]

512. ***Chitra indica***[70] **(Indian Narrow-headed Softshell Turtle) EN.** The Indian Narrow-headed Softshell Turtle is a large and highly specialized freshwater turtle. It is native to the rivers of Pakistan, India, Nepal, Bangladesh, Myanmar, and possibly parts of Malaysia. Known for its narrow head and elongated snout, the species is adapted for a highly aquatic lifestyle, spending much of its time submerged in riverbeds. Despite its historical abundance, populations have drastically declined due to habitat loss, pollution, and exploitation for trade, especially in South Asia. Its inclusion in CITES Appendix II highlights the need for regulated trade and international cooperation to ensure its survival.

513. The Indian Narrow-headed Softshell Turtle inhabits large rivers, preferring deep channels with sandy or muddy substrates. Its unique physiology, including its flattened body and camouflaged carapace, allows it to remain buried in riverbeds with only its head exposed for breathing. This behavior aids in ambushing prey, which consists mainly of fish and crustaceans.

514. Females of the species require undisturbed sandy beaches along riverbanks for nesting, where they lay their eggs in shallow burrows. Nesting typically occurs during the dry season when water levels are lower, exposing sandy banks. This reliance on specific nesting habitats makes the species particularly vulnerable to changes in riverine ecosystems caused by human activity and natural disruptions.

515. The Indian Narrow-headed Softshell Turtle was once widespread across its range in South and Southeast Asia. However, populations have sharply declined due to various threats. In India, while it is still found in the Ganges, Yamuna, Brahmaputra, and other major rivers, its numbers are dwindling. In Bangladesh, the species is categorized as Endangered, and it has vanished from many historical locations. In Nepal and Myanmar, the species is now rare, with fragmented populations surviving in isolated river stretches.

516. The turtle disappeared from Indian wildlife trade in the 1980s due to strict regulations and

[68] Swamp Grass Babbler (Laticilla cinerascens)
[69] Black-bellied Tern (Sterna acuticauda)
[70] Chitra indica (Indian Narrow-headed Softshell Turtle)

declining wild populations. However, illegal poaching and unregulated collection continue to pose risks, particularly in countries where enforcement is weak.

517. The most significant threat to the Indian Narrow-headed Softshell Turtle is habitat destruction. Large-scale sand mining, dam construction, and riverbed alterations have destroyed critical habitats, particularly nesting beaches and feeding areas. The construction of dams and irrigation projects disrupts natural river flows, leading to the loss of sandy banks where females lay their eggs. Pollution from agricultural runoff, industrial effluents, and urban waste severely degrades water quality in the rivers where the species lives. Reduced water quality affects the availability of prey and disrupts the turtle's aquatic environment.

518. Although the species vanished from India's formal wildlife trade in the 1980s, illegal poaching remains a threat. The turtle is hunted for its meat, which is considered a delicacy in some regions, and its eggs are collected for consumption. In addition, its carapace and other body parts are sometimes used in traditional medicine and the pet trade, despite being listed in CITES Appendix II, which regulates international trade.

519. Climate change exacerbates existing threats by altering river ecosystems. Changes in rainfall patterns, rising temperatures, and extreme weather events disrupt nesting and feeding behaviors. Prolonged droughts, for example, can reduce the availability of nesting sites, while floods can wash away eggs.

520. The Indian Narrow-headed Softshell Turtle is protected under national laws in several countries within its range. In India, it is listed under Schedule I of the Wildlife Protection Act of 1972, which prohibits its hunting and trade. Its inclusion in CITES Appendix II requires international cooperation to regulate trade and prevent overexploitation. However, enforcement of these laws remains inconsistent, particularly in remote areas.

521. Conserving the species' riverine habitats is critical. This includes regulating sand mining, preventing pollution, and maintaining the natural flow of rivers. Efforts are underway in some areas to designate critical habitats as protected zones, where human activity is restricted during key nesting and feeding seasons.

522. ***Geoclemys hamiltonii***[71] **(Spotted Pond Turtle), EN.** This is an freshwater turtle species native to South Asia, particularly the river basins of the Indus, Ganga, and Brahmaputra. Its population has been in significant decline, with a reduction exceeding 50% since 1980. Known for its strikingly patterned shell, which features yellow or white spots on a black background, this species is highly specialized, relying on shallow, vegetated waters for its survival. Despite thriving in some protected areas, it is increasingly rare outside these zones due to habitat loss, exploitation, and other anthropogenic pressures.

523. The Spotted Pond Turtle primarily inhabits freshwater ecosystems, including rivers, oxbow lakes, ponds, and marshes. It prefers shallow waters with abundant aquatic vegetation, which provide shelter and feeding grounds. The species has a varied diet, feeding on snails, insects, small aquatic organisms, and plant matter, making it an omnivore that plays an important role in maintaining the balance of aquatic ecosystems.

524. This turtle has a generation time of around 20 years, meaning that populations take a long time to recover once depleted. Females lay their eggs on sandy or muddy banks, making undisturbed nesting sites critical for reproduction. The species is relatively sedentary, with limited movement between habitats, which further isolates populations and makes them more vulnerable to localized

[71] Geoclemys hamiltonii (Spotted Pond Turtle)

threats.

525. The Spotted Pond Turtle is distributed across the Indus, Ganga, and Brahmaputra river basins in India, Pakistan, Nepal, and Bangladesh. However, its presence is becoming increasingly fragmented due to habitat degradation and other threats. While the species is known to thrive in some protected areas, such as wildlife sanctuaries and national parks, it is rarely found outside these zones. This highlights the importance of effective management and expansion of protected areas to safeguard the species' remaining populations.

526. The global population of the Spotted Pond Turtle is estimated to be declining at a rapid rate, with habitat loss and illegal trade being the primary drivers of this trend. In unprotected areas, populations have become critically small, and in some locations, the species may already be extirpated. The Spotted Pond Turtle is highly sensitive to changes in its habitat. The conversion of wetlands and floodplains into agricultural lands and urban areas has drastically reduced the availability of suitable habitats. Additionally, river pollution from industrial and agricultural runoff degrades water quality, affecting the availability of food and shelter for the species. Infrastructure projects like dams and irrigation systems disrupt the natural flow of rivers, further impacting critical habitats.

527. The species is heavily exploited for its meat, shell, and use in traditional medicine. It is also targeted for the pet trade, where its unique spotted appearance makes it highly desirable. Despite being listed under CITES Appendix I, which prohibits international trade, enforcement of these regulations remains inadequate in many parts of its range.

528. Climate change poses an emerging threat to the Spotted Pond Turtle by altering river ecosystems. Changes in rainfall patterns and the frequency of extreme weather events, such as floods and droughts, can disrupt nesting and feeding behaviors. Rising temperatures may also affect the sex ratios of hatchlings, as the species' reproductive success is temperature-dependent.

529. Nests and hatchlings are often predated by natural predators such as monitor lizards and birds. Human activities, including sand mining, fishing, and recreational use of riverbanks, further disturb nesting sites, reducing reproductive success.

530. ***Hardella thurjii***[72] **(Crowned River Turtle), EN.** This is a freshwater turtle species native to South Asia, particularly the river basins of the Indus, Ganga, and Brahmaputra. Its population has been in significant decline, with a reduction exceeding 50% since 1980. Known for its strikingly patterned shell, which features yellow or white spots on a black background, this species is highly specialized, relying on shallow, vegetated waters for its survival. Despite thriving in some protected areas, it is increasingly rare outside these zones due to habitat loss, exploitation, and other anthropogenic pressures.

531. The Spotted Pond Turtle primarily inhabits freshwater ecosystems, including rivers, oxbow lakes, ponds, and marshes. It prefers shallow waters with abundant aquatic vegetation, which provide shelter and feeding grounds. The species has a varied diet, feeding on snails, insects, small aquatic organisms, and plant matter, making it an omnivore that plays an important role in maintaining the balance of aquatic ecosystems.

532. This turtle has a generation time of around 20 years, meaning that populations take a long time to recover once depleted. Females lay their eggs on sandy or muddy banks, making undisturbed nesting sites critical for reproduction. The species is relatively sedentary, with limited movement between habitats, which further isolates populations and makes them more vulnerable to localized threats.

[72] Hardella thurjii (Crowned River Turtle)

533. The Spotted Pond Turtle is distributed across the Indus, Ganga, and Brahmaputra river basins in India, Pakistan, Nepal, and Bangladesh. However, its presence is becoming increasingly fragmented due to habitat degradation and other threats. While the species is known to thrive in some protected areas, such as wildlife sanctuaries and national parks, it is rarely found outside these zones. This highlights the importance of effective management and expansion of protected areas to safeguard the species' remaining populations.

534. The global population of the Spotted Pond Turtle is estimated to be declining at a rapid rate, with habitat loss and illegal trade being the primary drivers of this trend. In unprotected areas, populations have become critically small, and in some locations, the species may already be extirpated.

535. The Spotted Pond Turtle is highly sensitive to changes in its habitat. The conversion of wetlands and floodplains into agricultural lands and urban areas has drastically reduced the availability of suitable habitats. Additionally, river pollution from industrial and agricultural runoff degrades water quality, affecting the availability of food and shelter for the species. Infrastructure projects like dams and irrigation systems disrupt the natural flow of rivers, further impacting critical habitats.

536. The species is heavily exploited for its meat, shell, and use in traditional medicine. It is also targeted for the pet trade, where its unique spotted appearance makes it highly desirable. Despite being listed under CITES Appendix I, which prohibits international trade, enforcement of these regulations remains inadequate in many parts of its range.

537. Climate change poses an emerging threat to the Spotted Pond Turtle by altering river ecosystems. Changes in rainfall patterns and the frequency of extreme weather events, such as floods and droughts, can disrupt nesting and feeding behaviors. Rising temperatures may also affect the sex ratios of hatchlings, as the species' reproductive success is temperature-dependent.

538. Nests and hatchlings are often predated by natural predators such as monitor lizards and birds. Human activities, including sand mining, fishing, and recreational use of riverbanks, further disturb nesting sites, reducing reproductive success.

539. Efforts to conserve the Spotted Pond Turtle focus on habitat protection, legal enforcement, and research. The species is listed in CITES Appendix I and is protected under national laws in India, Pakistan, and other range countries. However, the implementation of these protections is often weak, particularly in remote areas where illegal activities go unnoticed.

540. Habitat protection is critical for the survival of the Spotted Pond Turtle. Protected areas such as national parks and wildlife sanctuaries have proven to be refuges for the species. Expanding these areas and improving their management are essential steps in ensuring the species' long-term survival. Additionally, habitat restoration projects, including replanting aquatic vegetation and improving water quality, can help rehabilitate degraded ecosystems.

541. Research and monitoring programs are vital for understanding the species' population trends, habitat requirements, and threats. Satellite tracking and field surveys can provide valuable data to inform conservation strategies. Public awareness campaigns can also play a role in reducing exploitation and encouraging local communities to participate in conservation efforts.



*The black pond turtle also known commonly as the spotted pond turtle and the Indian spotted turtle, is a species of freshwater turtle in the family Geoemydidae*[73]



*Hardella thurjii is found in northern India, Pakistan, and Bangladesh in the watersheds of the Ganges, Brahmaputra, and Indus rivers.*[74]

542. ***Leptoptilos dubius***[75] **(Greater Adjutant), EN.** It is a large stork species once widespread across South and Southeast Asia, it is now primarily found in Assam, India, and Cambodia, with smaller, scattered populations in Bangladesh. The global population is estimated at 1,360 to 1,510 mature individuals, making it one of the rarest stork species in the world. Despite recent stabilization of its population due to intensive conservation efforts, the species remains vulnerable due to its small population size, habitat loss, and dependence on human protection.

543. The Greater Adjutant inhabits wetlands, floodplains, and garbage dumps, relying heavily on both natural and anthropogenic habitats for foraging and nesting. Its diet is opportunistic, consisting of fish, carrion, reptiles, and small mammals, which it scavenges from water bodies and refuse sites. During the breeding season, the species nests in tall trees, often in close proximity to human settlements. Colonies of nesting adjutants can number in the hundreds, with the most significant nesting sites located in Assam and Cambodia.

544. Wetlands and riparian ecosystems are critical for the survival of this species, as they provide feeding grounds and nesting materials. However, the species' increasing reliance on garbage dumps for food due to the degradation of natural habitats underscores the urgent need for habitat restoration.

545. Historically, the Greater Adjutant was distributed across the Indian subcontinent and Southeast Asia, but habitat loss and hunting have restricted its range to a few strongholds. Assam, India, supports the largest population, with key breeding sites in Kamrup District, including the famed nesting colonies of Dadara and Pacharia villages. In Cambodia, the species is found primarily around the Tonle Sap Lake, where smaller breeding populations persist. Recent reports suggest isolated occurrences in Bangladesh, but these are extremely limited.

546. The population has stabilized in recent years due to dedicated conservation initiatives, particularly in Assam, where community-driven efforts have resulted in the protection of nesting colonies. However, the species remains dependent on active protection, and any lapse in conservation measures could lead to renewed declines.

547. The primary threat to the Greater Adjutant is the loss of wetland habitats due to agricultural expansion, urbanization, and infrastructure development. Draining wetlands for farmland and

[73] Black Pond Turtle (Geoclemys hamiltonii) · iNaturalist
[74] Crowned River Turtle (Hardella thurjii)
[75] Leptoptilos dubius (Greater Adjutant)

settlement reduces the availability of feeding and nesting sites. Additionally, deforestation, particularly the felling of tall nesting trees, disrupts breeding colonies.

548. Greater Adjutants often nest in areas close to human habitation, making them vulnerable to disturbances from noise, construction, and other activities. Nest abandonment due to human interference is a significant concern, particularly in unprotected areas. Pollution of wetlands with agricultural runoff, plastic waste, and industrial effluents impacts the species' feeding grounds. The increasing reliance on garbage dumps for food exposes the birds to health risks, including ingestion of toxic materials and pathogens.

549. With a global population of fewer than 1,600 mature individuals, the Greater Adjutant is highly vulnerable to stochastic events such as disease outbreaks or natural disasters. Its reliance on a few key nesting sites further exacerbates this risk, as the loss of these sites could have devastating consequences for the species.

550. Conservation programs in Assam and Cambodia have focused on protecting critical nesting and foraging habitats. In Assam, community-led initiatives have resulted in the protection of nesting trees in villages such as Dadara and Pacharia. These efforts have been supported by organizations such as the Hargila Army, a women-led conservation group that has been instrumental in raising awareness and safeguarding the species.

551. In Cambodia, the species benefits from wetland conservation projects around the Tonle Sap Lake, which aim to protect nesting colonies and maintain the health of surrounding ecosystems. Legal protections under national laws and international frameworks, such as the Ramsar Convention, also play a role in preserving wetland habitats.

552. To ensure the long-term survival of the Greater Adjutant, conservation efforts must continue to focus on habitat restoration, community involvement, and policy enforcement. Expanding protected areas to include key wetlands and nesting sites is essential, as is the restoration of degraded habitats. Efforts to reduce reliance on garbage dumps by improving wetland quality and food availability will be critical for the species' health.

553. Enhanced international collaboration is needed to protect the species across its range, particularly in Cambodia and Bangladesh, where conservation efforts are less developed. Climate change adaptation measures, such as maintaining water levels in wetlands and protecting climate-resilient habitats, should also be integrated into conservation plans.

554. ***Rynchops albicollis***[76] **(Indian Skimmer), EN.** This is a striking waterbird known for its unique foraging behavior and distinct black-and-white plumage. Found primarily in India, its global population is estimated at 2,450 to 2,900 mature individuals. Historically widespread across the Indian subcontinent and parts of Southeast Asia, the Indian Skimmer's range and population have been drastically reduced due to habitat loss and degradation. With a population decline of 34-46% over the past 16 years, the species faces significant threats, particularly from changes in riverine ecosystems caused by human activities.

555. The Indian Skimmer inhabits large rivers, lakes, and reservoirs, where it relies on sandy islands and riverbanks for breeding and roosting. The bird's name is derived from its unique feeding strategy-using its elongated lower mandible to "skim" the water's surface for fish and other aquatic prey. This behavior makes it highly dependent on calm, shallow waters with abundant fish populations.

556. Breeding typically occurs during the dry season, when water levels recede, exposing sandy

[76] Rynchops albicollis (Indian Skimmer)

riverbanks and islands that serve as nesting sites. However, these habitats are highly sensitive to fluctuations in water levels, making the species vulnerable to habitat changes caused by damming, irrigation, and unregulated sand mining.

557. Historically, the Indian Skimmer was found across India, Bangladesh, Myanmar, Cambodia, Laos, and Vietnam. However, the species has disappeared from much of its former range in Southeast Asia, including Myanmar, Cambodia, Laos, and Vietnam. Its current distribution is concentrated in India, with key breeding populations along the Chambal River, Ganges, Yamuna, Mahanadi, and Son Rivers. Some breeding colonies are also found in reservoirs like Pong Dam in Himachal Pradesh.

558. During the non-breeding season, the Indian Skimmer migrates to lower river stretches and estuaries, wintering in regions like Bangladesh and coastal India. However, breeding is now largely confined to a few key sites in India, underscoring the species' precarious dependence on limited and fragmented habitats.

559. The most significant threat to the Indian Skimmer is habitat degradation caused by river damming, irrigation projects, and sand mining. These activities alter water flows and destroy sandy nesting sites, forcing birds to abandon breeding attempts. Seasonal fluctuations in water levels caused by dam releases can inundate nests and reduce the availability of foraging habitats. Unregulated sand mining along riverbanks is particularly detrimental, as it destroys the sandy islands and banks required for nesting. This practice not only removes critical habitats but also increases human disturbance in breeding areas. River pollution from agricultural runoff, industrial waste, and untreated sewage degrades water quality and reduces fish populations, the primary food source for the Indian Skimmer. Pollution also disrupts the delicate balance of riverine ecosystems, further impacting the species. Human activities such as fishing, tourism, and recreational use of rivers disturb nesting colonies, leading to nest abandonment and reduced breeding success. Nesting sites located near human settlements are particularly vulnerable to disturbance. The impacts of climate change, including altered rainfall patterns, rising temperatures, and more frequent extreme weather events, pose additional challenges. Changes in river hydrology and the frequency of floods can wash away nests or render breeding sites unsuitable. Several of the Indian Skimmer's key breeding sites, such as the Chambal River Sanctuary, are located within protected areas. These sanctuaries play a vital role in safeguarding critical habitats. However, the effective management of these areas, including regulating sand mining and minimizing human disturbance, is crucial for the species' survival.



*Leptoptilos Dubius Once found widely across southern Asia and mainland southeast Asia, the greater adjutant is now restricted to a much smaller range including north-eastern state of Assam, Bhagalpur and Cambodia*[77].



*Indian skimmer seen skimming for food in the River Chambal near Dholpur, Rajasthan. The Indian skimmer is most common in northern and central India, rare sighting at Assam. It is less common south of Maharashtra and northern Andhra Pradesh.*[78]

[77] Greater Adjutant (Leptoptilos dubius)
[78] Crowned River Turtle (Hardella thurjii)

560. ***Morenia petersi* (Indian Eyed Turtle), EN.** The *Morenia petersi* is a freshwater turtle species found primarily in the northern tributaries of the Ganges and Brahmaputra basins in India and Bangladesh. It is a medium-sized turtle, recognizable by the distinctive “eyespots” on its carapace, which serve as its defining feature. Over the years, the population of *Morenia petersi* has experienced a significant decline due to a combination of habitat destruction, pollution, and exploitation for food and trade. This species is vital for maintaining the ecological balance of freshwater ecosystems, as it feeds on aquatic vegetation and small invertebrates, contributing to nutrient cycling.

561. *Morenia petersi* inhabits slow-moving rivers, wetlands, and oxbow lakes in the Ganges and Brahmaputra basins. It prefers shallow, vegetated waters with ample sunlight for basking. The species is omnivorous, feeding on a diet that includes aquatic plants, algae, and small invertebrates like snails and insects. Its dependence on freshwater wetlands makes it highly vulnerable to changes in water quality and habitat conditions. Breeding occurs during the warmer months, with females laying eggs on sandy riverbanks or other soft substrates near water bodies. The survival of hatchlings is heavily influenced by the availability of undisturbed nesting sites and the absence of predators.

562. One of the primary threats to *Morenia petersi* is the loss of freshwater habitats due to wetland conversion for agriculture, urbanization, and infrastructure development. The drainage of wetlands and the diversion of rivers for irrigation have significantly reduced the species’ habitat, leaving isolated populations in fragmented ecosystems. Pollution from agricultural runoff, industrial waste, and untreated sewage poses a severe risk to the Indian Eyed Turtle. Contaminants degrade water quality, affecting the availability of food and suitable nesting sites. The accumulation of pesticides and heavy metals in aquatic ecosystems can also harm the turtle’s health and reproductive success. *Morenia petersi* is extensively harvested for its meat and eggs, both for local consumption and for export to East Asian markets, where freshwater turtles are in high demand. The illegal trade of turtles has intensified in recent decades, with *Morenia petersi* often targeted despite its protected status. This exploitation has drastically reduced wild populations and continues to threaten the species’ survival.

563. Rising temperatures and altered rainfall patterns due to climate change are affecting the hydrology of the Ganges and Brahmaputra basins. Reduced water flow during dry seasons and extreme flooding events during monsoons disrupt the turtle’s habitat and nesting cycles.

564. Morenia petersi is listed under CITES Appendix II, which regulates international trade in the species to ensure that it does not threaten its survival. In Bangladesh, the species is protected under the Bangladesh Wildlife Protection Act, which prohibits hunting and trade. However, enforcement of these regulations remains inconsistent, particularly in remote areas.

565. The species is found in several protected wetland areas, including parts of the Ganges and Brahmaputra floodplains. These areas serve as critical refuges, safeguarding habitats from human encroachment. Expanding the network of protected wetlands is essential to ensure the long-term survival of Morenia petersi. Engaging local communities in conservation efforts has proven effective in reducing threats to the Indian Eyed Turtle. Awareness campaigns highlighting the ecological importance of turtles and their habitats encourage sustainable practices such as reducing pollution and curbing illegal trade.

566. ***Tringa guttifer* (Spotted Greenshank), EN.** Also known as the Nordmann’s Greenshank, this striking bird is known for its distinctive greenish-yellow legs and elegant plumage, with speckled patterns on its back during the breeding season. With a global population estimated at just 1,500–2,000 individuals, including 900–1,600 mature birds, the Spotted Greenshank faces a precarious future. The species has experienced significant declines due to coastal habitat loss caused by development, industrial activities, and aquaculture, making conservation efforts critical.

567. The Spotted Greenshank is highly dependent on coastal habitats, including mudflats, estuaries,

saltpans, and coastal meadows. During its breeding season, it nests in eastern Russia, primarily on Sakhalin Island and adjacent regions. These nesting sites are typically located in wet tundra environments with sparse vegetation, providing camouflage and protection. In winter, the bird migrates to Southeast Asia, including countries such as Bangladesh, Myanmar, Thailand, and Vietnam. Its wintering grounds are characterized by intertidal zones, where the bird forages on crustaceans, mollusks, and small invertebrates. The species is a key indicator of wetland health, and its decline reflects broader issues affecting coastal and intertidal ecosystems.

568. The Spotted Greenshank follows the East Asian-Australasian Flyway, one of the most critical migration corridors for wader species. This flyway spans Russia, East Asia, and Southeast Asia, with key stopover and wintering sites in Bangladesh, Thailand, and Myanmar. Unfortunately, habitat loss along this flyway has drastically reduced the number of suitable sites available for resting and foraging during migration. Coastal reclamation and industrialization in countries like Vietnam have particularly impacted stopover habitats.

569. The bird's breeding range is restricted to parts of eastern Russia, including Sakhalin Island and nearby coastal regions. The wintering population is scattered across a few key wetlands in South and Southeast Asia, with some of the largest groups observed in Bangladesh's Sundarbans, Myanmar's Gulf of Martaban, and Thailand's Inner Gulf. The primary threat to the Spotted Greenshank is the loss of intertidal habitats due to land reclamation, industrial projects, and aquaculture. Vast areas of mudflats and coastal meadows have been converted into shrimp farms, salt pans, and urban developments, leaving the species with fewer foraging and roosting sites.

570. Human activities, including fishing, tourism, and infrastructure development, disturb the bird's natural behavior. Increased noise and movement in intertidal zones force birds to abandon feeding grounds, reducing their energy reserves for migration and breeding. Although hunting is illegal in many parts of its range, illegal trapping for food and the pet trade persists, particularly in countries with weak enforcement of wildlife protection laws. This adds further pressure to an already small population. Rising sea levels and changes in weather patterns caused by climate change threaten the Spotted Greenshank's habitats. Coastal erosion, saltwater intrusion, and the increasing frequency of extreme weather events, such as typhoons, pose additional challenges for this species.

571. Key wintering and stopover sites for the Spotted Greenshank are now included in protected areas and Ramsar sites, such as the Sundarbans in Bangladesh and the Inner Gulf of Thailand. These designations aim to safeguard critical habitats and reduce human disturbance. The Spotted Greenshank benefits from international agreements under the East Asian-Australasian Flyway Partnership (EAAFP) and CITES Appendix I. These frameworks promote coordinated conservation actions across its range, including habitat restoration and anti-poaching measures.

572. Efforts to restore degraded wetlands and mudflats, particularly in key countries like Thailand, and Bangladesh, are underway. These projects aim to enhance the quality of foraging and roosting habitats, ensuring sufficient resources for migrating birds.

573. ***Aborichthys garoensis, VU.*** This is a freshwater hill stream fish native to the Garo Hills of Meghalaya India. Its status reflects its restricted distribution, with a range of less than 20,000 km², and its susceptibility to habitat degradation. This species thrives in clear, oxygenated streams with pebbly or rocky bottoms, making it highly dependent on pristine freshwater habitats. However, its habitat is increasingly under threat from human activities, particularly deforestation, siltation, and pollution.

574. *Aborichthys garoensis* is adapted to fast-flowing, oxygen-rich streams typically found in forested hill regions. These streams provide ideal conditions for the species, including ample oxygen levels, low temperatures, and a substrate of pebbles or rocks where the fish can shelter and forage. The species plays a role in maintaining the ecological balance of its habitat by feeding on small invertebrates, algae, and detritus. The monsoon season, which brings heavy rains and increased water flow, is critical for

the species' lifecycle. However, this period also introduces risks such as increased siltation and habitat disturbance due to runoffs from deforested and degraded areas.

575. *Aborichthys garoensis* is endemic to the Northeast Indian hill regions, particularly the Garo Hills in Meghalaya. Its limited distribution makes it vulnerable to localized threats, and there is a lack of comprehensive data on its population trends. Surveys suggest that its numbers are declining in several areas due to habitat fragmentation and degradation. The restricted range of this species also means that any significant changes to its habitat-such as pollution or climate-induced alterations in water flow-can have a severe impact on its population.

576. The primary threat to *Aborichthys garoensis* is habitat destruction caused by deforestation for agriculture, logging, and infrastructure development. Forest cover is crucial for maintaining the health of hillstream ecosystems, as it stabilizes soil, regulates water temperature, and prevents siltation. The removal of vegetation leads to increased sedimentation in streams, which clogs the rocky substrates the fish rely on for shelter and food. Siltation from deforested and degraded landscapes, especially during the monsoon season, reduces water clarity and oxygen levels, making the habitat unsuitable for the species. Additionally, agricultural runoff and pollutants from nearby settlements degrade water quality, further threatening the fish. Changes in rainfall patterns and rising temperatures due to climate change can disrupt the flow and temperature of streams, negatively affecting the species' habitat. Prolonged droughts or altered monsoon cycles can reduce water availability, while extreme flooding events can physically damage habitats.

577. One of the key challenges in conserving *Aborichthys garoensis* is the lack of detailed data on its population size, distribution, and ecology. Limited awareness about the species among local communities and policymakers further hampers conservation efforts. Additionally, many of the streams where the fish is found lie outside protected areas, leaving them vulnerable to unregulated exploitation and degradation.

578. ***Chrysomma altirostre***[79] **(Jerdon's Babbler), VU.** It primarily inhabits tall wet grasslands along the Indus River in Pakistan, Nepal's Terai, and the Ganga-Brahmaputra floodplain, including Majuli Island in Assam, India. With a global population estimated at 2,500–9,999 mature individuals, the species is experiencing a steady decline due to the widespread destruction and fragmentation of its habitat. Jerdon's Babbler is highly dependent on undisturbed wet grasslands for nesting and foraging, making it particularly susceptible to human-induced threats such as agriculture, overgrazing, and infrastructure development. Its declining population highlights the critical need for conservation actions to protect its grassland habitat and mitigate ongoing threats.

579. Jerdon's Babbler thrives in tall, dense grasslands typically associated with wetlands, floodplains, and riverine systems. These habitats provide the bird with the necessary cover for nesting and protection from predators. The species feeds on a diet of small insects, invertebrates, and seeds, which are abundantly available in undisturbed grassland ecosystems. Its preference for wet grasslands also makes it an indicator of the health of these ecosystems, which support a wide variety of flora and fauna.

580. The bird is predominantly non-migratory, with populations remaining within their limited range throughout the year. During the breeding season, which coincides with the monsoon period, the species constructs nests in thick vegetation close to the ground. These habitats are vulnerable to seasonal flooding and human activities, further complicating the survival of the species.

581. Historically, Jerdon's Babbler was widely distributed across the wetlands and floodplains of South Asia. However, its range has become increasingly fragmented due to the loss of suitable

[79] Chrysomma altirostre (Jerdon's Babbler)

habitats. Today, the bird is restricted to small, isolated populations in Pakistan, Nepal, and India. In Pakistan, it is found along the Indus River and its tributaries, while in Nepal, it occurs in the Terai grasslands, including protected areas such as Chitwan National Park. In India, its population is concentrated in the Ganga-Brahmaputra floodplains, particularly in Assam, where it is known to inhabit Majuli Island and other wetland regions.

582. The population of Jerdon's Babbler is estimated to be declining at a moderate rate due to ongoing habitat destruction. Most of its surviving populations are located within protected areas, but even these are under pressure from human activities. Without targeted conservation measures, the species is at risk of further population declines and local extinctions.

583. The primary threat to Jerdon's Babbler is the loss of tall wet grasslands, which are increasingly being converted into agricultural fields and urban areas. The expansion of intensive farming practices, particularly in the fertile floodplains of the Ganga and Brahmaputra, has replaced large tracts of natural grassland with cropland, leaving little room for the species to thrive. Overgrazing by livestock further degrades the remaining grasslands, reducing the density and diversity of vegetation. This not only limits nesting opportunities but also diminishes food availability. Grazing pressure is particularly severe in unprotected areas, where there are few restrictions on livestock movement. Infrastructure projects such as roads, dams, and urban settlements fragment and degrade wet grassland habitats. In the Brahmaputra floodplains, dam construction has altered natural flood cycles, disrupting the growth of grasslands and reducing the availability of suitable habitats for Jerdon's Babbler. The species is also vulnerable to climate change, which affects rainfall patterns and river flow regimes. Changes in monsoon intensity and frequency can result in either excessive flooding or prolonged droughts, both of which can destroy the grasslands essential for the bird's survival. Jerdon's Babbler benefits from the inclusion of its habitats in several protected areas, such as Chitwan National Park in Nepal and Kaziranga National Park in India. These areas provide a safe refuge from habitat destruction and human disturbance. However, the protection of additional grassland areas, particularly outside the boundaries of existing reserves, is crucial for ensuring the long-term survival of the species.

584. Habitat management efforts, including the control of invasive species, regulation of grazing, and replanting of native grasses, are essential to restore degraded ecosystems. Seasonal burning of grasslands, a traditional practice in some regions, must be carefully regulated to avoid disrupting nesting birds.

585. ***Clanga clanga***[80] **(Greater Spotted Eagle), VU.** Found across Europe, Asia, and parts of Mongolia, its population is estimated to consist of fewer than 10,000 mature individuals. Over the past three generations, the species has experienced a suspected population decline of over 30%, primarily due to habitat loss, persecution, and competition with related species. The Greater Spotted Eagle is ecologically significant as a top predator in its wetland ecosystems, feeding on small mammals, waterbirds, and reptiles, and contributing to ecological balance.

586. The Greater Spotted Eagle inhabits lowland forests and areas close to wetlands, including marshes, riverbanks, and lakes. These habitats provide ample hunting grounds and nesting sites. The species prefers undisturbed environments with a mix of open spaces and forest cover, which facilitate hunting and breeding activities. It is a highly opportunistic predator, feeding on a variety of prey, including rodents, small reptiles, and wetland birds. During the breeding season, it constructs large nests in trees, often near water bodies.

587. This species is migratory, with breeding populations in Eastern Europe, Russia, and Central Asia. During the winter, it migrates to South Asia, the Middle East, and parts of Africa, depending on local climatic conditions and food availability. Wetland degradation in these wintering grounds has

[80] Clanga clanga (Greater Spotted Eagle)

severely impacted the eagle's survival and reproductive success.

588. One of the most significant threats to the Greater Spotted Eagle is the loss of wetland and forest habitats. Wetlands are often drained for agriculture, urbanization, and infrastructure development, leaving the species with fewer breeding and hunting grounds. Forests near wetlands are also being cleared, further reducing nesting sites. Despite legal protections in many countries, the Greater Spotted Eagle is occasionally targeted by hunters. Persecution arises from conflicts with poultry farmers and misconceptions about the bird's role in ecosystems. In some regions, it is also hunted for trophies or as part of traditional practices. Hybridization with the Lesser Spotted Eagle (Clanga pomarina) is an emerging threat, particularly in areas where their ranges overlap. The resulting hybrid offspring can reduce the genetic purity of the species and impact reproductive success. Competition with the Lesser Spotted Eagle for food and nesting sites further exacerbates the decline of the Greater Spotted Eagle. Changes in climate patterns, such as altered rainfall and rising temperatures, have disrupted the availability of wetlands and prey species. Droughts and prolonged dry seasons in breeding and wintering grounds have further reduced the eagle's habitat suitability.

589. The global population of the Greater Spotted Eagle is fragmented and declining. Key breeding populations are found in Russia, Belarus, and parts of Eastern Europe, while wintering populations are distributed across India, Pakistan, the Middle East, and parts of Africa. In countries like Mongolia, the species' range is limited to isolated pockets of suitable habitat. The overall population decline is driven by habitat degradation across both breeding and wintering sites, leaving the species highly vulnerable to extinction.

590. The Greater Spotted Eagle is protected under several international agreements, including the CMS and CITES Appendix II, which regulate hunting and international trade. It is also listed in the EU Birds Directive, requiring member states to implement conservation measures. Conservation efforts focus on preserving and restoring wetlands and lowland forests. Protected areas, such as nature reserves and national parks, provide critical refuges for the species. Wetland restoration projects, including rehydration of drained marshes and control of invasive plant species, aim to enhance habitat quality.

591. ***Cuora amboinensis***[81] **(Southeast Asian Box Turtle), VU.** This species is classified as Vulnerable (VU) on the IUCN Red List due to a 50-80% population decline over the last three generations. This alarming decline is attributed to unsustainable exploitation for the pet trade, food markets, and traditional medicine, as well as widespread habitat destruction. Found across a broad geographic range in Southeast Asia, including India and Bangladesh, the species thrives in lowland swampy areas, rice paddies, and mangrove creeks. Despite stable populations in a few protected areas in Indonesia and the Philippines, its numbers are rapidly dwindling in regions such as Vietnam, Cambodia, and Laos.

592. The Southeast Asian Box Turtle is semi-aquatic, inhabiting a variety of wetland environments, including marshes, rice fields, mangrove forests, and slow-moving rivers. These habitats provide the turtle with access to abundant food sources, including aquatic vegetation, small invertebrates, and detritus. The species is well-adapted to both terrestrial and aquatic environments, with a hinged plastron that allows it to completely enclose itself for protection.

593. The species' breeding season varies across its range but is typically influenced by rainfall. Females lay 2-5 eggs per clutch in soft, moist soil near water bodies, often coinciding with the monsoon season. Hatchling survival is highly dependent on habitat quality and the absence of predators, making degraded ecosystems less viable for reproduction.

594. The pet trade is one of the primary threats to the Southeast Asian Box Turtle. Its appealing

[81] Cuora amboinensis (Southeast Asian Box Turtle)

appearance and manageable size make it a popular choice for exotic pet owners, particularly in East Asian and Western markets. Additionally, the species is heavily harvested for use in traditional medicine and as a delicacy in food markets. The destruction of wetland habitats due to agricultural expansion, urbanization, and deforestation has significantly reduced the species' available range. In countries like Vietnam and Cambodia, large-scale conversion of wetlands into rice paddies and industrial zones has disrupted ecosystems, leaving the turtles with fewer suitable habitats. Wetland pollution from agricultural runoff, industrial waste, and untreated sewage has degraded the water quality in many of the turtle's habitats. Furthermore, climate change is altering wetland hydrology, with rising temperatures and irregular rainfall patterns affecting the availability of food and nesting sites. Despite being listed under CITES Appendix II, which regulates international trade, the species is frequently smuggled across borders due to high demand in the pet and food industries. Weak enforcement of wildlife protection laws in some Southeast Asian countries exacerbates this issue.

595. The species is distributed across Southeast Asia, including India, Bangladesh, Myanmar, Thailand, Vietnam, Laos, Cambodia, Indonesia, Malaysia, and the Philippines. While populations in certain protected areas in Indonesia and the Philippines remain relatively stable, numbers have declined sharply in unprotected regions due to overexploitation and habitat degradation. Countries like Vietnam, Cambodia, and Laos have seen some of the steepest declines, with local extinctions reported in several areas.

596. The Southeast Asian Box Turtle is protected under CITES Appendix II, restricting international trade, and is listed under various national wildlife protection laws in countries like India, Bangladesh, and Indonesia. However, enforcement of these regulations is inconsistent, particularly in regions with high levels of illegal trade. Conservation efforts in protected areas, such as national parks and wildlife sanctuaries, have been moderately successful in safeguarding stable populations. Expanding the network of protected wetlands and implementing stricter management practices can help protect critical habitats. In regions where the species is harvested for food and trade, promoting sustainable harvesting practices can reduce pressure on wild populations. Community-based conservation initiatives that involve local stakeholders in protecting and managing turtle populations have shown promise in similar contexts. Captive breeding programs have been established in some countries to bolster wild populations and reduce pressure from illegal trade. These programs aim to release healthy individuals into restored habitats and create genetically diverse populations for future reintroductions. Raising awareness about the ecological importance of Cuora amboinensis and the threats it faces can help reduce demand in the pet trade and food markets. Educational campaigns targeting local communities and international consumers are critical to addressing the root causes of exploitation.

597. ***Devario assamensis***[82]***,*** **VU.** This is a freshwater fish species endemic to India, specifically found in the Tangla region of Assam and the Dibrugarh-Kalmoni drainage area, which spans the boundary between Assam. This rare species, originally classified under the genus *Danio*, was later reclassified into the genus *Devario* due to its distinct morphological features. As a habitat specialist, it thrives in fast-flowing streams with clear, oxygen-rich water, making it highly susceptible to environmental changes. The restricted distribution of *Devario assamensis* and the growing anthropogenic threats to its habitat underscore the urgent need for conservation actions to ensure its survival.

598. *Devario assamensis* inhabits small, fast-flowing streams and rivers in the foothills of the Eastern Himalayas. These streams are characterized by rocky substrates, cool water temperatures, and high oxygen levels, which provide ideal conditions for this species. The fish is primarily omnivorous, feeding on small aquatic invertebrates, algae, and detritus. As a schooling species, it plays a vital role in maintaining the ecological balance of its freshwater ecosystem by contributing to nutrient cycling and serving as prey for larger predators.

[82] Devario assamensis

599. While its exact breeding behavior remains poorly studied, the species is believed to spawn during the monsoon season, similar to other members of the Devario genus. This seasonal dependency further links its survival to the health and natural flow regimes of its aquatic habitats.

600. The primary threat to *Devario assamensis* is habitat degradation caused by deforestation, agricultural expansion, and human settlement. Deforestation in the catchment areas of its streams leads to increased sedimentation and siltation, which disrupt water clarity and reduce the availability of suitable spawning grounds. Damming of rivers and water diversion for hydroelectric projects and irrigation have severely impacted the flow and ecological characteristics of the streams where Devario assamensis resides. These activities alter water flow patterns, reduce oxygen levels, and fragment populations, leading to a decline in genetic diversity. Industrial development and unregulated agricultural practices have resulted in the contamination of freshwater systems with pesticides, heavy metals, and other pollutants. This not only affects the water quality but also impacts the food web dynamics, further endangering the species. The species' highly restricted range makes it more vulnerable to localized threats. With populations confined to a few isolated streams, any adverse environmental changes in these areas can have a disproportionate impact on the overall population.

601. Some of the streams inhabited by *Devario assamensis* may fall within or near Nameri National Park in Assam and Pakke Tiger Reserve. These protected areas offer some level of habitat security by safeguarding ecosystems from large-scale deforestation and industrial encroachment. However, targeted efforts are required to include its critical habitats in conservation management plans.

602. ***Francolinus gularis***[83] **(Swamp Francolin), VU.** Formerly *Francolinus*, is a Vulnerable species according to the IUCN Red List, is endemic to the low-lying floodplains and grasslands of South Asia. Historically classified under the genus *Francolinus*, this bird is now placed in the genus *Scleroptila*. Its range primarily spans India and Nepal, with significant populations concentrated in protected areas such as Kaziranga National Park and Dudhwa National Park. The global population of the Swamp Francolin is estimated at 7,500 to 20,000 mature individuals, with its numbers stabilized in some well-managed protected zones. However, habitat degradation, hunting, and other anthropogenic pressures remain substantial threats to its survival.

603. The Swamp Francolin inhabits tall, wet grasslands, marshes, and the floodplains of major river systems like the Ganges and Brahmaputra. These habitats provide ample cover for nesting and access to a diet consisting of seeds, insects, and small invertebrates. The bird is a ground-dwelling species, rarely seen flying except when disturbed, and relies on dense grass cover for shelter and foraging.

604. Breeding occurs during the monsoon season, with nests typically hidden within thick grasses to protect eggs from predators and environmental disturbances. As a species dependent on wetland ecosystems, the Swamp Francolin is particularly vulnerable to changes in water availability and grassland quality.

605. The primary threat to the Swamp Francolin is habitat loss due to agricultural expansion, urbanization, and infrastructure development. Conversion of wetlands and grasslands into croplands and settlements has drastically reduced the extent and quality of its habitat, particularly in unprotected areas. Encroachment into protected zones further exacerbates the problem. Overgrazing by livestock in grassland ecosystems depletes the vegetation cover required by the Swamp Francolin for nesting and foraging. Additionally, the spread of invasive plant species, such as water hyacinth (*Eichhornia crassipes*), disrupts the natural composition of wetland ecosystems, making them unsuitable for the bird. Although hunting is illegal in most of its range, the Swamp Francolin has historically been targeted for its meat and as a game bird. While this threat has been reduced within protected areas, sporadic

[83] Ortygornis gularis (Swamp Francolin)

poaching persists in unprotected regions, where enforcement of wildlife protection laws is weak. The Swamp Francolin is heavily reliant on seasonal flooding to maintain its wetland habitat. Changes in rainfall patterns due to climate change, along with increasing instances of droughts and floods, have disrupted the natural hydrology of these ecosystems, further threatening the bird's survival.

606. The Swamp Francolin is primarily found in northern and northeastern India, along with southern Nepal. Its most significant populations are concentrated in well-protected reserves such as Kaziranga National Park, Manas National Park, Dudhwa National Park, and other parts of the Terai Arc Landscape. Smaller populations have also been recorded in Assam and Bihar, though these are more vulnerable due to inadequate habitat protection.

607. The designation of national parks and wildlife sanctuaries, such as Kaziranga and Dudhwa, has played a critical role in stabilizing populations of the Swamp Francolin. Effective management practices in these areas, including controlled grazing, invasive species removal, and wetland restoration, have improved habitat quality. Expanding the network of protected areas to include additional grassland and floodplain habitats is essential for long-term conservation. Local communities living near protected areas are key stakeholders in the conservation of the Swamp Francolin. Efforts to involve these communities in habitat restoration and anti-poaching initiatives have shown positive results. Providing alternative livelihoods for communities dependent on grassland resources can reduce pressures on critical habitats. Ongoing research to understand the ecological requirements and population dynamics of the Swamp Francolin is crucial. Regular monitoring of its populations in protected and unprotected areas can help identify emerging threats and assess the effectiveness of conservation strategies.

608. The Swamp Francolin is protected under the Wildlife Protection Act of India, 1972, and its inclusion in CITES Appendix II restricts international trade. Strengthening the enforcement of these legal protections, particularly in areas outside of national parks, is necessary to combat hunting and habitat encroachment.



*Devario assamensis is a large danionin from the Assam and Mirik area of India. It grows to 6 inches and has a deep-red stripe along the length of its body, as well as the more usual yellow and blue stripes*[84].



*The swamp francolin (Francolinus gularis), also called swamp partridge, is a francolin species native to the foothills of the Himalayas in northern India and Nepal.*[85]

609. ***Geoclemys hamiltonii***[86] **(Spotted Pond Turtle), VU.** This is a freshwater turtle native to South Asia, with a range that includes the Indus, Ganga, and Brahmaputra River basins across India, Pakistan, Bangladesh, and Nepal. The species is easily recognizable by the distinctive white or yellow spots on its shell and limbs, making it one of the more striking freshwater turtles in its range. Despite its ecological and aesthetic importance, this species has suffered significant population declines of approximately 50% since the 1980s, primarily due to habitat destruction, pollution, and overexploitation for local consumption and international trade. Its vulnerability is further heightened by its specialized habitat requirements and fragmented populations, which are increasingly confined to protected areas.

[84] Devario assamensis
[85] Swamp Francolin (Ortygornis gularis)
[86] Geoclemys hamiltonii (Spotted Pond Turtle)

610. The Spotted Pond Turtle thrives in shallow, vegetated wetlands, such as ponds, oxbow lakes, marshes, and slow-moving rivers. These habitats provide ample food sources, including snails, insects, aquatic vegetation, and detritus, which form the basis of the turtle's omnivorous diet. Females, which are significantly larger than males, lay their eggs in sandy areas near waterbodies, further underlining the species' dependence on intact and undisturbed wetland ecosystems. The turtles play an essential ecological role in maintaining the health of wetlands by controlling insect populations and contributing to nutrient cycling. However, their preference for specific wetland conditions makes them highly sensitive to changes in habitat quality and availability, exacerbating their decline in unprotected areas.

611. The range of the Spotted Pond Turtle extends across four countries, but its populations are unevenly distributed and increasingly fragmented. In India, the species is relatively common in protected areas such as Kaziranga National Park, which provides critical refuge. However, it has become rare in non-protected regions, particularly in Assam, where habitat destruction has nearly extirpated the species. In Pakistan, the turtle remains relatively frequent in the rivers of Punjab, but urbanization and water pollution pose growing threats. Bangladesh has seen a sharp population decline, with the species now considered rare, especially in heavily urbanized or agricultural zones. In Nepal, the turtle's presence is limited to small, isolated populations in the lowland regions of the Terai. Globally, the population is in sharp decline, and outside of protected areas, sightings are becoming increasingly infrequent.

612. The most significant threat to the Spotted Pond Turtle is wetland destruction and degradation. Across its range, wetlands are being drained or converted for agriculture, urban expansion, and industrial development. Pollution from agricultural runoff, untreated sewage, and industrial effluents has further degraded water quality, reducing the availability of suitable habitats. In particular, the Indus and Ganga River basins, once home to thriving populations, have seen large-scale habitat loss due to human activities. The turtle is heavily exploited for local consumption, particularly in rural areas where it is valued for its meat. Additionally, it is sought after in the international pet trade, despite being listed under CITES Appendix I, which prohibits international trade. In some regions, the species is also used in traditional medicine, further contributing to its decline. The impacts of climate change, including erratic rainfall patterns, prolonged droughts, and rising temperatures, pose an emerging threat to the Spotted Pond Turtle. Changes in water availability and quality directly affect its breeding and feeding habitats, while extreme weather events can disrupt nesting behavior. Efforts to conserve the Spotted Pond Turtle focus on habitat protection, legal measures, and public awareness. In India, the species is protected under the Wildlife Protection Act of 1972, and its trade is regulated under CITES Appendix I. Protected areas such as Kaziranga National Park play a crucial role in providing safe habitats, but more wetlands need to be included in the protected area network to ensure the species' survival. Habitat restoration initiatives, such as the rehabilitation of polluted wetlands and the creation of buffer zones around critical habitats, are essential for addressing the species' habitat needs. Additionally, local communities must be involved in conservation efforts, with programs designed to educate them about the ecological importance of the turtle and the benefits of sustainable resource use.

613. ***Leptoptilos javanicus***[87] **(Lesser Adjutant), VU.** This species is a large wading stork native to South and Southeast Asia, recognized for its distinctive bald head, prominent beak, and a wingspan that can exceed two meters. Currently listed as Vulnerable (VU) on the IUCN Red List, the species is experiencing population declines across much of its range due to habitat loss, hunting, and human disturbances. Once widely distributed across its range, the Lesser Adjutant is now confined to fragmented populations in India, Sri Lanka, Nepal, Bhutan, Bangladesh, Myanmar, and Cambodia, with significant declines reported in Sumatra, Borneo, and other parts of Southeast Asia. Conservation actions are urgently required to prevent further population declines and to secure the species' long-

[87] Leptoptilos javanicus (Lesser Adjutant)

term survival.

614. The Lesser Adjutant primarily inhabits wetlands, including marshes, swamps, riverbanks, and flooded forests. It is also found in rice paddies and agricultural landscapes close to waterbodies. The species is an opportunistic feeder, preying on fish, amphibians, reptiles, and small mammals, often scavenging in shallow wetlands or along water edges. Its nesting habitat typically consists of tall trees near wetlands, where breeding colonies are formed. In Cambodia, for example, the Tonle Sap Lake provides a critical nesting and foraging site, supporting an estimated 500 breeding pairs as of 2021. The Lesser Adjutant is also known to forage in human-altered landscapes, which exposes it to various anthropogenic threats.

615. The global population of the Lesser Adjutant is estimated to be fewer than 20,000 mature individuals, with the largest remaining populations concentrated in India and Cambodia. India serves as a critical stronghold, especially in the northeastern states like Assam, which historically hosted significant breeding colonies. However, the conversion of wetlands and logging of nesting trees have led to the disappearance of several colonies. The species is still relatively common in parts of eastern and southern India, where conservation efforts have helped stabilize some populations.

616. In Cambodia, the Lesser Adjutant remains abundant in wetlands around Tonle Sap Lake, which represents one of its last viable strongholds in Southeast Asia. However, in other regions of Southeast Asia, including Sumatra, Borneo, and Java, the species is increasingly rare due to widespread habitat destruction and hunting. In Sri Lanka, the species persists in low numbers, often associated with protected wetlands and reserves. Similarly, in Nepal and Bhutan, the population is highly fragmented, with records primarily confined to lowland forests and riverine habitats.

617. The largest threat to the Lesser Adjutant is the destruction and degradation of wetlands, primarily due to agricultural expansion, urbanization, and infrastructure development. The drainage of marshlands for rice cultivation and the conversion of wetlands into industrial or residential areas have drastically reduced available habitats. Logging of large trees used for nesting has further impacted breeding success. The species is often hunted for its meat and feathers, particularly in parts of Southeast Asia. Wetlands inhabited by the Lesser Adjutant are increasingly polluted by agricultural runoff, pesticides, and untreated industrial waste. Human activities such as fishing, tourism, and urban encroachment near nesting sites disturb the species' natural behaviors, often causing abandonment of nests or foraging areas.

618. ***Lissemys punctata***[88] **(Indian Flapshell Turtle), VU.** is classified as Vulnerable due to a population decline of more than 30% over the past three generations, primarily driven by wetland loss and extensive local collection. It is found across the Indian subcontinent, except the Thar Desert, and is present in diverse habitats, including rivers, lakes, rice fields, and urban canals. The species is an opportunistic omnivore and typically matures at around 4-5 years, with females laying clutches of 2–15 eggs. While populations were historically stable, illegal trade and habitat degradation pose ongoing threats. The species is included in CITES Appendix II, which regulates international trade, though local trade for food and medicinal use remains significant.

[88] Lissemys punctata (Indian Flapshell Turtle)



*The lesser adjutant is a large wading bird in the stork family Ciconiidae. It is however more closely associated with wetland habitats where it is solitary and is less likely to scavenge than the related greater adjutant. It is a widespread species found from India through Southeast Asia.* [89].



*The Indian flapshell turtle (Lissemys punctata) is a freshwater species of turtle found in South Asia Indian flapshell turtles are widespread and common in the South Asian provinces including Assam State.*[90]

619. ***Melanochelys tricarinata***[91] **(Tricarinate Hill Turtle), VU.** It is a species native to the Himalayan foothills, with a distribution range spanning western Uttar Pradesh in India, as well as southern Nepal. This small, terrestrial turtle primarily inhabits grasslands, scrublands, and lowland forests, thriving at elevations up to 300 meters. The species is semi-fossorial, meaning it spends part of its life burrowed in the soil or leaf litter, and it is most active during the wet season. While it is uncommon across much of its range, localized populations in areas like Dehradun, India, can be relatively abundant. However, its population is under significant threat due to habitat destruction, illegal wildlife trade, and subsistence exploitation.

620. The Tricarinate Hill Turtle is a semi-fossorial species that inhabits areas with dense vegetation, particularly terai regions, grasslands, and forest edges. It prefers environments where it can burrow and find refuge, making it well-suited to a semi-fossorial lifestyle. During the monsoon and wet seasons, the species becomes more active, foraging for food and engaging in reproductive behaviors. Its diet primarily consists of fruits, leaves, and small invertebrates, indicating an omnivorous feeding pattern. The turtle's ability to remain inconspicuous in leaf litter and soil helps it avoid predators, but this same cryptic behavior can make population monitoring challenging.

621. The Tricarinate Hill Turtle's range is primarily concentrated in the Himalayan foothills of northern India and southern Nepal. While its exact population size is unknown, the species is considered uncommon across much of its range. Localized populations, such as those in Dehradun, are relatively stable, but in other regions, particularly in eastern Nepal and northeastern India, habitat loss and exploitation have led to significant declines. The species' restricted distribution and patchy populations exacerbate its vulnerability to anthropogenic pressures.

622. In Nepal, the turtle is predominantly found in the terai lowlands, where forests and grasslands are rapidly being converted to agricultural land. Similar patterns of habitat fragmentation and degradation are evident in parts of Assam, where deforestation for timber and agricultural expansion threaten its habitat. Habitat destruction is the most significant threat to the Tricarinate Hill Turtle. The conversion of terai grasslands and forests into agricultural fields, along with infrastructure development and logging, has severely reduced suitable habitats. In eastern Nepal and northeastern India, deforestation for monoculture plantations and urban expansion has further fragmented the turtle's habitat, making it increasingly difficult for populations to thrive.

[89] Lesser Adjutant (Leptoptilos javanicus)
[90] Swamp Francolin (Ortygornis gularis)
[91] Melanochelys tricarinata (Tricarinate Hill Turtle)

623. The Tricarinate Hill Turtle is highly sought after in the international pet trade, as well as for the creation of curio masks and other decorative items. Between 2000 and 2015, over 2,000 specimens were confiscated in seizures, highlighting the scale of illegal trade. The species is particularly vulnerable to poaching due to its small size and cryptic behavior, which makes it relatively easy to capture. Additionally, its popularity as an exotic pet has surged, with high demand in East Asian and Western markets.

624. In rural areas, the Tricarinate Hill Turtle is often captured for local consumption, with its meat considered a delicacy in some communities. The turtle's eggs are also harvested for food, further contributing to population declines. This subsistence exploitation is particularly prevalent in remote regions where alternative protein sources may be scarce.

625. The Tricarinate Hill Turtle is listed as VU on the IUCN Red List and is protected under CITES Appendix II, which regulates international trade. In India, it is protected under the Wildlife Protection Act, 1972, which prohibits hunting and trade of the species. Despite these legal protections, enforcement remains a challenge, particularly in remote areas where poaching is widespread.

626. Conservation efforts include habitat protection and the establishment of protected areas such as national parks and wildlife sanctuaries. In India, the turtle benefits indirectly from protection in areas like Rajaji National Park and Jim Corbett National Park, which harbor suitable habitats. Similarly, in Nepal, conservation initiatives in the Chitwan National Park region have provided some refuge for the species.

627. ***Nilssonia gangetica***[92] **(Indian Softshell Turtle), VU.** This species is native to the river basins of northern India, Nepal, Pakistan, and Afghanistan. It is one of the largest freshwater turtles in South Asia, recognized for its flattened, leathery shell and ability to thrive in turbid, muddy rivers and large canals. Despite its adaptability, the species has experienced a population decline exceeding 50% over the past three generations, driven primarily by overexploitation for its meat, calipee (a gelatinous cartilage used in soup), and the illegal pet trade. This once-abundant turtle is now increasingly rare, with stable populations limited to select protected areas such as temple ponds and regions with reduced human impact. However, habitat loss and targeted exploitation continue to pose severe threats to its survival.

628. The Indian Softshell Turtle is primarily found in large river systems, including the Ganges, Indus, and Brahmaputra River basins, along with associated wetlands, reservoirs, and canals. It is highly adapted to turbid, muddy environments, where it relies on its cryptic coloration to avoid predators and human capture. This species is omnivorous, feeding on a combination of animal matter, fish, insects, and aquatic vegetation. Its role as a scavenger and predator makes it an integral part of freshwater ecosystems, helping maintain ecological balance by controlling fish populations and consuming organic debris. In addition to rivers, the species can often be found in temple ponds, particularly in northern India, where turtles are protected due to religious or cultural practices. However, even in such sanctuaries, habitat degradation and unchecked exploitation are emerging concerns.

629. The Indian Softshell Turtle has a wide but fragmented distribution across South Asia. In India, the species is present in most northern states, particularly in the Ganges and Yamuna river systems, while in Nepal, it is confined to the Terai lowlands. In Pakistan, populations are found in the Indus River, and isolated populations occur in Afghanistan. The overall population size remains unknown, but significant declines have been documented due to habitat destruction and exploitation. Regions like Assam and Uttar Pradesh have seen sharp population drops, while pockets of stability exist in protected wetlands and religious sites.

[92] Nilssonia gangetica (Indian Softshell Turtle)

630. The Indian Softshell Turtle is extensively hunted for its meat and calipee, which are considered delicacies in local and international markets. The illegal pet trade also contributes to its decline, with hatchlings often smuggled across borders for sale as exotic pets. Due to its large size and slow reproductive rates, the species is particularly vulnerable to overharvesting. Habitat destruction, including river pollution, sand mining, dam construction, and agricultural expansion, has drastically reduced the availability of suitable habitats for the species. Water pollution from industrial runoff and agricultural pesticides further degrades the quality of its habitat, limiting the availability of food and nesting sites. Changing river hydrology due to erratic rainfall patterns and prolonged droughts poses a long-term threat to the species. The drying of wetlands and seasonal rivers, coupled with reduced water flows in major river systems, exacerbates the loss of critical habitats. While temple ponds offer a refuge for many turtles, these sites are increasingly becoming overcrowded and polluted. Overfeeding and improper management in such ponds can lead to health issues and reduced reproductive success among turtle populations.

631. The Indian Softshell Turtle is listed under CITES Appendix I and enjoys protection under the Indian Wildlife Protection Act, 1972, which prohibits hunting and trade. However, enforcement of these laws remains inconsistent, particularly in remote areas. Efforts to conserve the species include the establishment of protected areas and river sanctuaries, such as the National Chambal Sanctuary, which provides a critical refuge for softshell turtles and other aquatic species. Habitat restoration programs, particularly in degraded river systems, are essential for ensuring the survival of the species. Stronger enforcement of wildlife trade regulations is needed to curb illegal trafficking. This includes border patrols, increased penalties for poaching, and awareness campaigns targeting local communities involved in turtle hunting.

632. ***Nilssonia hurum***[93] **(Indian Peacock Softshell Turtle), VU.** A freshwater turtle which native to the river basins of northern India, Bangladesh, and southern Nepal. This species is notable for its distinctive peacock feather-like markings on its carapace, which give it its name. Despite its ecological importance as a scavenger and predator in freshwater ecosystems, the species has experienced significant population declines over the past few decades due to overexploitation, habitat destruction, and pollution. The turtle's populations have become fragmented, and sightings in the wild are increasingly rare, indicating a troubling trend toward localized extinctions.

633. *Nilssonia hurum* primarily inhabits large rivers, floodplains, ponds, and marshes, often preferring slow-moving or stagnant waters with muddy or sandy bottoms. The species is highly adapted to freshwater environments, where it plays a critical role in maintaining ecosystem balance by preying on snails, fish, aquatic invertebrates, and occasionally consuming aquatic vegetation. Adult turtles can grow up to 60 cm in length and exhibit sexual dimorphism, with females generally larger than males. The species is known to bask on riverbanks during the day and burrow into the mud during cooler months, making it semi-aquatic and behaviorally versatile.

634. Despite its adaptability to a range of aquatic habitats, *Nilssonia hurum* is particularly sensitive to environmental changes. Rivers polluted by agricultural runoff, industrial discharge, and untreated sewage have drastically reduced the quality of its habitats. Additionally, the loss of nesting sites due to riverbank erosion and sand mining has further contributed to the species' decline.

635. The geographic distribution of Nilssonia hurum spans northern India, particularly in the Ganges and Brahmaputra river systems, as well as southern Nepal and parts of Bangladesh. While the species was once relatively abundant, market surveys and field studies indicate that populations have sharply declined, especially in non-protected areas. Localized populations remain in some protected zones, such as wildlife sanctuaries and national parks, but even these are under increasing pressure from

[93] Nilssonia hurum (Indian Peacock Softshell Turtle)

illegal activities and habitat degradation. The turtle's market presence has dwindled, with fewer individuals appearing in trade, suggesting either scarcity or stricter enforcement of wildlife protection laws.

636. One of the primary threats to Nilssonia hurum is overexploitation for food, calipee (cartilage used in traditional soups), and the illegal pet trade. The species is particularly sought after in East Asian markets, where demand for exotic turtles remains high. Despite legal protections, the illicit capture and trade of the turtle continue unabated, driven by organized smuggling networks. Habitat destruction due to urbanization, agricultural expansion, dam construction, and sand mining poses a severe threat to the survival of Nilssonia hurum. The conversion of wetlands and floodplains into agricultural or industrial land reduces available habitats, while river pollution from pesticides, fertilizers, and industrial waste further degrades water quality. In some areas, river flow regulation through dams and barrages has altered the hydrological regimes, negatively impacting the turtle's ability to find suitable breeding and feeding grounds. The species often becomes entangled in fishing nets, leading to accidental injuries or deaths. The use of fine-mesh nets and traps in rivers and floodplains frequently results in the unintentional capture of turtles. The lack of awareness among local fishers about the ecological role of these turtles exacerbates the problem.

637. *Nilssonia hurum* is listed under CITES Appendix I, which prohibits international commercial trade of the species. In India, the turtle is protected under the Wildlife Protection Act of 1972, which imposes strict penalties for hunting, capturing, or trading protected species. However, enforcement remains inconsistent, particularly in remote areas where monitoring is challenging. Efforts to conserve the turtle's habitat include the designation of protected areas and wildlife reserves, particularly in regions such as Kaziranga National Park and the National Chambal Sanctuary. These areas serve as critical refuges for the species, safeguarding both their habitats and breeding sites. Wetland restoration programs and initiatives to mitigate river pollution are also vital for preserving the turtle's natural habitats. To combat illegal trade, stricter enforcement of wildlife trafficking laws is essential. Community-based anti-poaching programs and increased patrolling of trade routes can help curb illegal activities. Public awareness campaigns aimed at reducing demand for turtle products in local and international markets are equally important.

638. ***Ophiophagus hannah***[94] **(King Cobra), VU.** is widely distributed across South and Southeast Asia, from Nepal and India to the Philippines and Indonesia. Despite its broad range, it is rare in most areas, with notable declines in population in many parts of its habitat. Habitat destruction, deforestation for agriculture, and overexploitation for the leather trade have significantly reduced its numbers, with some regions reporting over 80% declines over the past decade. In Thailand, the species remains relatively stable in protected areas, but in other regions like Vietnam and Nepal, it is increasingly rare. The King Cobra prefers undisturbed forests but can also be found in degraded habitats and agricultural areas. It faces continued threats from human activities and is listed under CITES Appendix II to regulate trade.





[94] Ophiophagus hannah (King Cobra)

*Indian softshell turtle (Nilssonia gangetica), or Ganges softshell turtle is a species of softshell turtle found in South Asia in rivers. This species is often found to occur in the Indus, Ganges/Padma, Meghna, Brahmaputra, Jamuna, Narmada and Mahanadi basins and most of their tributaries* [95].

*The king cobra has a wide distribution throughout tropical Asia. It occurs in elevations of 2,000 m (6,600 ft) from the Terai in India and southern Nepal to the Brahmaputra River basin and northeast India, down to Bangladesh, Myanmar, Cambodia, Thailand, Vietnam; to the maritime Southeast Asian countries.*[96]

639. ***Paradoxornis flavirostris***[97] **(Black-breasted Parrotbill), VU.** This is a grassland species considered likely endemic to northeastern India, where it has become rare and is found in only a few isolated areas. Once more widespread across South Asia, the bird has suffered a dramatic reduction in its range due to extensive habitat loss and fragmentation. This rare species is now limited to isolated populations in specific regions such as Assam, and Manipur. Characterized by its striking black breast and stout yellow bill, the Black-breasted Parrotbill relies on specialized habitats, particularly tall grasslands and reed thickets along river floodplains. However, these habitats are under significant threat, making the conservation of this species increasingly critical.

640. The Black-breasted Parrotbill thrives in floodplain habitats dominated by tall grasses like *Saccharum* and *Phragmites*, which provide cover, nesting sites, and food resources. These habitats are found in protected areas such as D'Ering Memorial Wildlife Sanctuary, Kaziranga National Park, and Manas National Park. Recently, a small population was discovered near Loktak Lake in Manipur. The most significant populations are in D'Ering Wildlife Sanctuary and the Lower Dibang Valley, where a few hundred individuals persist. In contrast, populations in Kaziranga, Manas, and Loktak are much smaller, with Loktak hosting fewer than 250 individuals.

641. Historically, the species had a broader distribution across the floodplains of northeastern India and neighboring countries, but its range has been severely fragmented. Outside protected areas, the bird is now extremely rare, highlighting the importance of safeguarding these critical refuges. The loss of suitable habitats, largely due to agricultural expansion and urbanization, has confined the species to a fraction of its former range. Globally, the population of the Black-breasted Parrotbill is estimated at 1,500 to 4,000 mature individuals. These birds are distributed across scattered subpopulations, with the most viable populations found in the D'Ering Wildlife Sanctuary and the Lower Dibang Valley. Smaller populations persist in Kaziranga, Manas, and Loktak Lake, but their fragmented nature makes them particularly vulnerable to extinction. The species' reliance on small, isolated habitats increases the risk of genetic bottlenecks and reduces its ability to adapt to environmental changes. Without targeted conservation efforts, these subpopulations face a high risk of further decline.

642. The primary threats to the Black-breasted Parrotbill stem from human activities that degrade and destroy its grassland habitats. Agricultural expansion in the fertile floodplains of the Brahmaputra and B. rivers has converted large swaths of grasslands into cropland. Urbanization and infrastructure development further exacerbate the loss of suitable habitats. Additionally, overgrazing by livestock disrupts vegetation and destroys nesting sites, while inappropriate grassland management practices, such as frequent burning during the dry season, render habitats unsuitable for the species.

643. Hydrological changes caused by dam construction and flood control measures have also had a significant impact. These changes disrupt the natural flooding cycles that sustain grassland ecosystems, leading to the drying of wetlands and the loss of critical habitats. The fragmented distribution of the Black-breasted Parrotbill further compounds these challenges, as isolated subpopulations are more vulnerable to localized threats and natural disasters.

644. Conservation efforts for the Black-breasted Parrotbill focus on habitat protection, restoration,

[95] Ganges Softshell Turtle (Nilssonia gangetica)
[96] King Cobra (Ophiophagus hannah)
[97] Paradoxornis flavirostris (Black-breasted Parrotbill)

and management. Protected areas like Kaziranga National Park and D'Ering Wildlife Sanctuary provide essential refuges, but habitat management within these areas needs improvement. Restoring degraded grasslands by replanting native vegetation and controlling invasive species is critical to expanding suitable habitats. Engaging local communities in sustainable grazing practices and habitat monitoring can also play a significant role in the species' conservation.

645. ***Pelecanus philippensis*** **(Spot-billed Pelican), VU.** This is a large waterbird primarily found in South and Southeast Asia. Its population, estimated at 13,000–18,000 individuals globally, has been experiencing fluctuations due to both conservation efforts and ongoing threats. This species primarily breeds in India, Sri Lanka, and Cambodia, with South India hosting the largest population of over 5,000 individuals. The species' preferred habitats include freshwater wetlands, reservoirs, and marshes, where it feeds predominantly on fish. Despite some population increases in certain protected areas, habitat degradation, human disturbance, and deforestation continue to threaten its long-term survival.

646. The Spot-billed Pelican is largely resident in the Indian subcontinent and parts of Southeast Asia, particularly Cambodia and Myanmar. In India, it is most abundant in southern regions, including Karnataka, Tamil Nadu, and Andhra Pradesh, where it breeds in colonies located near waterbodies. Sri Lanka and Cambodia also support smaller populations, with significant breeding colonies recorded at Prek Toal in Cambodia's Tonle Sap Lake.

647. The pelican inhabits diverse wetland habitats, including lakes, ponds, marshes, and reservoirs, where it finds its primary food source-fish. It nests in tall trees, often Acacia and Tamarind, in proximity to wetlands. These colonial nesting sites are critical for the survival of the species and are often shared with other waterbirds like cormorants and herons. However, the availability of suitable nesting and feeding habitats has declined significantly due to urbanization and agricultural expansion.

648. Although global population estimates range between 13,000 and 18,000 individuals, local populations have shown varying trends. South India remains a stronghold, with over 5,000 individuals benefiting from protection in areas like the Ranganathittu Bird Sanctuary and Nelapattu Bird Sanctuary. In Cambodia, the breeding population at Prek Toal has been stable, largely due to community-based conservation efforts. However, in other parts of its range, particularly in Myanmar and Bangladesh, the population has declined or become fragmented, with sightings becoming increasingly rare.

649. The Spot-billed Pelican faces numerous threats that jeopardize its survival. Habitat loss and degradation, primarily caused by wetland drainage, agricultural expansion, and urban development, have significantly reduced the availability of suitable nesting and foraging sites. Deforestation, particularly the removal of tall trees near wetlands, has destroyed critical nesting habitats. Human disturbance, including tourism and fishing activities, often disrupts nesting colonies, leading to abandonment of eggs and chicks. Illegal hunting for meat and feathers, though less common in recent years, remains a localized threat in some regions. Additionally, pollution from agricultural runoff and industrial waste degrades water quality in the wetlands, affecting fish populations and, consequently, the pelicans' primary food source. Climate change, with its associated impacts on hydrology and wetland ecosystems, poses an emerging threat to the species' habitats.

650. Efforts to conserve the Spot-billed Pelican focus on habitat protection, awareness programs, and legislation. Protected areas such as bird sanctuaries and Ramsar wetlands in India and Cambodia have played a critical role in stabilizing some local populations. Community involvement, particularly in Cambodia, has been instrumental in reducing disturbance and hunting near nesting colonies. Legal protections under national wildlife acts and international agreements like the CMS provide a framework for conservation.

651. Restoration of degraded wetlands, reforestation near nesting sites, and sustainable fishing practices are vital for the long-term survival of the species. Monitoring programs and research initiatives

are helping to identify key habitats and track population trends. Public awareness campaigns aimed at reducing human disturbance and promoting the ecological importance of wetlands have also shown promising results in some regions.

652. ***Pellorneum palustre***[98] **(Marsh Babbler), VU.** It inhabits tall grasslands and wetlands in scattered locations, including Kaziranga National Park, Dibru Saikhowa National Park, and other areas in Meghalaya. The species is highly specialized in its habitat requirements, relying on dense grassland ecosystems for foraging and nesting. Unfortunately, these habitats are rapidly diminishing due to human activities, putting the Marsh Babbler at significant risk of extinction.

653. The Marsh Babbler is restricted to northeastern India, where it thrives in the dense grasslands and wetlands along the Brahmaputra floodplain. These areas are characterized by seasonal flooding, which supports the growth of tall grasses essential for the bird's survival. Key strongholds for the species include protected areas such as Kaziranga and Dibru Saikhowa National Parks. However, the species has also been recorded in less-protected regions of Meghalaya. The total remaining habitat for the Marsh Babbler is estimated to cover less than 500 square kilometers, highlighting its highly localized and fragmented distribution.

654. The global population of the Marsh Babbler is estimated to be between 2,500 and 9,999 mature individuals, with the population trend declining. The species is scarce and highly localized, occurring in small, isolated populations. Its Vulnerable status reflects the rapid habitat loss and fragmentation it faces, which are compounded by the species' reliance on specific grassland ecosystems. Despite the presence of some populations in protected areas, the overall decline in suitable habitat poses a serious threat to its long-term survival.

655. The primary threat to the Marsh Babbler is habitat loss, driven by agricultural expansion, overgrazing by livestock, and grassland conversion for human settlement. Inappropriate grassland management practices, such as over-burning and unregulated cutting of grasses, further degrade the quality of its habitat. Climate change also poses an emerging threat, as rising temperatures and altered rainfall patterns could disrupt the seasonal flooding that maintains its preferred grassland habitats. In addition to habitat loss, human disturbance in and around protected areas contributes to population declines. Many protected areas lack effective management to address these pressures, leaving the species vulnerable even within supposedly safe habitats.

656. ***Criterion 2: Endemic and Restricted-range Species*****.** For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an extent of occurrence less than 50,000 square kilometers ($km^2$). The threshold for Criterion 2 is area holds ≥10% of the global population size and ≥10 reproductive units of a species. Under this criterion, only the following species may trigger this criterion.

657. ***Devario assamensis,*** **VU.** is a large danionin from the Assam and Mirik area of India. It grows to 6 inches and has a deep-red stripe along the length of its body, as well as the more usual yellow and blue stripes. Its rare a fish species found in only a few streams near Tangla in Assam and the Dibrungharh-Kalmoni drainage area between Assam, India.

658. ***Channa bleheri*** **(Rainbow Snaahehead), NT.** It is an endemic fish species restricted to the Brahmaputra River basin in northeastern India, specifically Assam. This small and vibrantly colored snakehead is renowned for its ornamental value and ecological role in freshwater ecosystems. It thrives in slow-moving or stagnant freshwater habitats, including wetlands, beels (oxbow lakes), floodplains, and shallow ponds with abundant vegetation. Despite its localized presence in Assam, *Channa bleheri* is under increasing threat from habitat destruction and overexploitation, necessitating urgent

[98] Pellorneum palustre (Marsh Babbler)

conservation attention.

659. In Assam, *Channa bleheri* is predominantly found in regions such as Dibrugarh, Tinsukia, and Lakhimpur districts, where the seasonal flooding of wetlands creates ideal conditions for its survival. Wetlands near protected areas like Kaziranga National Park and Dibru-Saikhowa National Park are known to harbor populations of this species, although no comprehensive population surveys have been conducted to estimate its abundance across the state. Anecdotal evidence suggests that while populations in less disturbed habitats remain stable, numbers are declining in areas affected by agricultural expansion, urbanization, and overfishing. Habitat degradation has fragmented populations, leaving them isolated and more vulnerable to local extinction.

660. The population of *Channa Bleheri* in Assam faces significant threats from human activities. Habitat loss is one of the primary drivers of its decline, as wetlands are increasingly converted into agricultural land, infrastructure, and urban settlements. Pollution from agricultural runoff, untreated sewage, and industrial effluents further degrades the water quality, making it unsuitable for the species. Additionally, the ornamental fish trade poses a major threat to *Channa bleheri*. The species' vivid coloration makes it highly sought after in the aquarium market, leading to overharvesting from the wild. This is particularly concerning as the fish is not widely distributed and relies on specific habitats that are rapidly disappearing.

661. Despite these challenges, there are opportunities for conservation. Protected wetlands and national parks such as Kaziranga and Dibru-Saikhowa offer crucial refuges for *Channa bleheri*. However, conservation efforts must extend beyond these protected areas to include community-managed wetlands and other freshwater ecosystems. Habitat restoration projects, particularly those aimed at rehabilitating degraded wetlands and beels, could help stabilize and enhance populations. In addition, regulating the ornamental fish trade through sustainable collection practices, captive breeding programs, and strict enforcement of quotas could alleviate pressure on wild populations. Raising awareness among local communities about the ecological importance of wetlands and the species they support is also vital to achieving long-term conservation goals.



***Channa Bleheri*** *is among the most colorful species of snakehead and* Endemic to the Brahmaputra River basin, particularly northeastern part of Assam.[99]

662. ***Ctenops nobilis*** **(Frail Gourami), NT**[100]. The frail gourami is known to inhabit various freshwater ecosystems in Assam, particularly the floodplain wetlands, beels (oxbow lakes), and slow-flowing tributaries of the Brahmaputra River basin. Although detailed population studies in Assam are limited, anecdotal evidence and localized surveys suggest that the species is present in areas such as Deepor Beel, Dibru-Saikhowa National Park, and the surrounding wetlands of Kaziranga National Park. These habitats provide the ideal conditions of clear, overgrown, and slow-moving waters that are critical for the survival of this micro-predatory species.

663. Despite its historical abundance, the population of *Ctenops nobilis* in Assam has been showing signs of decline. Factors such as wetland degradation, agricultural expansion, and pollution have led to significant habitat loss. Siltation, caused by heavy monsoon rains and deforestation in upstream

[99] Rainbow Snakehead (Channa bleheri)
[100] Frail Gourami (Ctenops nobilis)

areas, has altered the water clarity and flow, negatively affecting the habitats preferred by the Frail Gourami. Furthermore, increased human activities, including the conversion of wetlands for agriculture and urban expansion, have fragmented populations and reduced the availability of suitable breeding sites. Some reports suggest that the species is becoming increasingly rare outside protected areas, though it remains relatively stable in less disturbed wetlands.

664. Localized surveys have noted the presence of *Ctenops nobilis* in Deepor Beel, a Ramsar site, where conservation measures have helped maintain some of the natural wetland characteristics. However, even in protected areas, challenges such as invasive species and pollution persist. For example, Deepor Beel and other Brahmaputra floodplain wetlands are facing encroachment and eutrophication, which threaten the biodiversity, including the Frail Gourami.

665. In Assam, community-driven initiatives, such as the restoration of degraded wetlands and sustainable fishing practices, could play a crucial role in stabilizing *Ctenops nobilis* populations. Additionally, scientific monitoring and ecological studies are needed to better understand the distribution and population trends of this species in the state. Improved habitat protection, combined with awareness campaigns about the ecological importance of wetlands, can help ensure the long-term survival of the Frail Gourami in Assam. Without proactive conservation efforts, the continued degradation of Assam's wetlands may result in further population declines, potentially pushing the species closer to a threatened status.



***Ctenops nobilis*** *NT. It is an endemic and is restricted range species native to northeastern India and Bangladesh.*

666. ***Criterion 3: Migratory and Congregatory Species.*** Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem). While, congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable. The thresholds for Criterion 3 are:

a. Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle.
b. Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.

667. ***Anas Acuta (*Northern pintail), LC.** With its distinctive long neck and tail, it is a migratory duck species that plays an important ecological role in Assam's wetland ecosystems. During the winter months, it migrates 'in large numbers from its northern breeding grounds in Europe, Asia, and North America to warmer regions, including the wetlands of Assam. This species is a common sight in Assam, particularly in Deepor Beel, Maguri Motapung Beel, and other floodplain wetlands of the Brahmaputra Valley. The pintail's preference for shallow freshwater lakes, floodplains, and wetland habitats makes Assam a crucial wintering ground for this globally distributed species.

668. In Assam, the population of Northern Pintails fluctuates annually but remains robust, with thousands of individuals recorded in major wetlands. At Deepor Beel, a Ramsar site, pintails constitute a significant portion of the migratory waterfowl population observed during the winter. Bird counts conducted in recent years have reported flocks ranging from 1,000 to 3,000 individuals, underscoring the wetland's importance as a wintering site. Similarly, at Maguri Motapung Beel, a rich biodiversity hotspot, flocks of pintails are a common sight, often seen foraging in the shallow waters alongside other migratory duck species. Smaller wetlands, such as those in Dibru-Saikhowa National Park and Pobitora Wildlife Sanctuary, also host pintail populations, though typically in lower numbers.

669. Despite their widespread presence, the Northern Pintail's population in Assam faces challenges linked to habitat degradation. Rapid urbanization and industrial activities in areas like Deepor Beel have led to habitat loss and water pollution, which directly impact migratory birds' ability to forage and roost. Additionally, encroachment and agricultural expansion in floodplain wetlands threaten the open, shallow water habitats preferred by pintails. Wetlands like Maguri Beel have also been affected by oil exploration activities, which can lead to long-term habitat alterations and siltation.

670. Overall, the **Northern Pintail population in Assam remains stable**, benefiting from the large network of wetlands and floodplains in the state. However, conservation efforts must focus on habitat protection and restoration to ensure that these birds continue to find suitable wintering grounds. Initiatives such as the sustainable management of Ramsar sites, community engagement in wetland conservation, and stricter regulations on industrial activities near wetlands are essential for maintaining the pintail's population. Regular bird censuses and ecological studies are also necessary to monitor population trends and identify emerging threats.

671. The Northern Pintail is not only an indicator of wetland health but also a reminder of the global importance of Assam's wetlands in supporting migratory bird species. By prioritizing wetland conservation, Assam can continue to serve as a vital link in the migratory pathways of waterfowl like the Northern Pintail, ensuring their survival for generations to come.



*Anas acuta LC. is a migrating bird. It is migratory and winters south of its breeding range to the equator*[101]*.*

672. ***Aythya nyroca* (Ferruginous Pochard), NT**.[102] Known locally as the common white-eye or white-eyed pochard, this diving duck migrates to Assam as part of its seasonal journey, taking refuge in the region's protected wetlands, such as Deepor Beel, a Ramsar site of international importance, and other quieter waterbodies in the state. These wetlands offer the secluded and vegetation-rich environments that are essential for the species' survival, providing foraging grounds and roosting areas away from human disturbances.

[101] Northern Pintail (Anas acuta)
[102] Ferruginous Duck (Aythya nyroca)

673. In Assam, the population of Ferruginous Pochards is relatively sparse, reflecting the global trend of declining numbers. Observations in Deepor Beel and other key wetlands reveal that only small flocks of these ducks arrive during the winter. The species' affinity for deeper, quieter wetlands with abundant aquatic vegetation means that it is primarily seen in isolated, less-disturbed areas. These conditions are critical for the ducks to access their primary diet, which consists of aquatic plants, seeds, and invertebrates. However, compared to other migratory waterfowl in Assam, the Ferruginous Pochard's numbers remain disproportionately low, indicating that the species is at risk and its habitat under increasing pressure.

674. Despite the species being near-threatened globally, specific population estimates for Ferruginous Pochards in Assam remain unavailable, although their scarcity highlights the urgency of conservation efforts. Their dependence on wetlands such as Deepor Beel, Maguri Motapung Beel, and other smaller waterbodies underscores the need to protect these habitats. Local environmental organizations and birdwatching groups often document sightings during winter migration, but detailed studies are required to accurately assess the population dynamics of this species in Assam.

675. The major threats to the Ferruginous Pochard in Assam include wetland degradation, urban encroachment, and pollution. Wetlands like Deepor Beel face challenges from industrial waste discharge, expansion of urban settlements, and increased human activities such as fishing and tourism. These factors reduce the availability of undisturbed zones and lead to a decline in habitat quality. Additionally, climate change and altered water regimes due to dam construction and river channelization further stress the delicate ecosystems that support these ducks.

676. Conservation initiatives in Assam have shown promise in protecting the Ferruginous Pochard's wintering grounds. Projects aimed at wetland restoration, community engagement, and awareness campaigns have emphasized the importance of safeguarding Assam's unique ecosystems for both migratory and resident species. Furthermore, bird censuses and monitoring programs conducted by organizations like the Bombay Natural History Society (BNHS) and local wildlife groups have contributed to a better understanding of the species' seasonal distribution and habitat use.

677. To ensure the survival of the Ferruginous Pochard in Assam, it is essential to expand protected areas, regulate human activities around sensitive wetlands, and implement sustainable wetland management practices. Strengthening anti-pollution measures and promoting community-driven conservation efforts are also critical steps in securing the future of this vulnerable species. Assam's wetlands, if properly conserved, can continue to serve as a vital refuge for the Ferruginous Pochard and other migratory waterfowl, highlighting the state's role in global biodiversity conservation.



***Aythya Nyroca* are observed during winter months in some of larger Assam's wetlands.**

678. ***Criterion 4: Key evolutionary processes***. This emphasizes the role of topography, geology, soil, temperature, vegetation, and their interactions in driving evolutionary mechanisms. These factors create the regional species richness and unique ecological features that we observe today. In Assam, a state known for its rich biodiversity and varied landscapes, these evolutionary processes are

especially pronounced. The state's diverse habitats, ranging from floodplains of the Brahmaputra River to dense forests of the Eastern Himalayan foothills, support a wide array of flora and fauna. These ecosystems are critical not just for species survival but also for ongoing evolutionary processes that foster genetic diversity and adaptability.

679. Assam's topographical variety-from riverine floodplains to the hills of Karbi Anglong and the Naga Hills serves as a natural laboratory for speciation and adaptation. For instance, the Kaziranga National Park, a UNESCO World Heritage Site, and the adjacent areas of the Brahmaputra floodplain provide an ideal environment for aquatic species and large terrestrial mammals such as the Indian one-horned rhinoceros (*Rhinoceros unicornis*), Asian elephants (*Elephas maximus*), and Bengal tigers (*Panthera tigris*). These species have adapted to seasonal flooding, which shapes their behavior and feeding patterns.

680. Assam's unique geological features include alluvial soil deposits from the Brahmaputra River and its tributaries, which sustain rich vegetation that acts as a foundation for evolutionary changes in herbivores and their predators. Forested regions such as those in Manas National Park, another UNESCO World Heritage Site, harbor species that have evolved in response to the diverse microhabitats within these landscapes. Endangered species like the Golden Langur (*Trachypithecus geei*) and the Pygmy Hog (*Porcula salvania*) represent evolutionary adaptations to these ecosystems, underscoring Assam's role in fostering unique biodiversity.

681. There is no site within such areas. The project will not permit site selection in these locations for upcoming components. Hence, this criterion is not triggered.

682. ***Criterion 5: Areas having biodiversity of significant social, economic, or cultural importance to local communities.*** Assam, a biodiversity-rich state in Northeast India, is home to 22 legally designated Protected Areas, including national parks, wildlife sanctuaries, and reserve forests. Most of these Protected Areas are recognized as Key Biodiversity Areas (KBAs) due to their exceptional ecological significance and unique habitats that support rare and endangered species. Assam's ecological diversity stems from its location in the Brahmaputra River basin, a region that serves as a vital habitat for endemic and migratory species. These KBAs emphasize the state's critical role in biodiversity conservation, particularly in safeguarding ecosystems ranging from wetlands and forests to grasslands and riverine habitats.

683. Majuli Island, located on the Brahmaputra River, is a prominent ecological landscape and a remarkable natural feature. Recognized as the world's second-largest river island, Majuli comprises a vast riverine island with numerous small islets, locally called *chapories*. Its topography is characterized by flat floodplains interspersed with lakes (*beels*), marshes, and anthropogenic structures such as embankments and roads. This unique combination of natural and man-made features creates diverse habitats, making Majuli a hotspot for biodiversity. Wetlands, grasslands, and riverine areas provide essential habitats for a variety of bird species, including both resident and migratory birds. Over 250 bird species have been recorded on Majuli, highlighting its ecological importance. Notable species include migratory waterfowl, raptors, and wetland-dependent species, underscoring the island's status as a high-priority conservation area.

684. Majuli Island has been designated a Key Biodiversity Area (KBA) and an Important Bird Area (IBA) due to its rich avian diversity and unique ecosystem. Despite lacking legally designated Protected Areas, the island's natural and ecological value has made it a focal point for conservation. Two critical wetlands, Tatinga Mekheli Barbeel and Paranm Beel, are located on Majuli Island, with additional *beels* near the KBA boundary (shown in Figure 4-13). These wetlands provide critical habitats for waterbirds, aquatic species, and other wildlife, forming an integral part of the island's ecological network.

685. In addition to above two Majuli beels, Bera Na Beel, located in Dhemaji District, falls within the broader Dibru-Saikhowa Complex Key Biodiversity Area (KBA), a globally recognized biodiversity landscape covering approximately 1,000 km². The KBA comprises the Dibru-Saikhowa National Park, adjoining reserve forests, river islands (chaporis), wetlands, and the interconnected river systems of the Brahmaputra and Lohit Rivers. While Bera Na Beel itself has not been identified as a site supporting globally threatened species, it forms part of this ecologically significant landscape and contributes to the conservation of freshwater habitats supporting waterbirds, fish, and other aquatic biodiversity. A preliminary site assessment undertaken by ARIAS indicates the need for conservation and ecological management of the beel.

686. Considering its location within this biodiversity-rich landscape (as shown in Figure 4-14 and Figure 4-15), it is recommended that detailed biodiversity surveys, habitat assessments, and appropriate environmental due diligence be undertaken prior to implementation of any interventions. It is further recommended that the IEE be updated based on the findings of these studies for Bera Na Beel as necessary. No physical works should proceed until the required due diligence has been completed and all applicable safeguard measures have been incorporated in accordance with the requirements of the ADB SPS, 2009.

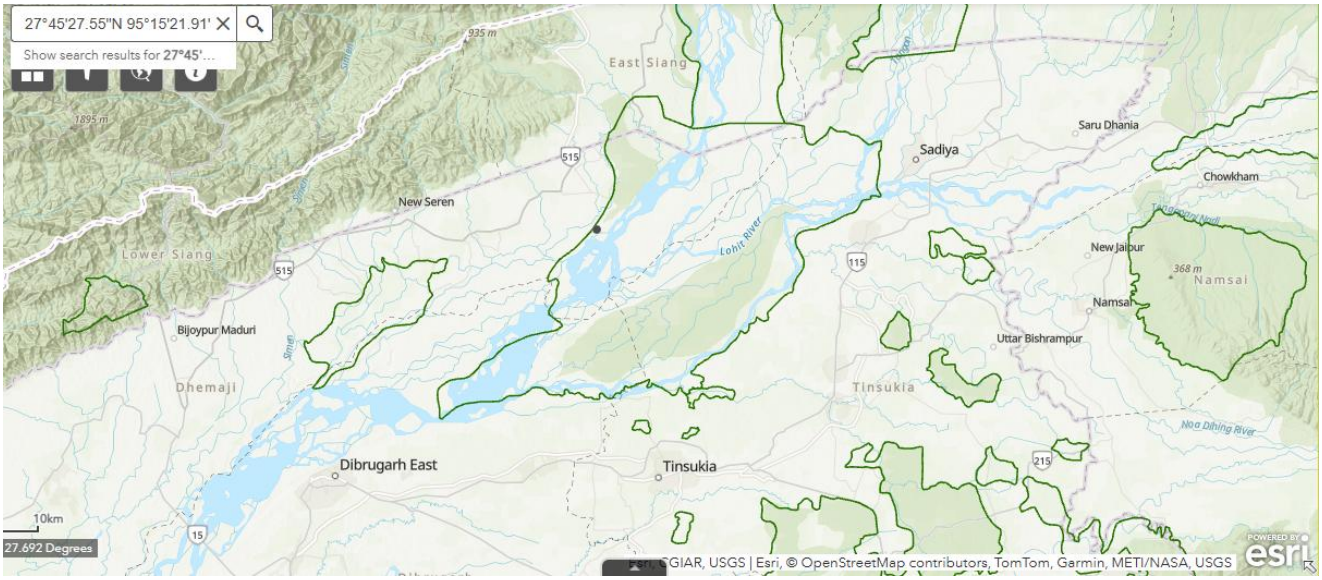



**Figure 4-13. Map Showing location of Bera Na Beel (Black dot) within a recognized KBA and IBA.**

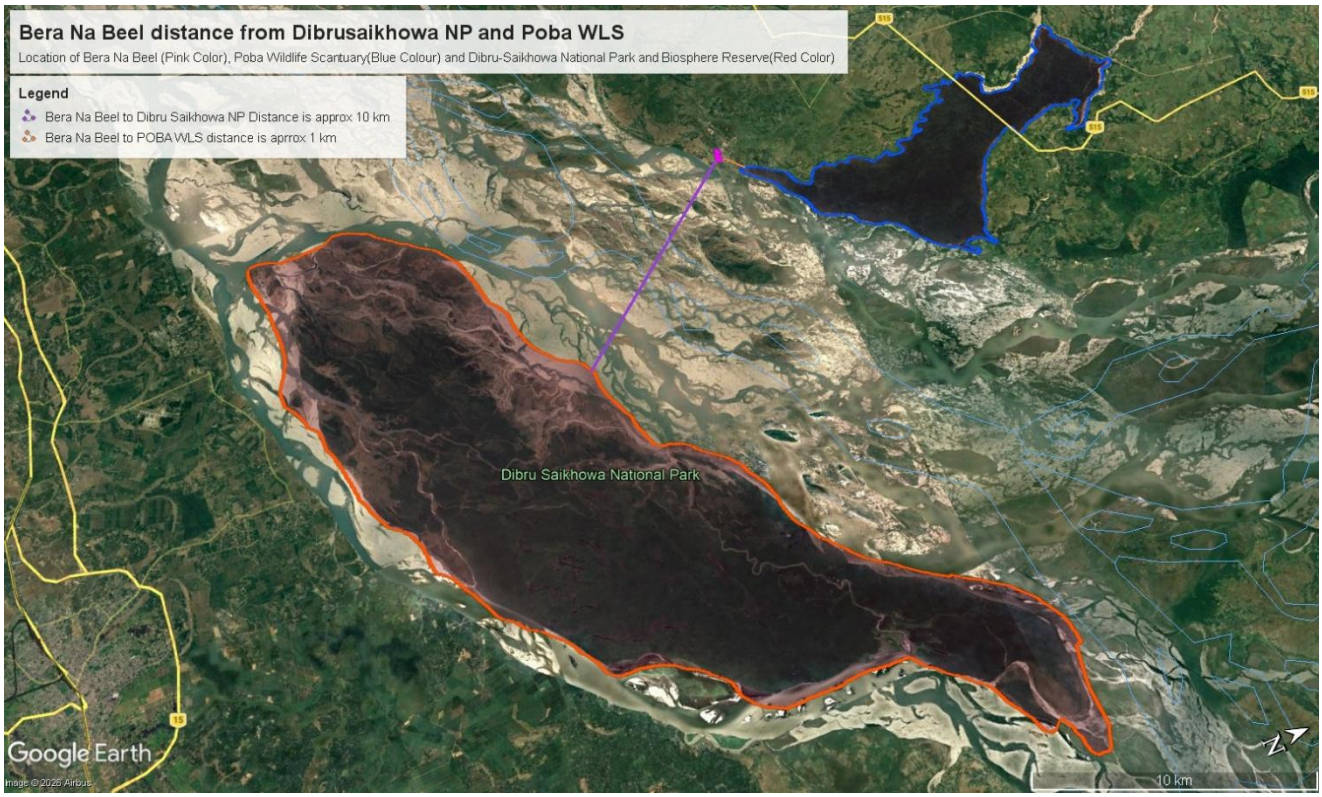



**Figure 4-15. Map Showing location of Bera Na Beel (Pink dot) and location of Dibru Saikhowa Biosphere resrve in red colour, Poba WLS in blue colour**

687. Planned project activities related to these beels have been carefully designed to minimize ecological impacts. It is important to note that the majority of the biodiversity found on Majuli is closely linked to the Brahmaputra River rather than the beels. Furthermore, several other beels not included in the project are also present nearby, and these beels are not the sole habitats supporting the biodiversity of Majuli. Therefore, no significant impacts are expected on the island's unique landscape, biodiversity, or ecological balance due to these activities. Not the particular beel but the wider KBA is internationally recognized for providing habitat to globally threatened species such as the White-winged Duck, Black-breasted Parrotbill, and Marsh Babbler, highlighting the ecological importance of wetlands within the Dibru-Saikhowa landscape. Owing to its location within this biodiversity-rich ecosystem, conservation and development interventions at Bera Na Beel should be implemented with due consideration to the ecological sensitivity and connectivity of the surrounding habitats and conducting due all necessary due delegience following ADB's SPS 2009.

688. Development activities are restricted to the *beel* areas and their immediate surroundings to avoid any significant disturbance to the broader landscape of Majuli Island. This approach ensures that the island's unique biodiversity, ecological balance, and cultural heritage remain protected. Furthermore, stringent monitoring and environmental safeguards are in place to ensure that these activities align with conservation priorities and support the long-term preservation of Majuli's ecosystems. The Tuni River, which flows through Majuli, further enhances the island's ecological significance. Its fertile floodplains and highly productive wetlands provide ideal conditions for diverse flora and fauna. The riverine ecosystems also serve as critical breeding, feeding, and roosting grounds for bird species, including several that are globally threatened.




**Figure 4-16. Map of Majuli Island a recognized KBA and IBA along with location of project beels**

Apart from the three beels located within the Key Biodiversity Area (KBA), Borthol Beel in Nagaon District, Assam, lies adjacent to Deobali Jalah, Sialmari, Haibargaon, and Khutikatia (Nagaon), which are identified as a KBA. This wetland landscape supports important habitats and serves as a refuge for threatened avifauna species, including the Greater Adjutant, Bengal Florican Lesser Adjutant, Swamp Francolin (Francolinus gularis) and Bristled Grassbird. The presence of these EN and VU species in nearby KBA enhances the ecological significance of Borthol Beel and underscores its conservation priority, particularly considering its hydrological and habitat connectivity with the adjoining KBA wetlands.

**Table 4-10. Summary of Critical Habitat Assessment**

| Critical Habitat defined by ADB (2009) | Quantitative Thresholds of Critical Habitat based in IFC PS-6 | Species/ sites | Likelihood to trigger criterion | Remarks |
|---|---|---|---|---|
| **Criterion 1:** The area includes habitat required for the survival of critically endangered (CR) or endangered (EN) species | (a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units GN16 of a CR or EN species). | *Pangshura sylhetensis, CR* | Unlikely | Found in the Brahmaputra valley of India and Bangladesh; possible presence in Bhutan and Myanmar. Populations restricted to Kaziranga and Manas National Parks in India. Secondary information and consultations confirm that no direct observations of the species have been recorded in the project beels |
| | | *Aythya baeri, CR* | Unlikely | Breeds in Russia. Rare sightings in Bangladesh, Myanmar, and India. No direct observations in project beels. |
| | | *Cairina scutulata, CR* | Unlikely | Populations span India, Myanmar, Thailand, Cambodia, and Indonesia, with Myanmar likely having |

| Critical Habitat defined by ADB (2009) | Quantitative Thresholds of Critical Habitat based in IFC PS-6 | Species/ sites | Likelihood to trigger criterion | Remarks |
|---|---|---|---|---|
| | | | | the largest numbers. No direct observations in project beels. |
| | | *Houbaropsis bengalensis, CR* | Unlikely | Found in India, Nepal, and Cambodia. Fragmented populations around the Brahmaputra River in India and Nepal. No direct observations in project beels. |
| | | *Sterna acuticauda, CR* | Unlikely | Populations mainly confined to India, with scattered occurrences in Southeast Asia. No direct observations in recorded in project beels. |
| | | *Heliopais personatus, CR* | Unlikely | Species is found in India including Assam, Myanmar, Thailand, and other Southeast Asian countries. However, No direct observations in project beel. |
| | | *Chitra indica, EN* | Unlikely | Found in the Indian subcontinent (India, Nepal, Bangladesh, and Pakistan). No direct observations in project beels. |
| | | *Geoclemys hamiltonii, EN* | Possibly to occur on Majuli Island and in beels connected to river systems or located on Brahmaputra floodplain. However, it is unlikely to meet the threshold | *Geoclemys hamiltonii* is distributed in India, Pakistan, and Bangladesh. Species reported at Kaziranga National Park (Aahotguri Camp, Borbeel Nullah), Orang National Park (Raumari beel, Near range office), Majuli (Raunapukhuri), Tezpur (Deurigaon). However, no direct observation reported in any of project beel. |
| | | *Hardella thurjii, EN* | Unlikely | Its native to India, Bangladesh, and Nepal. No direct observations in project beel. |
| | | *Laticilla cinerascens, EN* | Unlikely | It is found in India, Bangladesh and Pakistan Kaziranga NP seems to hold largest population of this species in the |

| Critical Habitat defined by ADB (2009) | Quantitative Thresholds of Critical Habitat based in IFC PS-6 | Species/ sites | Likelihood to trigger criterion | Remarks |
|---|---|---|---|---|
| | | | | region. However, no direct observations in project beel. |
| | | *Leptoptilos dubius, EN* | Unlikely | Found in India, Nepal, Bangladesh, Myanmar, and Cambodia. No significant overlap with project beels. |
| | | *Morenia petersi, EN* | Unlikely | Found in the Brahmaputra and Ganges River systems in India and Bangladesh. No observations in project beels. |
| | | *Rynchops albicollis, EN* | Unlikely | Found in India, Bangladesh, Pakistan, and Myanmar. No direct observations in project areas. |
| | | *Tringa guttifer, EN* | Unlikely | Found in Russia, Southeast Asia, and Bangladesh. No direct observations in project beel. |
| | (b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds of (a). | *Aborichthys garoensis, VU* | Unlikely | Found in the Garo Hills of Meghalaya. Habitat threatened by deforestation and siltation. Conservation efforts recommended. No observation in project beels. |
| | | *Chrysomma altirostre, VU* | Unlikely | Found along the Indus River, Nepal's Terai, and the Ganga-Brahmaputra floodplain. However, No observations in project beel. |
| | | *Clanga clanga, VU* | Unlikely | Found across Europe, Asia, and Mongolia etc. It lives in lowland forests near wetlands, preying on small mammals, waterbirds, and reptiles that possibility found on Brahmaputra basin. No observations in project beel. |
| | | *Cuora amboinensis, VU* | Possibly occurring in beels connected to river systems | *Cuora amboinensis* found in swampy lowlands and mangroves across Southeast Asia, including India and Bangladesh. |

| Critical Habitat defined by ADB (2009) | Quantitative Thresholds of Critical Habitat based in IFC PS-6 | Species/ sites | Likelihood to trigger criterion | Remarks |
|---|---|---|---|---|
| | | | or located on Brahmaputra floodplain. However, it is unlikely to meet the threshold | Population in India is the westernmost population in the range of this species. Inhabit in rivers, lakes, marshes, ponds, channels, creeks, swamps and paddy fields in and around lowland forests. It also found on Brahmaputra basin but no observations in project beels. |
| | | *Devario assamensis, VU* | Unlikely | Endemic to India, particularly in northeastern regions found in only a few streams near Tangla in Assam and the Dibrungharh-Kalmoni drainage area between Assam. No observations in project beel. |
| | | *Francolinus gularis, VU* | Unlikely | Found in protected areas like Kaziranga and Dudhwa National Parks in India and Nepal. Population stable in protected areas but declining elsewhere due to habitat loss. However, No observation recorded in project beels. |
| | | *Geoclemys hamiltonii, VU* | Unlikely | Found in the Indus, Ganga, and Brahmaputra River basins across India, Pakistan, Bangladesh, and Nepal. No observations recorded in any project beels. |
| | | *Leptoptilos javanicus, VU* | Unlikely | Found in fragmented populations across South and Southeast Asia, including India, Sri Lanka, Nepal, Bhutan, Bangladesh, Myanmar, and Cambodia. No observations in project beels. |
| | | *Lissemys punctata, VU* | Possibly to found in the beels connected to river systems or located on Brahmaputra | *Lissemys punctata* found across the Indian subcontinent (except the Thar Desert) including rivers, lakes, rice fields, and urban canals. It is reported at Guwahati, |

| Critical Habitat defined by ADB (2009) | Quantitative Thresholds of Critical Habitat based in IFC PS-6 | Species/ sites | Likelihood to trigger criterion | Remarks |
|---|---|---|---|---|
| | | | floodplain. However, it is unlikely to meet the threshold | Barpeta, Sarupeta (temple pond), Kaziranga NP, Nameri NP, Orang NP. However, no direct observation recorded in project beels. |
| | | *Melanochelys tricarinata, VU* | Unlikely | Found in the Himalayan foothills from western Uttar Pradesh, and southern Nepal. No observations recorded in project beels. |
| | | *Nilssonia gangetica, VU* | Possibly to found in the beels connected to river systems or located on Brahmaputra floodplain. However, it is unlikely to meet the threshold | *Nilssonia gangetica* distributed across the river basins of northern India, Nepal, and parts of Pakistan and Afghanistan. In North Eastern region of India, it is recorded at Kaziranga National Park, Biswanath Ghat, Brahmaputra near Guwahati, Temple Pond at Biswanath and Sarupeta. However, no observations recorded in project beels. |
| | | *Nilssonia hurum, VU* | Possibly to occur on Majuli island and few beels that connected to river systems. however unlikely to meet threshold | *Nilssonia hurum* found in the river basins of northern India, Bangladesh, and southern Nepal. Some of the direct observations recorded in Assam including Gauhati Univerty campus, Deepor Beel, Kaziranga National Park, Manas NP, Chakrashila Wildlife Sanctuary, Dulung RF (N. Lakhimpur). Tihu (Nalbari), Biswanath Ghat. Temple pond at Biswanath and Sarupeta in Assam. However, no observations recorded in project beels. |
| | | *Ophiophagus hannah, VU* | Unlikely | Widely distributed across South and Southeast Asia, including India, Nepal, the Philippines, and Indonesia. No observations recorded in project beels. |
| | | *Paradoxornis flavirostris, VU* | Unlikely | Confined to northeastern India, primarily Assam, with small populations in Manas, Kaziranga, and Dibru Saikhowa. No |

| Critical Habitat defined by ADB (2009) | Quantitative Thresholds of Critical Habitat based in IFC PS-6 | Species/ sites | Likelihood to trigger criterion | Remarks |
|---|---|---|---|---|
| | | | | observations recorded in project beels. |
| | | *Pelecanus philippensis, VU* | Unlikely | Found in India, Sri Lanka, and Cambodia, with breeding populations in southern and eastern India. No observations recorded in project beels. |
| | | *Pellorneum palustre, VU* | Unlikely | Endemic to northeastern India, primarily inhabiting grasslands along the Brahmaputra floodplain. No observations recorded in project beels. |
| | (c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species | None | Not applicable | None of the beel sites contain concentrations of EN nor CR species (i.e. national or regional level). |
| **Criterion 2:** The area has special significance for endemic or restricted-range species; | a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species | *Devario assamensis.* VU | Unlikely | Found in northeastern India. No significant populations or observations recorded in the project beels. |
| | | *Channa bleheri* NT | Unlikely | Found in northeastern India, primarily Assam. No significant populations or observations recorded in project beels. |
| | | *Ctenops nobilis* NT | Unlikely | Distributed in northeastern India and Bangladesh. No significant populations or observations recorded in project beels. |
| **Criterion 3:** The area represents a site that is critical for the survival of migratory species; or supports globally significant concentrations or numbers of individuals of congregatory species; | (a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle. | ***Anas acuta*, LC** | Unlikely | Distributed across Eurasia and observed in the region, but no significant populations recorded in the project beels. |
| | | ***Aythya nyroca,* NT** | Unlikely | Distributed in Asia and Europe. Declining population, but no significant concentrations recorded in the project beels. |

| Critical Habitat defined by ADB (2009) | Quantitative Thresholds of Critical Habitat based in IFC PS-6 | Species/ sites | Likelihood to trigger criterion | Remarks |
|---|---|---|---|---|
| | (b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress. | Not applicable | - | - |
| **Criterion 4:** The area includes unique assemblages of species that are associated with key evolutionary processes or provide key ecosystem services; | | Not applicable | Unlikely | There is no project beel inside or in close proximity to areas that have distinct assemblages of species. |
| **Criterion 5:** The area holds biodiversity of significant social, economic, or cultural importance to local communities; | | Majuli Island | Possible | Two project beels, Tatinga Mekheli Barbeel and Paranm Beel, are located on Majuli Island which is a KBA. The planned activities for these project beels are carefully confined to the beel areas and their immediate surroundings, ensuring minimal impact on the broader ecosystem of Majuli Island. It is important to note that the majority of the biodiversity found on Majuli is closely linked to the Brahmaputra River rather than the beels. Furthermore, several other beels not included in the project are also present nearby, and these two beels are not the sole habitats supporting the biodiversity of Majuli. Therefore, no significant impacts are expected on the island's unique landscape, biodiversity, or ecological balance due to these activities. |
| **Criterion 6:** The area is either legally protected or officially proposed for | | Not applicable | Unlikely | Project beels are well away from the legally protected areas heritage site, Ramsar site etc. Not triggering Criterion 6. |

| Critical Habitat defined by ADB (2009) | Quantitative Thresholds of Critical Habitat based in IFC PS-6 | Species/ sites | Likelihood to trigger criterion | Remarks |
|---|---|---|---|---|
| protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's World natural Heritage sites. | | | | |
| **Criterion 7** (Criterion 4 in IFC Performance Standard 6): Highly threatened and/or unique ecosystems. Highly threatened or unique ecosystems | a) Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN. | Not applicable | Unlikely | Due to limited and rare occurrence of the species, landscape unlikely to representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN. Not triggering Criterion 7. |
| | b) other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning. | | | |

EN = Endangered, IUCN = International Union for Conservation of Nature, PAI =project area of influence, VU = vulnerable

689. In addition, specific attention was given to the 2 beels (i.e. Paranm Beel and Tatinga Mekheli Barbeel) within Majuli Island, a region known being a KBA. The assessment confirmed that while Majuli Island along the Brahmaputra River hosts a variety of wetland ecosystems, none of the selected beels for the SWIFT Project fall within officially designated protected areas, such as wildlife sanctuaries.

690. The two beels indicated no presence of viable populations of CE or EN species within the project influence areas. Although Majuli Island is part of the larger Brahmaputra floodplain ecosystem, the target beels were carefully chosen based on ecological and social criteria that excluded areas with high conservation sensitivity. No measurable adverse impacts on high biodiversity value or ecosystem function are expected from project interventions in these beels.

691. Furthermore, the project's design in Majuli focuses on non-intrusive, eco-restorative activities such as controlled de-weeding, desilting at inlet and outlet points, and enhancement of fisheries habitat which will guided by the EMP. These activities will be carried out in compliance with ADB SPS 2009 ensuring that any potential minor impacts are fully mitigated. For instance, timing restrictions will be enforced to avoid fish spawning seasons, and no activities will be conducted near bird nesting sites, further reducing any residual ecological risks.

692. Importantly, mitigation measures have been designed to achieve at least no net loss of biodiversity, as required under ADB's critical habitat policy. This includes maintaining aquatic vegetation that supports fish breeding, conserving microhabitats within beels, and enhancing natural regeneration processes. Where possible, the project will pursue opportunities for net biodiversity gain, particularly through community-based conservation actions, ecological monitoring, and habitat restoration. In summary, the SWIFT Project's interventions in Majuli's beels are carefully tailored to maintain ecological integrity, avoid critical habitat impacts, and sustain the long-term viability of host ecosystems in full alignment with ADB's biodiversity safeguards.

693. As part of the IEE, a biodiversity action plans (BAP) for turtles and birds have been specifically prepared, with a targeted focus on the conservation of wildlife. These plans were developed in recognition of waterbirds and turtle species. These targeted actions are integrated within the IEE and aligned with ADB SPS 2009 requirements, ensuring that biodiversity values are maintained and enhanced throughout the project lifecycle.

694. Site-specific Human-Animal Conflict (HAC) Management Measures are also incorporated into the construction strategy for beels where interactions between wildlife and human activities are likely (Refer Annexure A22). Prior to commencement of works, potential conflict risks will be assessed, and appropriate mitigation measures such as awareness programmes for workers, restriction of construction activities during sensitive periods, proper waste management, and coordination with local communities and the Forest Department will be implemented. These measures will help minimize disturbance to wildlife and reduce the likelihood of human–animal conflict during project implementation.

## 4.4. Socio-Economic Environment

**Demographic Profile**

695. Ensure correct technical terms:As per the Census 2011, the total population of Assam is 3.12 crore. Therefore, Assam's population constitutes 2.58 percent of the total population. The districts of Assam that are covered under this initial phase of SWIFT viz. Bongaigaon, Dhemaji, Dhubri, Goalpara, Jorhat, Sribhumi, Lakhimpur, Majuli, Morigaon, Nagaon, Sivasagar, and Tinsukia are all diverse in terms of their geography, demographics, and administrative divisions. Bongaigaon covers an area of 1,093 sq km with a population of 738,804 and is known for its high urbanization (85%). Five taluks divide the district, concentrating on the oil and tea industries. Dhemaji, with an area of around 3,000 sq km, has a population of over 600,000 and is primarily rural, with a heavy reliance on agriculture, particularly rice cultivation. Dhubri, located on Assam's western border, spans 2,176 sq km and has a population of nearly 1.95 million. Three sub-divisions divide the district, which boasts a high Muslim population. Goalpara covers 1,820 sq km and has about 900,000 people, with an ethnically diverse community, including Assamese and Bengali speakers. Jorhat, covering 2,849 sq km with a population of 1.3 million, is famous for its tea gardens and has a relatively high literacy rate. With an area of 1,831 sq km and a population of about 900,000, Sribhumi primarily focuses on agriculture, especially rice and jute production, while Lakhimpur, spanning 2,877 sq km and home to over 1.2 million people, also relies heavily on agriculture, producing rice and mustard. Majuli, a river island of 880 sq km with a population of 170,000, is mainly rural and renowned for its cultural significance, particularly the Vaishnavite monasteries. Morigaon, with an area of 1,200 sq km and a population of around 800,000, relies heavily on agriculture and fisheries. Nagaon, spanning 3,000 sq km with over 1.5 million people, is an important agricultural hub for rice cultivation. Sivasagar, covering 2,600 sq km and home to 1.2 million people, is historically significant for the Ahom kingdom and tea production. Tinsukia, with an area of 3,000 sq km and a population of 1.2 million, is a major producer of tea and natural resources such as coal and oil.

696. Spanning 3,245 sq km, Barpeta is home to over 1.7 million people and is predominantly rural.

Agriculture forms the backbone of its economy, with rice and jute as the main crops. The district is also celebrated for its cultural heritage, particularly the Barpeta Satra, a significant center of Assamese Vaishnavism. Biswanath, covering 1,100 sq km and housing a population of around 600,000, was carved out of Sonitpur district. It is known for its lush tea gardens, thriving small-scale industries, and a diverse population comprising ethnic Assamese and tribal communities. Golaghat, spanning 3,502 sq km, is home to approximately 1.06 million people. The district is renowned for its tea estates, the globally recognized Kaziranga National Park, and its rich cultural legacy. Its economy is primarily driven by agriculture, tea production, and tourism. Kamrup Metro, the urban hub of Assam, covers 1,527 sq km and is home to over 1.26 million people. It includes Guwahati, the state's largest city, which serves as an economic, educational, and administrative center. The district reflects a unique blend of rapid urbanization and cultural heritage, with growing industries and institutions. Kamrup Rural, with an area of 3,105 sq km and a population of 1.52 million, retains a largely rural character. Agriculture dominates its economy, with rice and horticultural crops as key outputs. The district's rich cultural history and scenic landscapes also make it a significant destination for eco-tourism. Demographic profile of Assam Districts as per 2011 census is summarized in Table 4-11.

**Table 4-11. Demographic profile of Assam Districts as per 2011 census**

| District | Rural | Urban | Total |
|---|---|---|---|
| Total population | 26807034 | 4398542 | 31205576 |
| Male population | 13,678,989 | 2,260,454 | 15939443 |
| Female population | 13,128,045 | 2,138,088 | 15266133 |

**Agriculture**

697. Agriculture in Assam's districts is a vital component of rural economies, with each region showcasing a unique blend of traditional and modern farming practices. In Bongaigaon, the rural economy is driven by rice cultivation, supplemented by mustard, pulses, and maize. Jute is also a major crop, and some villages engage in sericulture. Livestock farming and fisheries further diversify livelihoods. Similarly, Dhemaji focuses on rice cultivation, alongside mustard, sugarcane, and seasonal vegetables. Fish farming and dairy farming are widespread in its rural areas.

698. In Dhubri, agricultural activities center around paddy cultivation, complemented by jute, mustard, wheat, maize, and vegetables. Livestock, especially cattle, and aquaculture play crucial roles in the village economies. Goalpara is dominated by rice cultivation, with jute, mustard, and maize also being important crops. Many households practice animal husbandry and fish farming.

699. Jorhat is known for rice cultivation, but tea gardens are a significant contributor to the local economy. The region also grows mustard, pulses, and fruits such as oranges and pineapples. Animal husbandry and dairy farming further contribute to rural incomes. In Sribhumi, agriculture revolves around rice, mustard, and vegetables, with jute remaining a significant crop. Villages also engage in small-scale fish farming and poultry.

700. Lakhimpur's villages produce rice, mustard, and pulses, while horticulture is gaining prominence. Fish farming and livestock farming are important, alongside cash crops like sugarcane. Majuli, known for its island culture, relies on rice and mustard cultivation, with vegetable farming and aquaculture common in rural communities. Morigaon has a rice-based agricultural system, supplemented by mustard, pulses, fish farming, and dairy and meat production, which contribute to the rural economy.

701. Nagaon is another rice-centric district, with a strong focus on mustard and vegetables. Fish farming and poultry help diversify agricultural output. In Sivasagar, rice and mustard cultivation

dominate, with tea gardens scattered throughout the district. The region also grows fruits like pineapples and bananas, while livestock farming plays an important role in local livelihoods. Lastly, in Tinsukia, agricultural activities focus on rice and mustard, while tea, fruits such as oranges, and livestock farming add variety to the rural landscape.

702. Barpeta district is predominantly an agrarian area with rice as the primary crop, along with pulses, oilseeds, and vegetables. Traditional farming practices dominate, with irrigation supported by seasonal rivers and low-lying beels. Biswanath district is known for its tea plantations and diversified cropping patterns, including rice, maize, and horticultural crops like vegetables and fruits. Golaghat district is a major tea-producing region, alongside paddy cultivation and mustard production. It also benefits from the fertile soils of the Brahmaputra floodplains.

703. Kamrup Metro district, though urbanized, supports peri-urban agriculture with paddy, vegetables, and floriculture, catering to local markets. Kamrup Rural district has a rich agricultural base with rice, jute, mustard, and vegetables as key crops. The district leverages traditional methods and river-based irrigation systems for farming. Across all districts, agriculture plays a critical role in the local economy, with efforts underway to adopt modern techniques for enhanced productivity.

704. Across these districts, agriculture is complemented by animal husbandry, fish farming, and horticulture, creating a diverse and resilient rural economy.

**Irrigation**

705. Out of a total geographical area of 78.438 lakh hectares, the total cropped area in Assam is approximately 41.59 lakh hectares, as per the latest figures. The state's ultimate irrigation potential is estimated at 27 lakh hectares. The Irrigation Department of Assam plans to achieve this potential through a phased approach by utilizing the state's abundant surface water and groundwater resources. It is responsible for the execution and maintenance of major irrigation schemes (with a potential above 10,000 hectares), medium schemes (2,000 to 10,000 hectares), and minor schemes (below 2,000 hectares).

706. At the village level, irrigation plays a vital role in sustaining agricultural productivity, particularly due to Assam's seasonal rainfall patterns. In Bongaigaon, traditional methods like surface irrigation are commonly employed in paddy fields, while modern techniques such as drip irrigation are gradually being adopted for vegetable and fruit crops. The district's proximity to the Brahmaputra River also supports irrigation in areas cultivating crops like jute and maize. Dhemaji, which experiences frequent monsoon flooding, relies on flood irrigation, with some villages using small-scale irrigation schemes to water fields during dry spells. Dhubri benefits from its location along the Brahmaputra River, where farmers utilize river water for rice cultivation. Small-scale irrigation projects in the district also support vegetables and pulses during dry seasons. In Goalpara, surface irrigation is widely used for rice fields, and farmers often draw water from nearby rivers and streams. Minor irrigation systems, such as ponds, further support agriculture during non-monsoon months.

707. In Jorhat, villages predominantly rely on flood irrigation for rice fields, with smaller-scale systems used for tea gardens and horticultural crops. The adoption of rainwater harvesting systems is increasing, supplementing irrigation during dry spells. In Sribhumi, with its abundant water resources, surface irrigation from rivers and ponds supports crops like rice, jute, and vegetables. Some villages have introduced modern systems such as drip and sprinkler irrigation to improve water efficiency. Lakhimpur's villages are known for surface irrigation in rice cultivation, supplemented by small-scale systems utilizing water from rivers and natural springs. Farmers in these areas also use shallow tube wells for crops like sugarcane and vegetables.

708. In Majuli, irrigation depends largely on monsoon floodwaters, with villagers constructing

embankments to manage water flow and protect fields. Morigaon relies on river-based irrigation, with small-scale water channels diverting water into agricultural fields. Many households also use rainwater harvesting to meet irrigation needs. Nagaon combines surface irrigation from rivers and small channels for rice cultivation, with modern systems gradually introduced for crops like vegetables and mustard. In Sivasagar, where tea and rice cultivation dominate, flood irrigation supports rice fields, while controlled systems are used for tea gardens. Villages in Tinsukia mostly employ surface irrigation, with water sourced from the Brahmaputra and local rivers. Controlled irrigation systems are used in tea gardens, and some villages adopt water conservation techniques to enhance efficiency during dry periods.

709. The irrigation profile of Barpeta primarily relies on surface water sources, including river-fed canals and traditional methods, supporting paddy cultivation as the primary crop. Limited groundwater usage is evident, and the irrigation coverage is often constrained by seasonal fluctuations and the availability of water. In Biswanath, irrigation systems are a mix of surface and groundwater sources, with tube wells and lift irrigation schemes playing a significant role. The district supports diverse cropping patterns, including tea plantations and rice, with moderate irrigation coverage.

710. Golaghat's irrigation infrastructure heavily depends on surface water from the Brahmaputra and its tributaries. Traditional irrigation methods, such as beels and ponds, are widely used, while modern facilities like tube wells and canals are limited. Paddy is the dominant irrigated crop.

711. Kamrup Metro, being urbanized, has minimal agricultural activity and irrigation. However, peri-urban areas rely on small-scale irrigation for vegetables and seasonal crops, primarily using groundwater. Kamrup Rural district exhibits a mix of traditional and modern irrigation practices, with significant reliance on river-fed canals, ponds, and tube wells. The district supports paddy as a staple crop, with irrigation needs met through a combination of natural and artificial water sources. Despite this, the irrigation potential remains underutilized in certain areas due to infrastructure gaps and dependence on seasonal water availability.

712. Crop area and irrigation water demand of Assam is summarized in Table 4-12.

**Table 4-12. Crop area and irrigation water demand of Assam**

| Category | Area |
|---|---|
| Gross Cropped area | 4075871 Ha |
| Net Cropped Area | 2817500 Ha |
| Irrigated area | 748530 Ha |
| As on 31st March, 2015 Irrigation potential created in Assam | 11.27 Lakh Ha (40% of the net cropped area) |
| Net cropped area brought under utilizable assured irrigation | 7.33 Lakh (26% of the net cropped area) |
| Crop water demand | 29065 MCM |
| Water potential requirement | 29065 MCM |
| Existing water potential | 9008 MCM |
| Water potential to be created | 20371 MCM |

**Source:** Irrigation | Directorate of Agriculture | Government of Assam, India

### Livestock and Dairy Production

713. Livestock is an integral part of the mixed-farming system that defines agriculture in Assam. In addition to contributing to food and crop production, livestock and poultry are regarded as a form of savings. For many poor households, livestock serves as a daily source of income and acts as insurance

against adversity. Animal traction remains significant in the state due to the increasing fragmentation of landholdings and the high cost of fuel, which limits the use of machinery. Tractor density per hectare of cultivated land in Assam is only one-sixth of the national average. Given the limited penetration of Green Revolution technologies and climatic uncertainties, livestock has immense potential to drive farm diversification and intensification. Livestock products form an integral part of the local diet, with more than 95% of the population being non-vegetarian.

714. Livestock production in Assam is predominantly managed by rural smallholders rearing indigenous cattle, buffaloes, pigs, goats, and chickens. Nomadic systems of livestock rearing are also practiced in forest fringe areas. In recent years, more specialized and commercially intensive production areas have emerged, with farmers adopting improved livestock and commercial poultry strains. Livestock in Assam is primarily fed on crop residues and food waste, while high-producing animals are supplemented with concentrated grain-based feed. Unlike states such as Gujarat, where cooperative farming models like Amul Dairy have revolutionized the livestock sector, cooperative farming in Assam has seen limited success. Livestock production in the state includes milk, meat (primarily chicken, pork, and chevon), and eggs, although average productivity remains low.

715. In rural Assam, livestock and dairy farming play a crucial role in supporting local economies. In Bongaigaon and Dhemaji, dairy farming with cows and goats is widespread, alongside poultry and fish farming. Dhubri and Goalpara focus on cattle and buffaloes for milk production, while Jorhat boasts a strong dairy industry complemented by goat and poultry farming. In Sribhumi and Lakhimpur, cattle, goat, and poultry farming are prominent. Majuli, though more limited in scale, engages in small-scale dairy and goat farming. Morigaon and Nagaon rely on cows for milk and also practice goat and poultry farming. In Sivasagar and Tinsukia, dairy farming with cows and goats is common, with poultry and fish farming adding to rural livelihoods.

716. Livestock and dairy production play a significant role in the rural economy of Barpeta, Biswanath, Golaghat, Kamrup Metro, and Kamrup Rural districts. In Barpeta, cattle, buffalo, and poultry farming are widespread, with smallholder farmers primarily engaged in dairy production and backyard poultry. Similarly, Biswanath sees mixed livestock farming, with cattle rearing for milk and broiler poultry farming contributing to household incomes. Challenges such as traditional farming practices and limited veterinary services constrain productivity in these districts. Golaghat, with its diverse livestock population, focuses on cattle, buffalo, goat, and pig farming. While dairy production is modest, pig farming is especially popular among tribal communities. However, insufficient veterinary care and a lack of organized dairy cooperatives remain obstacles.

717. In Kamrup Metro, livestock farming is limited to peri-urban areas, with small-scale dairy units catering to local demand and backyard poultry providing eggs and meat. Meanwhile, Kamrup Rural serves as a key hub for livestock farming, with widespread cattle rearing for milk and significant goat and pig farming among tribal and rural communities. Government initiatives to improve veterinary services and introduce improved breeds have helped, but traditional feeding practices and limited market access continue to affect productivity. Across all districts, livestock and dairy production remain vital for livelihoods and food security, with considerable potential for development through infrastructure and service improvements

**Industries**

718. Assam is the largest economy in the Northeast region of India. Owing to its proximity to the rest of the country and the availability of quality infrastructure, the state provides a favorable environment for industrial growth. Assam boasts the largest tea-growing area in the world, accounting for approximately one-seventh of global tea production. The state contributes over 50% of India's total tea output, with production reaching nearly 467.68 thousand tonnes during April to September 2018. Assam is also home to 20 industrial estates, three industrial growth centers, 11 Integrated

Infrastructure Development Depots, 17 industrial areas, 12 growth centers, eight mini-industrial estates, one export promotion park, and one food processing industrial park. Furthermore, Assam is the most popular tourist destination among the northeastern states.

719. The industrial landscape in Assam's rural areas is diverse, comprising a mix of traditional cottage industries and modern industrial activities. In Bongaigaon, the industrial sector is significantly influenced by oil refining, particularly with the presence of the Bongaigaon Refinery. At the village level, agriculture-linked industries such as rice mills, jute processing units, and small-scale mustard oil production units are common. Some villages also have small-scale factories related to sericulture and weaving.

720. In Dhemaji, industries include rice mills and mustard oil extraction units. Traditional handicrafts like bamboo and cane products, along with handloom weaving, contribute significantly to rural employment. Dhubri has small-scale industries focused on rice milling, oil extraction, and fish processing. Handloom and bamboo craft industries, driven by local artisans, are also prevalent.

721. In Goalpara, cottage industries such as rice mills and oil extraction plants dominate, with a growing presence of small food processing units focusing on fruits, vegetables, and fish. Bamboo and cane products, as well as handlooms, supplement rural incomes. Jorhat, known for its robust tea industry, has tea processing factories operating at both commercial and small-scale levels. Villages in Jorhat are also home to cottage industries producing woven goods and woodwork. Small manufacturing units for tools and implements used in agriculture further support the rural economy.

722. Sribhumi has seen growth in rice milling, mustard oil extraction, and fish processing industries. Bamboo products and handloom weaving provide additional employment opportunities. Lakhimpur hosts small agro-based industries, such as rice mills and mustard oil extraction units, along with a growing number of horticultural processing units for fruits and vegetables. Small-scale industries focusing on fish processing and dairy products further diversify the local economy.

723. In Majuli, cottage industries are centered on weaving traditional Assamese textiles, alongside small-scale agriculture-based industries like rice mills. Morigaon has small agro-processing units, particularly rice mills and mustard oil extraction units, as well as cottage industries for bamboo and cane products. In Nagaon, small-scale industries related to rice milling, oil extraction, and fish processing are prominent. The handloom industry, with artisans producing traditional textiles, is also a key contributor to the rural economy.

724. In Sivasagar, the tea industry is dominant, with numerous small tea processing units operating at the village level. Industries related to rice milling, mustard oil extraction, and dairy production are also significant. Small-scale workshops for carpentry and metalwork are common. In Tinsukia, agro-processing industries such as rice milling, mustard oil, and fish processing are prevalent. Cottage industries focusing on bamboo and cane products, as well as the weaving of traditional garments, add variety to the rural economy.

725. Barpeta is primarily an agrarian district, with a focus on agriculture-based industries like rice mills and handloom. The region has potential for growth in food processing, agro-based industries, and timber. Key crops include rice and mustard, and there is scope for expanding industries linked to these sectors.

726. Biswanath district, known for its tea gardens, Biswanath is also engaged in agriculture and horticulture. The district offers opportunities in organic farming, tea processing, and floriculture. The growing demand for organic products presents a significant opportunity for agro-based industries. Golaghat's economy is driven by the tea industry, rubber plantations, and food processing. With several large tea estates, the district has opportunities for expanding tea exports and agro-processing

industries, particularly in fruits and vegetables. Eco-tourism also offers growth potential.

727. Kamrup Metro, including Guwahati, is a hub for services, IT, and education. The region has a burgeoning IT sector, along with opportunities in tourism, retail, and light manufacturing. Its status as an educational center further strengthens its economic base while Kamrup Rural is primarily agricultural, with rice, mustard, and pulses as main crops. There is growing interest in agro-processing, bamboo-based industries, and eco-tourism. The district's natural beauty and agricultural resources make it a promising area for future industrial development.

# 5. IMPACT ASSESSMENT

## 5.1. Overview

728. Government of Assam has planned to cover 102 beels (wetlands) across 32 districts as part of the SWIFT Project. This initiative aimed to enhance the sustainable management and utilization of these wetlands for fisheries, benefiting local communities and promoting biodiversity conservation. It is designed to bring positive changes to both people and the local environment. However, interventions may have unintended impacts that can affect people and the environment if not properly managed. The key objective of this environment assessment study is to predict and quantify potential environmental impacts, evaluate their magnitude, and identify mitigation measures. Thereafter, impact assessment and mitigation measures constitute the basis for the development of EMP, which is crucial in translating mitigation measures into practice.

## 5.2. Subproject Impact Area

729. The project will engage with 32 districts of Assam, targeting 102 beels located across all five zones. The primary impact area where the subproject components are to be implemented includes the beel submergence area, fringe and bund area, inlets and outlets (if any), access road, site for dumping and disposal of weeds and excavated silt, composting site, office building construction sites, material and machineries storage area, contractor's camp (if any), and area where on and off beel and fisheries infrastructure are planned. The secondary impact area would be the nearby catchment and village area, where impacts (positive or negative) are anticipated during construction and operational phase of the project. For the analysis of the impact on biodiversity, the scope extends well beyond the vicinity of the beel and covers the subproject area up to an extent of 0.5 km.

## 5.3. Impact Identification and Significance

730. There were 74 beels (wetlands) identified for project's. These wetlands are subject to a range of interventions aimed at improving their ecological and economic potential. On-beel interventions include desilting, de-weeding, construction of earthen mounds, cleaning of inlets, embankment strengthening, installation of Hume pipes and composting of weeds. Additionally, on-beel infrastructure development involves constructing nursery rearing ponds and pens for raising fingerlings to optimal stocking size, as well as fish landing and aggregation sites with improved hygiene, sanitation and temporary storage facilities (e.g., insulated boxes and handling crates). Off-beel interventions focus on upgrading existing auction centers with enhanced sanitation facilities, washing bins, cooling tanks, and mini-ice-flake units. Furthermore, pilot eco-tourism initiatives are planned, including visitor centers, nature trails, birdwatching platforms, and eco-friendly accommodations. Office buildings for CPIUs and PMU are also to be constructed as part of the overall project infrastructure.

731. Given the uniform nature of the interventions, the impact assessment was initially conducted based on a detailed evaluation of 74 beels spread across 23 districts in all 5 clusters. The findings from these assessments were extrapolated to estimate potential impacts for the remaining beels. This approach allows the assessment of 74 subprojects to be considered sufficient for identifying appropriate mitigation and monitoring measures provided that all selected sites meet the established site selection eligibility criteria.

732. As mentioned above, key project activities include removing unwanted aquatic weeds, restoring beel connectivity to rivers, protecting against siltation, applying biofilters to reduce turbidity and nutrient input, conserving habitats, preserving indigenous fish species, and beel health monitoring. These activities are expected to benefit both the environment and local communities. However, some civil works and fisheries activities, such as the establishment of hatcheries, rearing tanks, fish landing sites, and pen culture, may cause environmental impacts. Operational risks include sedimentation, weed

infestation, water quality degradation, fish waste disposal, and the sustainability of fisheries infrastructure created under the project. This section addresses the basic concepts and approach for conducting environmental analysis of the potential impacts likely to happen as a result of the project.

733. Environmental risk analysis identified potential adverse effects. Refer to **Annexure A1** for the approach of risk analysis. An environmental risk analysis was conducted, taking into account the probability and severity of impacts. The summary of each impact is reflected below**.**

**Table 5-1. Analysis of Environmental Impacts during Construction and Operation Phase**

| S. No | Potential Environmental Impacts | Likelihood | Consequence | Risk |
|---|---|---|---|---|
| **1. Land and Soil Environment** | | | | |
| **Construction Phase** | | | | |
| 1.1 | Site or land clearing | Likely | Minor | Low |
| 1.2 | Impact of excavation and desilting | Likely | Moderate | Medium |
| 1.3 | Impact due to handling of construction materials and machineries at site | Likely | Minor | Low |
| 1.4 | Impact due to waste generation | Likely | Moderate | Medium |
| 1.5 | Soil erosion, compaction and contamination | Likely | Moderate | Medium |
| 1.6 | Change in topography and borrowing of Earth | Likely | Moderate | Medium |
| 1.7 | Change in land uses practices | Likely | Minor | Low |
| **Operation Phase** | | | | |
| 1.8 | Impact due to solid waste generation | Likely | Minor | Low |
| 1.9 | Soil contamination | Likely | Minor | Low |
| 1.10 | Bund erosion during flooding | Likely | Moderate | Medium |
| **2. Water Environment** | | | | |
| **Construction Phase** | | | | |
| 2.1 | Decline of water quality due to on-site activities | Likely | Moderate | Medium |
| 2.2 | Alteration of Water Flow | Likely | Moderate | Medium |
| 2.3 | Risk of erosion and sedimentation | Likely | Moderate | Medium |
| **Operation Phase** | | | | |
| 2.4 | Siltation, alteration of water volume and hydrology | Likely | Moderate | Medium |
| 2.5 | Degradation of water quality | Likely | Moderate | Medium |
| **3. Ambient Air Environment and Noise** | | | | |
| **Construction Phase** | | | | |
| 3.1 | Air quality decline | Likely | Minor | Medium |
| 3.2 | Noise level increase | Likely | Minor | Medium |
| **Operation Phase** | | | | |
| 3.3 | Unpleasant odour | Likely | Minor | Low |
| 3.4 | Emission of air pollutants and noise from diesel generators | Likely | Minor | Low |
| **4. Biological Environment** | | | | |
| **Construction Phase** | | | | |
| 4.1 | Terrestrial and aquatic habitat disruption | Likely | Moderate | Medium |
| 4.2 | Displacement of fish species | Rare | Minor | Low |
| **5. Socio-economic and Cultural Issues** | | | | |
| **Construction Phase** | | | | |
| 5.1 | Labor influx, conflict of cultural and regional bias | Unlikely | Minor | Low |
| 5.2 | Occupational health and safety risk to construction personnel | Likely | Moderate | Medium |
| 5.3 | Chance find of items/materials of cultural and/or archeological importance | Rare | Minor | Low |
| **Operation Phase** | | | | |
| 5.4 | Lack of maintenance of Beel, unequal distribution of share/profits and waterborne disease | Likely | Moderate | Medium |

## 5.4. Impacts and Mitigation Measures

### 5.4.1. Pre-Construction Phase

**Review of detailed designs and ground verification**

734. Before implementing subprojects, it is essential to ensure that all scheme designs are thoroughly prepared in accordance with IS codes, relevant standards, and norms for safety and sustainability to prevent design failures. Designs must be tailored to specific site conditions and supported by comprehensive engineering surveys and investigations. This preparation is critical for identifying and addressing potential challenges that may arise during project execution. Proactively addressing these issues mitigates risks and enhances the project's long-term success and resilience.

**Mitigation**

735. Before construction begins, the PIU and PMU must review and validate the design of each site through detailed surveys and assessments to fully understand the unique characteristics of the area. Tailored designs must reflect these site-specific conditions, while ensuring compliance with IS codes and other relevant standards. Engineering studies, including geotechnical, hydrological, and structural analyses, must be reviewed and confirmed to ensure the technical soundness of the designs. Additionally, engaging with local communities to gather insights and feedback on proposed designs is crucial. This participatory approach ensures that local knowledge and perspectives are integrated, promoting community acceptance and alignment with on-ground realities. Project's sub-activities shall be aligned with the approved Beel integrated Management Plan or community-based plans to ensure sustainable practices. Emphasis should be placed on nature-based solutions (NBS) to enhance natural processes for ecosystem restoration and biodiversity conservation. This approach supports ecological resilience, promotes long-term environmental and socio-economic sustainability

736. Wherever possible, green building and energy conservation measures should be incorporated into the proposed office buildings, following the guidelines of the Indian Green Building Council and the Energy Conservation Building Code (ECBC) 2017 of the Bureau of Energy Efficiency. These measures will help minimize the environmental footprint and promote sustainable development.

**Acquire official permission from government authorities through Consents, Permits, Clearances, No Objection Certificates (NOCs)**

737. Before beginning any construction work, it is crucial to comply with specific laws and regulations set by relevant government authorities. These regulations often require obtaining official permits and approvals for aspects such as building plans, environmental compliances, tree cutting, and fire safety measures. Failure to acquire the necessary authorizations can lead to significant delays in the subproject's implementation, as work may be halted or subjected to penalties until proper approvals are obtained. Adhering to these legal requirements ensures that the construction process follows established safety, environmental, and planning standards, ultimately facilitating smooth project execution and avoiding unnecessary setback.

**Mitigation**

The following measures will be conducted during the detailed design and preconstruction phase prior to start of construction:

- NOC for tree cutting (if any) to be obtained by project proponent before construction. However, contractor will support the proponent if any NOC to be obtained for cutting of additional tree during construction stage
- Necessary approvals (if any) for construction to be obtained by contractor before start of construction that includes Consent to Establish (CTE) and Consent to Operate (CTO) from the Assam Pollution Control Board (APCB) under the Air (Prevention and Control of Pollution) Act,

1981 and Water (Prevention and Control of Pollution) Act, 1974 for any activities likely to affect air and water quality.
- Contractor shall obtain NOC from local administration and water resources department for the bund construction (if needed)
- Additionally, the building plans for the proposed office buildings must be approved by the relevant local authorities to ensure compliance with zoning, safety, and building regulations. Furthermore, a Fire NOC (No Objection Certificate) from the relevant fire safety authorities must be obtained to ensure that fire safety measures meet the required standards and regulations for public safety.
- Also obtain all necessary local clearances and permits (if required) for any construction or infrastructure development, particularly those under Output 2. This ensures compliance with legal and regulatory frameworks, prevents potential delays, and mitigates environmental or social risks associated with the activities proposed under output 2 of the project.

**Ensure safeguards documentation, availability of expertise, resources and GRM before start of construction**

738. Strategies should be developed before the construction of the project to prevent potential issues arising from non-compliance. This will enable the CPIU and PIU to execute the subproject in an organized manner. Insufficient environmental safeguard measures can result in significant environmental impacts. Furthermore, a lack of expertise and resources for implementing the Environmental Management Plan (EMP) could undermine its effectiveness. Additionally, the absence of a responsive Grievance Redress Mechanism (GRM) may lead to public unrest and potential litigation

**Mitigation:**

- Review/revise model EMP to assess if the current mitigation measures need to be updated as per subproject site conditions, due to any changes in the final engineering designs, and/or as a result of any preparatory work undertaken before loan agreement.
- Bera Na Beel is located within the Dibru–Saikhowa Complex KBA, detailed biodiversity due diligence is recommended prior to implementation. The IEE should be updated accordingly, and no physical works should commence until all applicable ADB SPS (2009) safeguard requirements have been met.
- PMU shall ensure that the project's sub-activities must align with the approved Beel Integrated Management Plan (BIMP) or community-based plans to ensure sustainable practices including Nature-Based Solutions (NBS) to enhance natural processes for ecosystem restoration and biodiversity conservation.
- Ensure that staff with appropriate level of expertise for EMP implementation is appointed by the contractor.
- Ensure appropriate level of monitoring resources are in place before subproject implementation.
- Ensure that construction contracts are responsive to EMP provisions and that mitigation and monitoring measures are adequately budgeted.
- Establish GRM for the project and establish local access points.
- Disclose GRM to community, project beneficiary, affected people before construction begins through signage, websites and notices in community centres.
- Construction materials should only come from Government approved sources with prior approval of CPIU.
    - Concrete and Cement: Contractor to procure cement bags from Government approved sources and maintain necessary documents
    - Aggregates and sand: To be procured from government approved sources
    - River sand: To be procured from approved sources

- Water: To be procured from government approved water tanker operator. Contractor shall obtain permissions from the relevant authorities for use of groundwater (if any) for construction works. In case of beel water will be used for construction, contractor will take consent from BDC or VDC prior to any use.
- Steel for all works shall be procured from Government approved sources

**Lack of emergency response and construction plan**

**Impacts**

739. Prior to start of construction, the contractor shall draft a site-specific emergency response plan and submit it to CPIU for approval. Lack of emergency response plan may impact workers, machines/equipment and materials. The contractor shall also develop a construction plan that include sourcing of materials, hiring of workers, transportation of equipment's and vehicles, setting of labor camp and requirement of any shifting or dismantling of public utilities prior to construction activities. PIU and CPIU office buildings are to constructed within the existing premises of DoF offices without an appropriate construction plan, it could lead to significant inconvenience for staff and the public. Material from unauthorized/illegal sources may disrupt the natural environment and non-compliance to government laws. Construction quality may also be affected by using substandard materials. Improper hiring of laborers may give rise to issues related to labor influx, livelihood, and conflict of cultural and regional bias. Unmaintained machinery, equipment, and vehicles may also hinder and delay the construction. It may also lead to air, noise pollution and water pollution (due to fuel and oil leaks from project machinery especially in the use of machinery for de-weeding and dry siltation and construction of bunds and embankments/sluice gates). Setting of improper labor camp may lead to environmental pollution, sanitation, health and hygiene issues. In the absence of a dismantling plan, disruption of services and other inconveniences to the public may arise

**Mitigation Measures**

740. Contractor shall prepare an emergency response plan for situations like flash flood, medical emergency, inundation, accident and community conflicts etc. In the water pollution emergency response plan, the contractor will include measures to address spills or leaks promptly. These will involve deploying absorbent mats or barriers to contain spills, isolating affected areas to prevent further contamination, and using spill containment systems to manage leaks. The plan will also outline procedures for the safe collection and disposal of spilled fuel, oils, or filters in compliance with hazardous waste guidelines, ensuring no waste enters the Beels.

- Contractor shall identify the relevant officials and institutions to be involved during emergencies and shall prepare a telephone directory of these officials for timely communication and support.
- Adequate provisions shall be made in the engineering design to adapt to extreme meteorological and geo-physical events.
- To minimize inconveniences to staff and the public during construction, the contractor must develop a comprehensive construction plan. This plan should include provisions for barricading the construction area, implementing noise and dust control measures, designing clear access routes, and ensuring adequate parking facilities.
- Construction materials should only be from Government approved source with prior approval of CPIU.
- Contractor to submit to CPIU on monthly basis documentation on material obtained from each source for the subproject.
- Guidelines/procedure to ensure environmentally sound good practice for Reuse and Disposal of desilted material is provided in **Annexure A3.**
- Guidelines/procedure to ensure environmentally sound good practice for disposal/reuse of weeds is provided in **Annexure A4.**
- Early consultation shall be made by the contractor with the local community/VDC or BDC

before hiring of workers. Local workers will be given priority if they meet basic job requirements.
- Employment for local laborers should be encouraged to avoid setting of labor camp. However, in cases where a labor camp is needed to be set up, the contractor shall equip the camp with all the basic facilities for all the migrant workers employed until the completion of construction and maintenance work in accordance with the Building and Construction Workers (Regulation of Employment and Conditions of Service) Act and Rules,1996
- A guideline for setting up of labour camp is provided in **Annexure A5** for ready reference.
- Early consultations shall be made by the contractor with the local community/VDC to determine the appropriate location of labor camp.
- All migrant workers will undergo workshop/briefings to sensitize them on local culture.
- Contractor shall ensure that all the construction machinery, equipment and vehicles are properly inspected and maintained before transferring at site.
- Contractor shall select the machinery, equipment and vehicles as per the site conditions and available at the site.
- During construction by any chance, any utility (electric poles, telephone lines, water pipes etc.) require shifting, prior permission and assistance shall be obtained from the concerned agency. Alternate arrangement shall be made prior to any dismantling.

**Site Access**

741. All 74 selected beels involve the development of fisheries infrastructure, including seed rearing facilities, pen culture units, fish landing sheds, hume pipe installations, habitat management measures, vermi-compost units, katal fishing facilities, water pools, and solar lighting systems. The approach road requirements vary significantly across the beels, ranging from 10 m to 1,200 m, with a cumulative approach road length of approximately 21 km. Many of the beels are located in rural areas where access routes pass through agricultural fields, village settlements, and narrow internal roads. Consequently, transportation of construction materials, machinery, equipment, and construction waste may temporarily affect local traffic movement, agricultural activities, and community access. Potential impacts include dust generation, noise, temporary road congestion, localized damage to village roads, and safety risks to residents. To minimize these impacts, site-specific construction management measures, including traffic planning, controlled movement of vehicles, stakeholder consultations, restoration of any damaged access routes, and community safety provisions, will be incorporated into the construction strategy and contractor's Environmental Management Plan (EMP).

742. **Mitigation Measures**

- Contractor shall develop a site access route and submit it to CPIU and BDC. Contractor shall also use smaller, more maneuverable vehicles, if possible, to navigate narrow roads without causing damage.
- Engage with local residents and VDC early in the planning process to inform them of the project schedule and address any concerns they might have. This proactive communication can help in preventing conflicts.
- Implement protective measures, such as temporary road widening or reinforcement, to prevent damage to access roads and surrounding properties and crops.

### 5.4.2. Construction and Operational Phase Impacts

743. The environmental impacts during the implementation of the SWIFT project are generally standard for construction activities and are not expected to be significant. The EMP provides mitigation measures that must be strictly implemented by the contractor and monitored by the CPIU/PIU. Key project activities include removing unwanted aquatic weeds, silt removal, restoring beel connectivity (where applicable), preventing siltation, reducing turbidity and nutrient inputs, managing inflow and outflow, conserving habitats, preserving indigenous fish species and monitoring beel health. These

interventions aim to deliver environmental and community benefits. However, during the construction phase of the SWIFT Project, certain civil works and fisheries-related activities, such as constructing PIU office buildings, establishing hatcheries and rearing tanks, developing fish landing and aggregation sites, upgrading auction centers, and initiating pilot eco-tourism projects, may lead to temporary and localized environmental impacts. Potential impacts include the release of nutrient-rich water from fish-rearing ponds and hatcheries, waste generation from worker camps, and short-term degradation of water quality due to desilting and de-weeding activities. Construction operations, including the transportation of materials and use of vehicles for desilting, may result in minor noise and air pollution, particularly dust and particulate matter. Additionally, occupational health and safety risks may arise from construction activities, requiring careful management to mitigate these potential hazards.

744. During the operation phase of the SWIFT Project, several risks must be effectively managed to ensure sustainability and minimize environmental impacts. Sedimentation can reduce water flow, degrade habitat quality, and compromise beel connectivity, while weed infestation may disrupt ecosystems, hinder water flow, and impact fisheries productivity. Water quality degradation, caused by nutrient inputs, runoff, and discharge from fish-rearing facilities, could lead to eutrophication and aquatic ecosystem harm. Similarly, inadequate treatment of wastewater from hatcheries and rearing ponds may further degrade water quality. Improper disposal of fish waste, organic debris, and other operational waste can contribute to pollution and attract pests. Moreover, neglecting the regular maintenance of fisheries infrastructure, such as hatcheries, landing sites, and other facilities, may reduce efficiency and jeopardize long-term project goals. To address these challenges, proactive measures, including regular monitoring, maintenance, and community engagement, are crucial to sustain the environmental and socioeconomic benefits of the project.

745. In compliance with ADB's SPS 2009, an IEE has been prepared, including an EMP (refer to Chapter VIII) to address all project components. The EMP must be updated by the contractor into a site-specific Construction EMP under the supervision of the PIU and PMU, ensuring that all site-specific risks are adequately mitigated.

**Impacts on Land and Soil Environment**

**Construction Phase**

**Site or land clearing**

**Impacts**

746. Site or land clearing will take place for demarcation of the beel boundary, bund formation and excavation work. Currently, beel areas where activities are planned, doesn’t have large trees that to be cleared. However, some clearing of vegetation will be necessary to construct bunds and to provide access and to transport machineries and equipment at sites. Minor clearing may also be required to store machinery and materials, set up labor camps (if needed), and build construction facilities to accommodate buildings and equipment for the workers. The loss of these vegetations will affect the structural condition of the soil. The absence of vegetative covers will lead to site-specific impacts on soil and may affect stability of natural slopes that will lead to erosion.

747. **Mitigation:**

- In consultation with BDC and CPIU, contractor to identify areas that should be protected and/or managed in a way that minimizes site clearing.
- Identifying vegetation that can stay on site for as long as possible to reduce damage. Vegetation protects soil, reducing erosion and sedimentation. Letting as much plants as possible stay on site to minimize erosion.
- Proper disposal of materials and debris at designated sites (away from rivers/streams and

private lands) as prescribed by CPIU and community.
- Replanting should be done to help restore the vegetation and protect soil.
- During decommissioning, the construction sites shall be restored to its original condition before handing over.

**Impact of Excavation and Desilting**

748. The excavation and desilting activities under the SWIFT intervention, including the excavation of building foundations, bund construction, and desilting of connecting channels and beels including Digzari Beel, Tolong Beel, Tinsukia, Kordoiguri Beel, Bor Beel, Oram Beel, Pitkati, Borpothorua Beel, Mer Beel, and Kutnikuchi Beel,and others. The desilting process primarily involves dry excavation and the removal of a significant quantity of silt and sediment from the peripheral areas of the beels, as well as the inlets and outlets. Excavation and desilting can temporarily degrade water quality by resuspending sediments, which may increase turbidity and reduce light penetration in the water. This can negatively affect aquatic life, particularly fish and other species dependent on clear water. Additionally, the construction of bunds and buildings may result in soil erosion and runoff, leading to sedimentation and water quality degradation in surrounding areas. The construction process itself can cause disruption to local ecosystems, including the potential destruction of vegetation and disturbance to wildlife. If not properly managed, excavation and desilting activities may also cause the release of nutrients from disturbed sediment, leading to nutrient enrichment in the water and promoting algae blooms.

**Mitigation Measures:**

749. The following measures will be adopted to mitigate the potential impacts from excavation and de-silting and when reusing the silt and sediments.

- Desilting will be carried out using suitable equipment's only, depending upon the terrain of the area to be desilted.
- Use techniques (e.g., silt curtains)[103], to minimize adverse impacts on aquatic life from the re-suspension of sediments
- Contractor in consultation with CPIU shall finalize the slope gradient to be maintained for the hydrological function of the beel and avoid haphazard ponding of water (after carrying out pre-excavation bathymetry survey).
- Channelized water flow and slope gradient would be maintained.
- In case silt is wet or charged with water need to be stored in TDY for dewatering
- The loose silt may not be left longer at the shore or within fringe area of the lake
- Zone of fracture (hydro-geological) shall not be disturbed (to avoid leakage and spillage) due to De-silting operation. Therefore, Contractor by taking client in loop will consult, concerned Govt. Geological Department/University Geology Dept./Geologist to inquire about hydrological zone of fracture in Beels area prior to de-silting/wet excavation.
- Contractor shall avoid areas of spawning and nesting grounds**, s**ubmerged macrophyte beds and bird nesting sites (if any) during desilting operation.
- Place silt in designated areas to avoid altering natural drainage patterns and prevent erosion.
- Store excavated silt temporarily in a contained area to prevent it from being washed away during rain events.
- The contractor and CPIU shall ensure the reuse of excavated material, such as silt or sediments. This material can be used for strengthening or constructing bunds, developing

[103] Silt Curtains are constructed to meet different waterway conditions with the objective to provide a settling time and allow the dispersed silt or sediment time to fall to the bottom. The purpose of a Silt Curtain is to control the migration of suspended silt and sediment and facilitate localised settling.

mounds, filling or leveling low-lying areas (away from flood-prone zones), and for agricultural or horticultural purposes. The reuse of excavated material must be carefully planned and investigated to prevent negative impacts, such as bund erosion or the re-entry of excavated silt into the beels.

- Excess soil shall be handled, transported, and disposed properly; before loading it shall be ensured that it is dried so no water spills during transport, and material also should be covered during transport to avoid spillage and dust.
- Design earthen mounds in larger beels to provide safe habitats for birds, ensuring they are stable and do not erode easily.

**Impact due to handling of construction materials and machineries at site.**

750. Incorrect handling is a common factor in work-related injuries. The contractor will need to adopt the following mitigation measures:

- Materials shall be stored and placed that will not create problem to the public, the workers or the adjoining property.
- Materials shall be stacked on well drained, flat and unyielding surface avoiding private properties and agriculture fields.
- Material stacks shall not impose any undue stresses on walls or other structures
- Materials shall be separated according to kind, size and length and placed in neat, orderly piles.
- High piles shall be staggered back at suitable intervals in height.
- Piles of materials shall be arranged so as to allow a minimum 800 mm wide passageway in between for inspection and removal.
- All passageways shall be kept clear of dry vegetation, greasy substance and debris
- Materials stored at site, depending upon the individual characteristics, shall be protected from atmospheric actions, such as rain, sun, winds and moisture, to avoid deterioration.

**Impact due to Waste Generation**

751. Construction activities, such as office building construction, inlet and outlet management, approach road and bund construction will generate excess excavated soil, construction waste materials, and solid waste. However, the scale of these impacts will be limited, as no large-scale labor camp will be established, considering the scope of work involved. While these impacts are negative, they are expected to be short-term and reversible through effective mitigation measures. The contractor will need to adopt the following mitigation measures:

- All of the construction activity shall be contained inside the preidentified construction area. Contractor shall prepare and implement a Waste Management Plan.
- To minimize environmental impacts and avoid disposal of earthwork materials, subproject shall maximize the reuse of excavated materials.
- Manage solid waste according to the following hierarchy: reuse, recycling and disposal. Include designated/approved disposal areas in waste management plan.
- Coordinate with BDC and CPIU for beneficial use of excavated materials or immediately dispose to designated areas.
- Recover used oil and lubricants and reuse; or remove from the site.
- Avoid stockpiling and remove immediately all demolished materials, excess construction materials, solid waste (removed weeds, wood, packaging materials, empty containers, oils, lubricants, and other similar items).
- Prohibit disposal of any material or wastes (including human waste) into drainage, nallah, agriculture fields and beels

- Dumping and disposal of construction wastes should be done as per Construction and Demolition Waste Management Rules 2016 to avoid habitat and vegetative cover loss.
- Construction contractor shall ensure daily collection and periodic disposal of construction waste generated debris, concrete, metal cuttings waste etc.
- Solid waste will be managed as per the Solid Waste Management Rules, 2016. Waste generated at site to be segregated onsite and recyclables sold off to vendors.
- During decommissioning, remove all wastes from the construction site and dispose of non-hazardous waste as per recommendation of CPIU and community, while any hazardous waste is to be disposed as the requirement of pollution control board

**Soil erosion, compaction and contamination**

752. **Soil erosion** may occur during the clearing of vegetation and earth-moving activities required for desilting, construction of earthen mounds, and building embankments. The removal of topsoil and vegetation exposes the land to water erosion during rains, potentially leading to loss of soil and increases sedimentation. This erosion and bund can also disrupt natural drainage patterns and contribute to sediment runoff, negatively affecting both terrestrial and aquatic ecosystems.

753. **Soil compaction** is another concern, as the use of heavy machinery for construction can compact the soil, reducing its porosity and permeability. Compacted soil can hinder root growth, reduce water infiltration, and increase surface runoff, ultimately affecting plant health and ecosystem stability. Furthermore, **soil contamination** might arise from on-site and off-site construction activities including construction of approach road, particularly if there are accidental spills or leaks of fuels, oils, asphalt (bitumen) and other chemicals used during the construction process. Such contaminants can infiltrate the soil, affecting its quality and potentially harming plant life and groundwater resources. Therefore, implementing effective erosion control measures, careful planning of machinery use, and proper management of chemical handling and composting are essential to mitigate these impacts on the land environment

754. **Mitigation.** The following mitigation measures are proposed:

- Construction activities will be scheduled to minimize bare soil surfaces, especially at borrow areas and composting sites, during the monsoon.
- Exposed ground shall be resurfaced and stabilized as soon as possible. This shall also be covered with straw or mulch to avoid soil loss.
- Construction shall be done in phases and only at allowed areas so that it is limited to workable size and minimize ground disturbances.
- Other slope stabilization measures like selection of less eroding materials around stream shall be adopted.
- Check probable areas for soil erosion during construction. To control massive soil erosion, appropriate measures will be applied such as use of mulch, blankets, and wood binders, and/or dewatering.
- Erosion prone sites shall be identified by contractor and CPIU especially for the subprojects having bund construction.
- Slope protection works (viz. bioengineering measures) shall be implemented at strategic locations to avoid erosion/land subsidence
- Movement of construction vehicles, machinery and equipment shall be within the subproject site and pre-defined haulage road by CPIU and community only to avoid compaction agriculture land and loss of standing crops.
- Fueling and maintenance of construction machinery and vehicles shall be carried out at designated place with proper arrangement of waste management.
- During servicing/repair of equipment and vehicles, suitable drip tray shall be used to prevent

oil/grease spills onto the soil, especially in case of emergency repairs collection and disposal.

- Fuel storage and refueling sites shall be kept away from drainage channel.
- Unusable debris to be disposed in designated places assigned by CPIU and community.
- Provision of oil interceptors.
- Ensure hazardous waste is properly labelled, stored onsite at a location provided with impervious surface, shed and secondary containment system as per in accordance with the Hazardous and Other Waste (Management and Trans boundary Movement) Rules, 2016
- Waste oil shall be sold off to recyclers authorized by SPCB or MoEFCC, GoI

**Change in topography and borrowing of soil**

755. In majority of sites, no soil will be brought from outside to the project area and the desilted earth from the beel will be used for bund strengthening and constriction. Hence, the proposed subprojects will not result to any adverse impact to topography. However, in case of material shortage for bund construction*, it is advisable to choose government-approved operational borrow locations in the vicinity for extracting earth materials for construction purposes*. Nevertheless, if the contractor initiates the establishment of a new borrow area, it is imperative to adhere to the prescribed protocols for running the said borrow area. The choice and suggestions of borrowing sites will be determined by both environmental and civil engineering factors mentioned in Table 5-2.

756. It is necessary to implement all necessary measures to prevent unlawful borrowing by the contractor. Opening any borrowing area without permission from the CPIU is strictly prohibited and has to be endorsed by the CPIU and must be consistent with the approved/adopted BIMP and -Guidelines/Procedures provided for Borrow Area Operations and Management.

**Table 5-2. Site Selections for Borrow Area**

| Identification of Borrow Area locations | Location/Sites to be avoided |
|---|---|
| - Identify barren land or riverside land for borrowing of earth.<br>- Prefer areas of highland with respect to surroundings;<br>- Avoid locating borrow area close to any road (maintain at least 30m distance from ROW and 10 m from toe of embankment, whichever is higher)<br>- Should not be located in eco-sensitive zones<br>- Should be at least 1.0 km away from inhabited areas<br>- Minimum distance of about 1.0 km from school, hospital and any archaeological sites<br>- Ensure that unsuitable soft rock is not prominent within the proposed depth of excavation which will render rehabilitation difficult | - Lands close to toe line of roads and hill slopes.<br>- Irrigated agricultural lands (in case of necessity for borrowing from such lands, the topsoil shall be preserved in stockpiles.)<br>- Grazing land<br>- Lands within 1km from settlements<br>- A distance of 1km should be maintained from environmentally sensitive areas such as Reserved Forests, Protected Forests, Sanctuary, wetlands<br>- Designated protected areas/forests<br>- Unstable hills side<br>- Seepage areas (Site of emergence of groundwater where the water table is present at the ground surface, including springs)<br>- Ensure unsuitable soft rock is not prominent within the proposed depth of excavation which will render rehabilitation difficult<br>- streams and seepage areas, areas supporting rare plants/ animal species. It should be ensured that unsuitable soft rock is not prominent within the proposed depth of excavation which will render rehabilitation difficult.<br>- No borrow areas inside KBA |

757. **Restrictions with borrow area operation:**

- Contractor shall estimate the quantity of material to be collected from each borrow area based on allowable depth of excavation and topsoil preservation.
- Contractor shall provide appropriate fencing all around the borrowed/excavated pit to prevent any accident.
- The borrowing/excavation activity shall be restricted to a maximum depth of 2 m below general ground level at the site, and restricted to 2 m above the groundwater table at the site.
- Contractor shall ensure that borrowing/ excavation activity shall not alter the natural drainage pattern of the area.
- Contractor shall maintain a Material Collection Register on daily material collection for each of the borrow areas, which shall be made available to the CPIU as and when requested.
- The Contractor shall maintain photographic record of each borrow area during pre-excavation, during, and post excavation stage
- Regular joint inspections shall be carried out during operations by the Contractor and Engineer's representatives
- In general, the Contractor shall ensure compliance of the requirements listed below:
- All efforts shall be made to avoid or minimize tree loss due to borrowing. The trucks shall be covered while transporting the earth. While borrowing the earth topsoil shall be preserved. The borrow pits shall be rehabilitated after borrowing the earth.
- The Indian Road Congress (IRC):10-1961 guideline will govern the selection of borrow pits. In all cases good engineering and construction practices shall be followed. The construction contractor shall submit in advance the borrow area identification details along with borrow area rehabilitation plan.
- Guidelines/Procedures for Borrow Area Operations and Management is provided in **Annexure A6.**

**Change in land uses**

758. Establishing composting units will require approximately 1,500 sq. ft of flat area per unit, with an additional 800 sq. ft needed for drying soil conditioners. This will likely result in temporary changes to land use patterns at the composting sites, potentially affecting agricultural land or natural vegetation. Additionally, the implementation of activities such as the construction of fish-rearing ponds, fish landing and aggregation sites, and embankments may also lead to alterations in existing land use practices. These changes could impact the surrounding environment and land use, necessitating careful planning and mitigation measures to minimize adverse effects.

**Mitigation.** The following mitigation measures are proposed:

- Prioritize using degraded or unused land for composting to avoid encroaching on productive agricultural land or natural habitats
- Ensure that the composting units are placed at an appropriate distance from the beel to minimize any direct impact on the beel ecosystem
- Establish buffer zones with native vegetation around the composting units to act as a barrier, reduce runoff, and improve the local ecosystem's resilience
- Engage with local communities and provide training on best practices for composting and waste management to ensure sustainable operations and minimize conflicts
- Limit the construction activities to designated areas to avoid unnecessary clearing or alteration of the surrounding land.
- Avoid the areas for fish landing and aggregation sites construction that are existing fish habitats and biodiversity
- Employ construction methods that minimize soil erosion, sedimentation, and other disturbances to the land.

**Operation Phase**

759. **Solid waste generation:** During the operational phase of the SWIFT Project, activities such as the operation of rearing ponds, hatcheries, fish auction centres, fish landing and aggregation sites and operation of ecotourism infrastructure at pilot sites may generate solid waste. This waste may include organic matter, packaging materials, and other refuse related to fish processing and handling. While these impacts are negative, they are anticipated to be short-term and reversible with the implementation of appropriate mitigation measures.

**Mitigation.** The following mitigation measures are proposed:

- Implementing waste management systems that include proper segregation, storage, and disposal of solid waste.
- Setting up designated waste disposal bins with necessary infrastructure to handle both organic and non-organic waste.
- Use organic solid waste for composting
- Ensuring regular collection and disposal of waste
- Educating workers and local communities about waste minimization and proper waste disposal practices to reduce the overall environmental footprint.
- Monitoring waste generation and disposal regularly to ensure compliance with environmental guidelines.

760. **Soil Contamination:** In the operation phase, nutrient leaching and runoff from composting activities may also lead to soil contamination, affecting soil structure and fertility. Depending on the organic material used, compost can sometimes introduce heavy metals into the soil, which can accumulate over time and negatively affect plant growth and soil health. Activities like composting and fish-rearing could introduce harmful substances into the soil. For instance, excessive use of fertilizers or improper handling of fish waste could lead to nutrient overload, resulting in soil contamination. This could have adverse effects on both the soil's health and the surrounding water quality, necessitating careful monitoring and the implementation of best practices to mitigate the risks.

**Mitigation.** The following mitigation measures are proposed:

- Establish buffer zones with vegetation around composting and fish-rearing sites to absorb excess nutrients and prevent them from reaching surrounding soil and water bodies.
- Ensure proper disposal of fish waste. Use fish waste as a resource (e.g., converting it into organic fertilizer) rather than allowing it to decompose on the ground.
- Use ground cover, terracing, or silt fences to reduce soil erosion and prevent contaminated runoff from spreading.
- Excessive composting or over-application of compost can lead to nutrient overload, which can adversely affect soil health, making it less suitable for plant growth
- Use only safe, uncontaminated organic materials in composting, avoiding materials with high heavy metal content or pathogens.
- Regularly testing of compost and soil quality to detect any adverse changes early and implement corrective measures as needed.

**Bund erosion during flooding**

761. Erosion of bunds during flooding can lead to the inundation of nearby agricultural fields, causing soil loss and crop damage. Eroded soil and debris can enter the beel, increasing sedimentation, reducing water depth, and affecting the water quality by increasing turbidity and nutrient loads. In addition, erosion and subsequent flooding can wash away fish stock, damage fish habitats.

**Mitigation.** The following mitigation measures are proposed:

- Use materials like geotextiles, stones, or riprap to reinforce bunds and prevent erosion. Construct bunds with gentle slopes to reduce water pressure and improve stability.
- Plant deep-rooted vegetation, such as vetiver grass or mangrove species, on the bunds to stabilize the soil and provide natural protection against erosion. Prioritize use of NBS and ecologically sustainable technologies (i.e. vegetation and bio-textile materials).
- CPIU shall conduct regular inspections of bunds, especially before and after the monsoon season, to identify weak points or signs of erosion.
- Repair and maintain bunds promptly to prevent small damages from escalating during floods.
- Manage water levels in the beel using controlled release structures (e.g., spillways or sluice gates) to regulate the flow of water during floods and reduce pressure on bunds.

Water Environment

**Construction Phase**

**Decline of water quality due to on-site and off-site activities**

762. During the construction phase of a beel conservation project, several activities such as desilting, building construction, de-weeding, earthmoving, embankment construction and approach road construction can disrupt the aquatic environment and degrade water quality if not properly managed. Desilting operations can temporarily increase turbidity in the water, reducing light penetration and affecting aquatic photosynthesis. This process may also release trapped nutrients and pollutants from the sediment, further degrading water quality. Similarly, de-weeding can result in the decay of removed vegetation, raising organic matter and nutrient levels (e.g., nitrogen and phosphorus), which can lead to eutrophication and oxygen depletion. The construction of earthen mounds and embankments can contribute to soil erosion, increasing sedimentation and turbidity in the water. Additionally, construction activities often involve displacing soil and sediment and the use of cement concrete and accidental discharges of fuel and lubricants that can introduce contaminants into the water environment. If the sediments contain pollutants such as heavy metals, pesticides, or other hazardous materials (e.g., petroleum oil, lubricants, bitumen etc.), these may be released into the water, leading to contamination. Sediment runoff from approach road construction sites can pollute nearby waterbodies, affecting aquatic ecosystems. Spillage of bitumen during construction can create impermeable layers, harming water infiltration and quality.

763. Off-site construction activities such as PIU and CPIU building renovation and construction may also result in surface water pollution, with sewage and wastewater from construction camps being a major concern. It is anticipated that up to 30 laborers will be hired and stay in each construction camp. The domestic water requirement for each construction camp is expected to be about 4.0 $m^3$/day, with approximately 80% of the water supplied being generated as sewage, estimated at 3.0 $m^3$/day per site.

764. **Mitigation.** The following mitigation measures are proposed:

- To minimize disruption to aquatic life during desilting, CPIU will ensure desilting activity (dry excavation) will be carried out during low-flow periods only in peripheral areas and use silt curtains or barriers to contain sediment plumes and prevent their spread. Additionally, ensure that excavated material is either reused or properly disposed of in designated areas away from water bodies.
- The CPIU will ensure that weeds are removed manually or using mechanical methods to minimize the use of chemicals. Removed weeds will be disposed of properly, away from the beel, to prevent their decomposition in the water. Additionally, harvested weeds will be used for composting to reduce waste and promote sustainable practices.

- CPIU shall ensure that non-toxic, low-impact construction materials will be use wherever possible, and minimize the entry of cement and concrete into beel while construction by adopting best management practices.
- Fueling and maintenance of construction machinery and vehicles shall be carried out at designated place with proper arrangement of waste management. During servicing/repair of equipment and vehicles, suitable drip tray shall be used to prevent oil/grease spills onto the soil, especially in case of emergency repairs collection and disposal.
- Fuel storage and refueling sites shall be kept away from drainage channel. Unusable debris to be disposed in designated places assigned by CPIU and BDC. Provision of oil interceptors at wash down and refueling areas, if needed
- Contractor shall ensure hazardous waste (if any) is properly labelled, stored onsite at a location provided with impervious surface, shed and secondary containment system as per in accordance with the Hazardous and Other Waste (Management and Trans boundary Movement) Rules, 2016 to avoid any contamination. Waste oil shall be sold off to recyclers authorized by SPCB/ MoEFCC, GoI. Handle bitumen with care to avoid leaks into water sources and use lined areas for bitumen application.
- Stabilize mounds with vegetation or geotextiles to prevent erosion.
- Construct mounds during dry periods to minimize soil displacement.
- Use silt fences or sediment barriers around construction sites.
- Plant vegetation along embankments to stabilize soil and reduce erosion
- Ensure proper alignment and grading of pipes to maintain natural water flow
- Inspect and maintain pipes regularly to prevent blockages and water quality issues.
- Locate composting units away from the beel and on impermeable surfaces.
- To mitigate impacts on beel water quality, sustainable aquaculture practices should be adopted, including controlled feeding, waste removal, and avoiding chemical additives or antibiotics.
- Proper water and sanitation facilities will be provided to the construction labors at construction sites. Provision of solid waste collection and disposal system at the construction sites.
- Septic tanks shall be provided to treat the domestic sewage from construction camp. Guidelines for setting of labour camp (if any) is provided in **Annexure A5.**
- Water quality to be monitored as envisaged in the environmental monitoring plan and results to be compared with relevant environmental regulatory standards/threshold limits for Water Quality provided in **Annexure A7.**

765. To address the potential water pollution caused by the use of mechanical equipment's in Beel management, the following measures shall be implemented:

- Utilize machinery with low-emission engines that meet environmental standards.
- Ensure regular inspection and maintenance of machinery to prevent fuel leakage, oil spills, or engine malfunctions that may lead to water contamination.
- Equip machinery with spill-proof fuel tanks and secure lids to minimize the risk of leaks.
- Use absorbent mats or barriers around machinery to capture accidental spills.
- Refuel machinery away from Beels in designated areas with spill containment systems.
- Train operators to handle fuel with care to avoid spills.
- Collect and dispose of waste oils, lubricants, and used filters following hazardous waste management guidelines.
- Prevent the disposal of any machinery waste into the Beel or surrounding areas.
- Train operators and workers on eco-friendly practices and the importance of preventing water pollution

**Alteration of Water Flow**

766. The construction of embankments, earthen mounds, and the installation of hume pipes can significantly alter the natural flow of water in and around the beel. These structures may affect the hydrology of the beel, potentially disrupting its natural flooding and drying cycles, and could also lead

to the inundation of surrounding agricultural fields. Such changes can interfere with the natural flooding patterns that are crucial for maintaining the beel's ecological balance, impacting processes such as fish breeding cycles and the distribution of nutrients. Additionally, the construction of approach roads may disrupt natural drainage systems, potentially causing waterlogging or reducing water flow in some areas if not designed properly.

**Mitigation.** The following mitigation measures are proposed:

- Before construction, PMU shall ensure thorough site-specific survey and investigation to understand the natural water flow, flooding patterns, and seasonal dynamics of the beel. Design embankments, earthen mounds, and hume pipes to minimize alterations to these natural flows
- Conduct discussions with stakeholders, including the local community and the BDC prior to construction to ensure their concerns and suggestions are incorporated into the planning and implementation process.
- The contractor shall ensure that only the approved plan is implemented on the ground, adhering strictly to the specifications and guidelines provided.
- Use spillways, sluice gates, and other structures to regulate water levels and flows, ensuring that natural flooding and drying cycles are preserved to support the beel's ecological functions.
- Ensure that the design of embankments, earthen mounds, and Hume pipes incorporates features such as controlled openings or culverts to allow for natural water flow and maintain ecological connectivity
- Schedule construction activities outside of critical periods, such as fish breeding seasons, to minimize disruption to the beel's ecological processes.
- Contractor shall obtain NOC from local administration and water resources department for the embankment/bund construction (if needed)
- Design drainage systems to maintain natural water flow and prevent waterlogging.

**Risk of Erosion and Sedimentation**

767. Construction activities can destabilize the soil and vegetation around the beel, increasing the risk of erosion. Exposed soil, particularly on embankments or newly constructed mounds can be easily washed away by rain or flowing water, leading to sedimentation in the beel and surrounding water bodies.

**Mitigation.** The following mitigation measures are proposed:

- Implementing erosion control measures such as silt fences, erosion control mats, and planting vegetation on exposed surfaces can help stabilize the soil including prioritize use of NBS and ecologically sustainable technologies (i.e. vegetation and bio-textile materials).
- Construction should be planned to minimize the time that soil is left exposed, and activities should ideally be scheduled outside of the rainy season to reduce erosion risk.

**Operation Phase**

**Sedimentation, Alteration of Water Volume and Hydrology**

768. Sedimentation could occur primarily due to the deposition of soil particles carried by surface runoff from nearby land areas. During the operational phase embankments, sluice gate and spillway (if any) and hume pipes, may alter the water volume if not properly managed and operated. By blocking or redirecting natural water channels and inlets, these structures can decrease the volume of water flowing to downstream areas. If water flow is obstructed or redirected improperly, it can exacerbate flooding in other areas, leading to damage to property and infrastructure. Proper operation of spillways and sluice gates is crucial to managing water flow in and out of a beel, ensuring that neither excessive nor insufficient water flow disrupts the ecosystem or causes damage.

**Mitigation.** The following mitigation measures are proposed:

- establishing vegetative buffer zones around the beel and silt traps can help trap sediments before they enter the water body.
- PMU shall ensure that designs of water retaining structures such as sluice gate etc. are adequately sized to handle anticipated peak flow conditions without causing erosion or damage.
- Design of embankment/bund and water control structures should mimic natural flow patterns, seasonal flooding and should be constructed in consultation of water resources department and PWD.
- CPIU shall conduct routine inspections to check for inlet and outlet blockages, sediment build-up, or structural damage.
- During normal flow conditions, adjust the spillway to manage water levels effectively, maintaining the natural flooding and drying cycles of the beel.
- CPIU shall ensure removal of debris and vegetation regularly to prevent blockages that can restrict flow and cause overflow.
- Develop and implement plans to address potential issues related to water flow alterations, including localized flood management

**Degradation of Water quality**

769. Despite the benefits, there is a risk of nutrient runoff during the operational phase, particularly from activities like composting and the use of fertilizers in nearby agricultural lands or fish-rearing ponds. Excessive nutrients, especially nitrogen and phosphorus, can leach into the beel, leading to nutrient enrichment or eutrophication. This can cause rapid algal blooms, which deplete oxygen levels in the water, creating hypoxic conditions that are harmful to aquatic life. While these activities are often intended to enhance productivity, careful management is required to prevent nutrient overload and maintain a balanced ecosystem. In addition, the discharge of wastewater from office premises and sanitation facilities established at fish landing sites, aggregation areas, and auction centers can contribute to water pollution in nearby waterbodies if not properly managed. Additionally, pilot ecotourism activities, such as fuel spills from boats, wastewater discharge, improper solid waste disposal, and sediment disturbance by boat propellers, may degrade water quality and negatively impact aquatic life.

770. Regeneration of weed could also be an issue during operational phase that can further contribute to nutrient overload in the beels. When weeds decay, they release nutrients such as nitrogen and phosphorus into the water, which can lead to eutrophication.

**Mitigation Measures**

- Use organic fertilizers and controlled composting methods to minimize nutrient leaching.
- Establish vegetative buffer zones and silt traps to capture excess nutrients before they reach the beel.
- BDC under the supervision of CPIU shall adopt sustainable aquaculture practices, including controlled feeding and organic waste management to avoid risk of water contamination
- Regularly monitor water quality in fish-rearing ponds and implement natural or biological treatment systems to reduce pollution.
- No wastewater discharge on open land will be practiced and wastewater outlet, if any, shall be diverted away from pondage area or connected to soak pit.
- Construct a properly sized and designed septic tank to collect and treat wastewater generated by the office premises. Ensure it has adequate capacity to handle peak loads and complies with local environmental standards.
- Septic Tank Maintenance: routine cleaning and sludge removal to prevent overflow and contamination.

- Link the treated outflow from the septic tank to a municipal sewer line to ensure wastewater undergoes further treatment at a centralized facility, minimizing risks of pollution in nearby water bodies
- Consider treating and reusing greywater (e.g., water from handwashing sinks) for non-potable uses such as irrigation or toilet flushing.
- Sanitation facilities shall be provided and maintained by BDC. BDC will collaborate with nearby fish landing sites, aggregation areas, and auction centers to promote shared responsibility to avoid discharge of waste in nearby beels.
- BDC shall ensure regular maintenance of boats (if any) to prevent leaks, and encourage the use of eco-friendly fuels and lubricants. If possible, encourage battery operated or paddle boats for ecotourism (if any).
- Accidental discharge of solid waste shall be prevented by the application of waste management rules.
- Nutrients and chemical intensive farming shall be controlled in catchments. Organic farming shall be encouraged by BDC
- BDC shall ensure periodic manual removal of weeds and Implement regular and targeted weed management practices to control their growth before they decay

#### 5.4.2.1. Ambient Air Environment

**Air Quality Decline**

**Construction Phase**

771. Ambient air quality in the subproject areas is classified as “good” due to limited vehicle movement and absence of air pollution sources. Dust generation, fugitive and exhaust gases generation may occur during excavation and construction activities including PIU and CPIUs building construction, desilting, de-weeding, construction of bund, approach road, fish landing and aggregation site and auction centers etc. It is likely that dust and fugitive emissions from construction loading and unloading areas will remain highly localized and confined to the subproject area. Pollutants of primary concern include particulate matter i.e., PM10 and PM2.5. Generation of exhaust gases (NOx, CO) is likely due to movement and operation of heavy machinery and operation of DG sets for construction. The impact will be very localized and can easily spread downwind. The increase in the level of air pollution from mobile and stationary sources during the construction phase will have a short-term effect on air quality, which is not expected to be significant.

772. **Mitigation measures:** The following mitigation measures are proposed to minimize and mitigate the impacts on air quality:

- All vehicles used for the Project must have valid pollution under control (PUC) certificates.
- Dust suppression measures such as sprinkling of water (to moist the dust prone area/construction site/approach road) will be taken at regular intervals to control fugitive dust emissions during construction activities.
- Stock piling shall be carried out at designated place located away from drainage or drain.
- Make provision for covering of trucks/dumper by tarpaulin sheets to prevent windblown dust (fugitive dust generation).
- Construction equipment should be properly maintained to minimize smoke in the exhaust emissions.
- Diesel generators meant for emergency power supply to be optimally operated and regularly maintained to ensure that emissions from fuel combustion remain within standard or at baseline levels.
- The crushers and batching plants (if any) should be operated after obtaining consent to establish (CTE) and consent to operate (CTO) under Air and Water Acts from the State Pollution

Control Board (SPCB). Location of these installation to be sited at least 500 m in the downwind direction from the nearest human settlements or as per the conditions of NOC.
- All slopes and embankments are to be turfed as per the best engineering practices to minimize dust generation.
- Speed restriction, surface improvement and surface treatment shall be taken as options for control of emissions from unpaved approach roads.
- Machinery shall be turned off when not in use.
- Monitoring of the exhaust gases and noise levels will be carried out by an NABL/MoEFCC accredited Environmental Monitoring agency during the construction phase. Results shall be compared with the regulatory standards/ thresholds.

**Operational Phase**

**Unpleasant odour**

773. Odor issues at fish-rearing, fish landing and aggregation sites and auction centers may arise primarily from decomposing fish waste, poorly managed wastewater, inadequate cleaning, and improper waste disposal practices. composting of organic material may produce smells, especially if the process is not properly managed.

**Mitigation**

- BDC to implement prompt waste removal by collecting fish waste and organic materials immediately, using sealed containers for temporary storage, and segregating organic and inorganic waste for proper disposal or composting.
- Ensure frequent cleaning of work areas, equipment, and drainage systems with water and biodegradable disinfectants to prevent residue buildup, stagnant water, and odors.
- Treat wastewater effectively through well-maintained septic tanks before connecting it to municipal sewer systems for further processing.
- Upgrade infrastructure by installing cold storage to slow decomposition, providing covered odor-proof bins, and enhancing ventilation systems to minimize odors in enclosed spaces.
- Train staff on hygiene practices, cleaning protocols, and efficient waste management to maintain cleanliness and reduce odor issues.
- Engage stakeholders, including fishermen and traders, to adopt odor control measures and promote a collaborative approach to maintaining a cleaner and more pleasant working environment.

**Emission from Diesel Generators**

774. Installation and operation of diesel generators (DG) at office premises can lead to air and noise pollution, which may impact the surrounding environment. Air pollution results from the emission of particulate matter, nitrogen oxides, and carbon monoxide during generator operation, contributing to poor air quality and health risks. Noise pollution arises from the high decibel levels generated during operation, which can disturb nearby residents and office staff.

**Mitigation**

- Use newer, fuel-efficient, and low-emission diesel generator models that comply with local environmental standards.
- DG set will be regularly maintained to ensure emissions align with the designed output and comply with environmental standards.

- Stack height for DG sets will be provided as per CPCB guidelines, ensuring the height above the roof is calculated as 0.2√KVA to disperse emissions effectively.
- Conduct regular maintenance, including cleaning filters and servicing engines, to ensure optimal performance and reduce emissions.
- Transition to cleaner fuel alternatives or renewable energy sources, where feasible, to lower the environmental footprint.

### 5.4.2.2. Noise Environment

**Construction and Operation Phase**

775. During the construction phase, noise levels will increase due to various activities such as site clearing, excavations, vehicle movements and use of construction equipment's for building and approach road construction. The general noise levels during construction phase due to working of earth moving equipment including excavators, weed harvesters and other machineries may reach 100 dB(A) at the work site. As a worst-case scenario considered for predicting noise levels during construction phase, it has been assumed that all these equipment generate noise from a common point. Construction activities are anticipated to produce noise levels in the range of 70-80 dB(A). However, during excavation and drilling it may go up to 90dB(A) and this will occur only when all the equipment operates together and simultaneously. As per regulatory requirements, threshold noise level around the residential should not be more than 55dB(A) in daytime and at night 45 dB(A).

776. The sound pressure level generated from the noise sources decreases with increasing distance from the source due to wave divergence. Noise attenuation with respect to distance in all the direction over horizontal distance have been estimated with the equation:

$$Lp(R2) = Lp(R1) - 20 \cdot \text{Log10}(R2/R1)$$

Where: Lp(R1) = Sound Pressure Level at Initial Location Lp(R2) = Sound Pressure Level at the new Location R1 = Distance from the noise source to initial location R2 = Distance from noise source to the new location

777. For an approximate estimation of dispersion of noise in the ambient air from above mathematical model for sound propagation is used to by considering 90 dB(A) cumulative noise level generated from the construction activities. The Noise level is expected to be 56dB (A) at 50-meter distance while reduce to 50 dB(A) at 100-meter distance. Considering model output, it can be concluded that expected noise impact will be short term and minor in nature and can be reduced further by providing silencers, padding and separate enclosures for noise equipment's. Regular maintenance of equipment's, machinery and construction vehicles will also be ensured to reduce the noise. Summary of noise attenuation predicted levels are presented at Table 5-3.

**Table 5-3. Increase in Noise Levels due to Operation of Various Constructions**

| Distance from source (m) | Source Pressure Level at Initial Location | Noise attenuation dB (A) |
|---|---|---|
| 1 | 90 dB(A) | 90 |
| 10 | | 70 |
| 50 | | 56 |
| 100 | | 50 |
| 150 | | 46.5 |
| 200 | | 44 |
| 250 | | 42 |

778. During operational phase, increase in noise levels is expected due DG set operations. However, it will be localized, temporary and mostly occur during daytime only.

**Mitigation**

779. Following noise control measures shall be adopted:

- Stationary equipment shall be placed away from inhabited area in accordance to the National Noise Quality standard, particularly for residential areas (Category C) and silence zones (Category D: hospitals, educational institutions, courts, religious places, etc.), keeping the distance at least 150 m (Category C) and 250m (Category D), to minimize objectionable noise impacts. In the event potential noise sensitive receptors are identified who will experience higher noise due to construction, appropriate temporary noise barriers will be established.
- Operations will be scheduled when people would be least likely to be affected. Construction activities shall be restricted between10p.m. and 6 a.m. Near residential areas.
- Protection devices (ear plugs or earmuffs) will be provided to the workers operating in the vicinity of high noise generating machines.
- Construction equipment and machinery shall be fitted with silencers and maintained properly. Noisy equipment, if any, will be provided in separate enclosures. Rubber padding will be used underneath high noise and vibration generating machines
- Noise measurements shall be carried out along the vicinity as well as in nearby villages to ensure the effectiveness of mitigation measures.

**Operational Phase**

- Install acoustic enclosures around the DG set to reduce noise levels to permissible limits.
- Use vibration isolation pads or mounts to minimize noise and vibrations during operation.
- Position the DG set away from sensitive areas, such as key workspaces to limit noise disturbance.
- Construct noise barriers, such as walls or fences, around the DG set to absorb and deflect sound.
- Schedule generator operations during non-sensitive hours to minimize the impact on nearby communities.
- Regularly maintain the DG set, including lubricating moving parts, to prevent noise caused by mechanical wear and tear.

### 5.4.2.3. Biological Environment

**Construction Phase**

**Terrestrial and Aquatic Habitat Disruption**

780. Some beels are located within or adjacent to ecologically sensitive landscapes that require additional environmental safeguards. These include Paranm Beel and Tatinga Mekheli Barbeel on Majuli Island, which are located within the Majuli Island KBA; Bera Na Beel, which falls within the Dibru–Saikhowa Complex KBA; Borthol Beel, located in close proximity to a KBA; and Mariampur Eco-Tourism Lake, situated within a forest area. Although the proposed interventions are limited in scale and avoid protected areas, activities such as limited tree cutting for access, earthmoving, desilting, de-weeding, and rehabilitation of hydraulic structures may result in localized and temporary impacts on surrounding habitats. These activities may increase turbidity, noise, and sedimentation, causing temporary disturbance to fish, aquatic fauna, waterbirds, and other wetland-dependent species, and may affect their breeding, feeding, and movement patterns. Changes in local water flow and aquatic habitat conditions may also occur during construction. However, these impacts are expected to be site-specific, temporary, and reversible, and will be effectively mitigated through implementation of site-specific EMP, BAP and biodiversity due diligence where required in accordance with the requirements of the ADB Safeguard Policy Statement (SPS), 2009.In the case of the Mariampur Eco-Tourism Lake,

although it is located within a forest lands, the site lies along the fringe of a semi-degraded forest and is surrounded by habitations and frequently visited by local tourists. Importantly, the proposed interventions are aligned with principles of aquatic habitat conservation and management. The lake is easily accessible by road and situated in an area that does not require any tree cutting for the implementation of project activities. As such, the environmental impact at this site is expected to be minimal and manageable.

781. Removing weeds can alter the physical structure of the aquatic habitat. Macrophytes play a crucial role in providing habitat for fish and other aquatic organisms, and their removal can lead to habitat loss and decreased biodiversity. Furthermore, some of beels also attracts avi-fauna during the winter months, which can be disrupted by construction activities. The noise and disturbances associated with construction can interfere with the birds' feeding and nesting behaviors. In some beels, presence of tortoise is also reported by local fisherman. Construction activities such as earthmoving, desilting, and embankment building can disrupt the natural habitat of tortoises (if any).

**Mitigation Measures**

- A beel-specific pre-construction biodiversity and wildlife survey will be carried out by the PMU, with support from the Forest Department, to reconfirm the presence of key flora and fauna, identify any spawning and breeding grounds (if present), and appropriately schedule site-specific construction activities. Special attention shall be given to beels located within KBAs, such as Paranm Beel and Tatinga Mekheli Barbeel on Majuli Island, as well as to those located near KBAs, such as Borthol Beel, and to sites situated within forest areas, such as Mariampur Eco-Tourism Lake, due to their ecological sensitivity.
- Given the location of Bera Na Beel within the Dibru–Saikhowa Complex KBA, biodiversity due diligence is recommended prior to implementation or construction. The IEE should be updated accordingly, and no physical works shall proceed until the applicable requirements of ADB SPS (2009) have been addressed.For Mariampur Lake, which is located within a forest area, the PMU shall obtain prior No Objection Certificate (NOC) from the Forest Department before initiating any work. The CPIU and PIU must maintain close coordination and regular consultations with the Forest Department to establish a clear implementation mechanism and ensure compliance with forest regulations.
- At the Mariampur site, all activities shall be strictly confined to the lake area and its immediate surroundings on the village-facing side to minimize potential impacts on the forest. Entry into the forested area will be strictly prohibited, and project execution will be limited to designated zones to avoid any ecological disturbance.
- Vegetation clearance should be restricted to the subproject activities. efforts shall be made to minimize the tree felling as much as possible
- If any tree needs to be fell, NOC from concerned authority shall be obtained by CPIU/contractor prior to cutting and also execute compensatory plantation as per Govt. norms
- Reduce the amount of work directly in the water, which can stir up sediment. Contractor shall also explore alternatives like working from platforms. If needed construct basins that trap sediment laden runoff before it reaches the water. These allow cleaner water flow through while the solids settle at the bottom
- Focus on removing only invasive weed species such as Water Hyacinth (*Eichhornia crassipes*), Water Lettuce (*Pistia stratiotes*), Salvinia (*Salvinia molesta*), Duckweed (*Lemna spp*.) that threaten the health of the beel ecosystem. Avoid removing submerged macrophytes to prevent ecological and water quality impacts, such as increase turbidity, release of nutrients and sediments previously stabilized by the plants
- Employ manual or mechanical weed removal techniques that minimize disturbance to the surrounding environment
- No hunting or poaching by contractor/construction staff in the Project area and surroundings

during construction
- Prohibition of fishing activities for construction workers/staff
- Minimize noise and artificial lighting at night during construction
- Cutting of trees for cooking and heating shall be prohibited
- Based on preconstruction biodiversity and wildlife survey, CPIU shall confirm the contractor about specific spawning and breeding ground and scheduling of site-specific construction activities to avoid impacts on biodiversity.
- Restriction of construction activities near the identified fish breeding and spawning grounds (if any) during the breeding period specified under Assam Fisheries Rules 1953.
- Implementing construction schedules that avoid critical periods for wintering birds and providing habitat buffers can help reduce the impact on these avian species.
- Impacts of project activities on tortoises, including habitat disruption, water quality degradation, increased human disturbance, collision risks, disruption of breeding sites, and altered food sources, can be mitigated through implementation of Tortoise and Avi-Fauna Management Plan mentioned in **Annexure A8**

**Operation Phase**

**Displacement of existing fish species**

782. During the operational phase, activities such as the introduction of fish fingerlings and habitat modifications can lead to the displacement of existing species. Accidental release or introduction of new species into the beel may compete with or prey upon native species, potentially disrupting established ecological relationships and causing shifts in species distribution. Additionally, human interference, such as pollution, over fishing or unregulated fishing, can further disrupt the ecosystem. Overfishing poses a significant risk to the beel's aquatic ecosystem, potentially leading to the depletion of fish stocks and disruption of the food web.

**Mitigation Measures**

- CPIU shall select only native fish species for introduction that should base on compatibility with existing species and ecosystem needs.
- CPIU/BDC shall stablish and enforce regulations on fishing practices to prevent overfishing. This includes setting limits on catch sizes, implementing seasonal fishing bans, and regulating fishing gear to protect fish stocks.
- CPIU shall conduct regular assessments of the beel’s ecological health, including monitoring fish populations, species distribution, and overall ecosystem conditions. Use this data to inform management decisions and adapt practices as needed.
- Maintain an updated inventory of species present in the beel to track changes in species distribution and abundance.

**5.4.2.4. Socio-economic and Cultural Environment**
**Construction Phase**

**Labor influx, conflict on cultural and regional bias**

783. Due to the proposed subproject, bringing migrant workers at the sites may have potential impacts in terms of conflicting culture and lifestyle, and may compete with local laborers over job opportunities. Social tension and conflict may arise between workers with local community members. Labor influx may also exert pressure on the natural resources in the subproject area as they may require fuel wood for cooking and heating, water for daily needs and fishes for foods etc. The subproject's benefit to a certain number of beneficiaries may cause tension and conflict among non-beneficiary tribal households in the vicinity.

**Mitigation**

- Maximum number of unskilled labors to be employed from local areas, having their residences in the nearby areas. If needed, the establishment of labor camps by construction contractor will be outside the Project site in consultation with BDC.
- Contractor shall designate a local person or hire a community engagement officer to liaise and interact with local community representatives or VDC/BDCs.
- The contractor shall limit the movement of workers in the local community after working hours.
- All migrant workers will undergo workshop/briefings to inform them on local culture and lifestyle awareness.
- Contractor shall inform BDC prior to any labor influx from outside village area.
  If labor camp is required to be established, the contractor will be required to ensure provision of basic amenities of drinking water, adequate number of toilets, washrooms, sanitation and cleanliness, lighting, availability of provisions and groceries, and recreational facilities at the labor camp site as part of the contract agreements.
- CPIU shall monitor the contractors and sub-contractors in terms of resources, migrant workers, child labor and forced labor, health and safety, and payment of wages etc.
- Establish a grievance redress mechanism in place to allow the employees, workers and villagers to report any concern or grievance related to work activities.
- Checking of structural integrity and equipment before undertaking work. Use of PPEs and fall protection equipment shall be required.

**Occupational health and safety risk to construction personnel and public**

784. Different construction activities will result in a variety of occupational health and safety risks. Major occupational health and safety issues viz. falls, collapse of uncompleted structure, electric shock, hearing loss, injuries due to failure to use proper personal protective equipment etc. cannot be ignored and should be considered for adequate management. This will ensure the full safety of workers and villagers. Although the scale of construction activities would be small and limited to only a section of the subproject footprint area, utmost care should be taken to prevent any safety and health hazards to laborers and villagers.

**Mitigation**

- Contractor shall comply with the safety protocols, Building and Other Construction Workers Regulations of GoI[104] and Environment, Health and Safety (EHS) Guidelines of IFC[105].
- Contractor shall provide suitable safety barricading and alternate route and access (wherever applicable) at construction sites.
- Engage local communities and stakeholders to identify routes that cause the least disruption to livelihoods, cultural sites, and community structures
- Contractor shall provide and ensure use of PPEs (Personal Protective Equipment) such as helmets, mask, gum boots, gloves, ear plug etc.
- Setting up of speed limits for material transport vehicles and speed breakers at strategic or accident-prone locations.
- Adequate lighting and fluorescent signage shall be provided at construction sites.
- All vehicles and equipment shall have safety gear such as safety belt, reverse horn, etc.
- All electrical connections shall be provided earth link circuit breaker (ELCB) and earthing.
- Contractor shall provide appropriate and adequate safety signage in local language and English at all project areas.

[104] the Building And Other Construction Workers | Chief Labour Commissioner (clc.gov.in)
[105] World Bank Group Environmental, Health, and Safety Guidelines (ifc.org)

- Contractor shall deploy Environment, Health and Safety Officers at the construction sites
- Contractor shall provide facilities for first aid and medical support on call at project sites.
- Contractor shall monitor and analyze all safety incidents/accidents and take appropriate preventive/ mitigative actions.
- In case of COVID-19 and other diseases spread, guidelines of GoI and local government on disease awareness and prevention shall be followed at the construction site.

**Chance finds of items/materials of cultural and/or archaeological importance**

785. As per the due diligence, there is no physical cultural resource (PCR) at the subproject sites. However, if a PCR is discovered during land clearing and/or construction (referred to as a chance find), CPIU shall guide the management on any accidental discoveries while implementing the subproject. Any idols, artefacts, fossils, coins, articles of value of antiquity, structures and other remains or objects with geological or archaeological value discovered in the sites shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation.

**Mitigation Measures**

- The contractor will take reasonable precautions to prevent workers or any other persons from removing and damaging any PCR. Upon discovery thereof and before removal, acquaint the engineer from CPIU of such discovery and carry out instructions.
- CPIU shall also report to relevant authorities to comply with Archeological sites and Remains Act, 1958 and as amended Act 2010 of GoI.

**Operation**

**Lack of maintenance of Beel, unequal distribution of share/profits and waterborne disease**

786. Without regular maintenance, the beel can experience degradation of its natural habitat. This can lead to the overgrowth of invasive species, reduced water quality, and loss of biodiversity. Neglecting maintenance of infrastructure like embankments and sluice gates can result in their deterioration. This could cause breaches or malfunctions, leading to flooding or reduced control over water levels, affecting both the beel's health and nearby areas. In addition, unequal distribution of profits from beel-related activities can lead to social tensions and inequities within the community. Poor water quality due to inadequate maintenance or contamination could also increase the risk of waterborne diseases.

**Mitigation**

- BDC will Implement a scheduled maintenance program that includes regular inspections of infrastructure and habitat conditions. Address any issues promptly to prevent long-term damage.
- BDC shall ensure adequate resources and funding are allocated for maintenance activities. Prioritize critical infrastructure and ecological areas for regular upkeep.
- BDC shall establish and communicate a clear and equitable profit-sharing framework that ensures fair distribution among all stakeholders. Include community representatives in decision-making processes.
- BDC will ensure prevention the breeding of mosquitoes by using appropriate measures removal of algae and weeds, keeping the beels surroundings clean.

## 5.5. Summary of Impacts and Residual Impact

787. The environmental assessment revealed that the subprojects are unlikely to cause any severe negative impacts on the environment or the communities in the subproject areas. Most of the potential

environmental impacts identified during the assessment are associated with the construction phase and are considered minor to moderate in nature. These impacts, primarily arising from physical interventions related to civil works, are temporary, reversible, and manageable. With proper design, construction planning, and the implementation of the Environmental Management Plan, these impacts can either be avoided or effectively mitigated. Furthermore, the implementation of mitigation measures will significantly minimize the identified impacts, ensuring that no residual or cumulative impacts are anticipated. In contrast, the project is expected to have positive environmental outcomes by rejuvenating degraded wetlands (beels) and protecting critical habitats for native fish species. These efforts will help restore ecological balance and ensure the long-term health of the ecosystem. Additionally, by improving habitats and increasing fish stocks, the project will enhance livelihood opportunities and contribute to income generation for local communities, fostering both environmental and socioeconomic benefits. The strict enforcement and monitoring of the implementation of identified mitigation measures, alongside ensuring consistency with the adopted/approved Beel Integrated Management Plan and engagement of local communities, will be overseen by the CPIU and BDC to ensure effective outcomes.

# 6. ALTERNATIVES ANALYSIS

## 6.1. Introduction

788. The consideration of alternatives is a proactive component of environmental impact assessment, typically undertaken during the planning phase to enhance project design and minimize environmental impacts. This approach involves exploring various options rather than merely focusing on mitigating the negative effects of a single design and implementation strategy. The targeted beels (floodplain wetlands) are site-specific and were selected based on their suitability for sustainable conservation and fisheries transformation. Although alternative sites were initially considered, the final selection and prioritization of beels were conducted through a rigorous screening mechanism. This mechanism evaluated multiple criteria, including morphological, hydrological, limnological, environmental, and socio-economic factors such as community dependence, land use issues, potential for livelihood and income generation, and any legal, social, or other conflicts.

789. To justify the subprojects, an evaluation of potential environmental and socio-economic impacts was carried out for both 'with' and 'without' project scenarios. Additionally, alternative methods for activities like de-weeding, desilting, weed disposal, were examined to ensure the most effective and sustainable approach.

## 6.2. 'With Project' Scenario

790. The 'with project' scenario involves implementing the SWIFT Project across various districts of Assam. This scenario has been assessed as economically viable and is expected to improve current conditions and opportunities. The project is not anticipated to trigger any land acquisition or cause loss of properties and livelihood options. It is designed to enhance the conservation of floodplain wetlands through activities like weed removal, habitat restoration, and siltation control, while also promoting sustainable fishery practices and increasing fish production. The project aims to improve water quality, strengthen institutional capacity for ecosystem management, and develop community-based fisheries for diversified income. Additionally, ongoing monitoring and sustainable practices will increase resilience to climate change. Overall, the project is expected to contribute to the development goals of the Government of Assam by enhancing fish production, promoting sustainable conservation of beels, and improving livelihoods. The Project envisages following benefits:

- Improved conservation of floodplain wetlands through activities like aquatic weed removal, habitat conservation, and protection against siltation.
- Promotion of sustainable fishery practices, leading to increased fish production, preservation of indigenous fish species, and long-term ecosystem health.
- Use of silt traps and beel connectivity restoration to reduce turbidity and nutrient input, enhancing water quality and beel ecosystem health.
- Strengthening of institutional capacity and regulatory frameworks for effective management of beel ecosystems and fisheries, ensuring sustainable use and conservation.
- Development of community-based fisheries businesses, leading to diversified income sources for beel communities and improved economic resilience.
- Ongoing monitoring of beel health to detect changes in ecosystem conditions, allowing for adaptive management and timely interventions.
- Increased resilience of wetland ecosystems and communities to climate change impacts through sustainable practices and habitat restoration.

## 6.3. 'Without Project' Scenario

791. If the SWIFT project is not implemented, several negative environmental, social, and economic impacts are anticipated. The absence of targeted interventions to conserve and restore floodplain wetlands (beels) and promote sustainable fishery practices could lead to a continued decline in the health of these ecosystems and the livelihoods of the communities that depend on them. In without project scenario, following are the negative impacts are anticipated:

- Without the project, floodplain wetlands will likely face further degradation due to unchecked siltation, invasive aquatic weeds, and poor water quality, leading to the loss of aquatic ecosystems, native fish habitats.
- Continued use of unsustainable fishing practices will reduce fish populations, including indigenous species, threatening food security and local livelihoods that rely on fishing as a primary income source.
- Lack of intervention to remove aquatic weeds and install biofilters will result in persistent water quality issues, such as increased turbidity and nutrient loading, further degrading the beel ecosystems.
- Without strengthening institutional frameworks and capacities, effective management of beel ecosystems and fisheries will remain inadequate, resulting in poor governance, enforcement, and oversight.
- The absence of support for community-based fisheries businesses will restrict income diversification opportunities, making local communities more vulnerable to economic shocks and reducing their resilience.
- Without sustainable management practices and habitat restoration, wetland ecosystems and local communities will remain highly susceptible to the impacts of climate change, such as flooding, drought, and biodiversity loss.
- Without regular monitoring, the ability to detect changes in ecosystem health and implement timely interventions will be severely limited, leading to long-term environmental and socio-economic losses.

792. Overall, the "without project" scenario would lead to the continued decline of Assam's beel ecosystems, reduced fish production, and weakened socio-economic conditions for local communities, undermining the development goals of sustainable conservation and livelihood enhancement.

793. No-action alternative is neither a reasonable nor a prudent course of action against the subprojects. Keeping in view the site conditions and the scope of development of the area, the 'With' and 'Without' project scenarios have been compared as shown in Table 6-1. By looking at the table it can be concluded that "With" project scenario and the positive/beneficial impacts will vastly improve the environment and enhance social and economic development of the village community compared to the "Without" project scenario, which will further deteriorate the present beel ecosystems and reduce the livelihood options. Hence the "With" project scenario with minor reversible impacts is an acceptable option than the "Without" project scenario. The implementation of the subprojects will be definitely advantageous to achieve the holistic development of the economy and progress of the state.

**Table 6-1. Comparison of 'With' and 'Without' project scenarios for alternative analysis**

| With Project | | Without Project | |
|---|---|---|---|
| **Impacts** | | **Impacts** | |
| **+ve** | **-ve** | **+ve** | **-ve** |
| • Improved conservation of floodplain wetlands through activities like aquatic weed removal, habitat conservation, and protection against siltation.<br>• Promotion of sustainable fishery practices, leading to increased fish production, preservation of indigenous fish species, and long-term ecosystem health.<br>• Use of silt trap and beel connectivity restoration to reduce turbidity and nutrient input, enhancing water quality and beel ecosystem health.<br>• Strengthening of institutional capacity and regulatory frameworks for effective management of beel ecosystems and fisheries, ensuring sustainable use and conservation.<br>• Development of community-based fisheries businesses, leading to diversified income sources for beel communities and improved economic resilience.<br>• Ongoing monitoring of beel health to detect changes in ecosystem conditions, allowing for adaptive management and timely interventions.<br>• Increased resilience of wetland ecosystems and communities to climate change impacts through sustainable practices and habitat restoration.<br>• | • Temporary impacts on environmental component during construction<br>• Minor noise and air pollution, mainly dust and particulate matter, due to vehicle use for construction and material transport.<br>• Temporary degradation of water quality from desilting and de-weeding activities.<br>• release of nutrient-rich water from fish-rearing ponds and hatcheries, which could affect beel water quality<br>• Occupational health and safety hazards to construction personnel and public | Nil | • Without the project, floodplain wetlands will likely face further degradation due to unchecked siltation, invasive aquatic weeds, and poor water quality, leading to the loss of aquatic ecosystems, native fish habitats.<br>• Continued use of unsustainable fishing practices will reduce fish populations, including indigenous species, threatening food security and local livelihoods that rely on fishing as a primary income source.<br>• Lack of intervention to remove aquatic weeds and install biofilters will result in persistent water quality issues, such as increased turbidity and nutrient loading, further degrading the beel ecosystems.<br>• Without strengthening institutional frameworks and capacities, effective management of beel ecosystems and fisheries will remain inadequate, resulting in poor governance, enforcement, and oversight.<br>• The absence of support for community-based fisheries businesses will restrict income diversification opportunities, making local communities more vulnerable to economic shocks and reducing their resilience.<br>• Without sustainable management practices and habitat restoration, wetland ecosystems and local communities will remain highly susceptible to the impacts of climate change, such as flooding, drought, and biodiversity loss.<br>• Without regular monitoring, the ability to detect changes in ecosystem health and implement timely interventions will be severely limited, leading to long-term environmental and socio-economic losses. |

## 6.4. Alternative Sites

794. In the initial phase of the Project, alternative sites were thoroughly examined to maximize project benefits and to minimize environmental impacts. The final selection and prioritization of beels were carried out through a rigorous screening mechanism that assessed a range of criteria, including morphological, hydrological, limnological, environmental, and socio-economic factors. This also included community dependence, land use issues, livelihood potential, and any legal, social, or other conflicts. The Department of Fisheries (DoF) identified 191 beels for development based on this screening mechanism. These beels cover a total area of 6,212 hectares and are distributed across 26 districts in Assam.

795. Later, beel prioritization was conducted to determine which beels would be considered for the project. These beels were further reduced in number based on factors such as environmental sensitivity, the extent of weed infestation, proximity to major rivers, and the number of beels in each district. Beels located fully or partially within protected areas (such as national parks, wildlife sanctuaries, and reserve forests) were excluded from the list. Additionally, beels with over 80% weed infestation, visible via Google Earth, were removed, though replacements can be considered in future phases. Beels within 300 meters of the Brahmaputra River, due to high flood risk, were also eliminated. Districts with fewer than three beels were not prioritized for the initial phase but will be considered in later stages.

## 6.5. Alternative Methods

796. Alternative methods for activities like de-weeding, desilting, weed disposal, were examined to ensure the most effective and sustainable approach.

**Selection between Dry Excavation in Peripheral Beel Area and Under water Dredging**

797. Dry excavation and dredging represent two different approaches to sediment management in beels. Dry excavation is conducted when beels are dry or partially dry, which helps to minimize disruption to aquatic environments and preserve water quality. This method allows for more controlled sediment removal, reduces water turbidity, and has a lower impact on aquatic life. Additionally, dry excavation is operationally simpler and safer for workers. In contrast, dredging involves removing sediment from the bottom of water bodies while they are inundated, which can increase water turbidity, disrupt aquatic habitats, and re-suspend pollutants and nutrients, potentially degrading water quality. Dredging is also more complex and costly. For the SWIFT project, dry excavation is preferred as it aligns with conservation goals by minimizing environmental impacts and maintaining better water quality.

**Selection between De-Weeding of Floating Weeds and removal of Submerged Weeds**

798. Removing floating weeds, such as water hyacinth, is prioritized due to their widespread dominance and significant impact on beels of Assam. Their presence can block sunlight, reduce oxygen levels, and obstruct water flow, negatively affecting aquatic health and usability. Floating weeds can be effectively managed through manual or mechanical means, improving water quality, restoring flow, and enhancing recreational value. In contrast, removing submerged weeds, risks deteriorating water quality by releasing trapped nutrients, causing habitat loss, and potentially increasing fish mortality. Submerged weeds are vital for aquatic ecosystems, offering habitat and stability, making their removal more disruptive compared to addressing the more immediate issues caused by floating weeds.

**Selection between Normal Composting and Accelerated Anaerobic Composting method**

799. Accelerated Anaerobic Composting (AAC-Developed by Indian Institute of Chemica Technology, Hyderabad, India) provides a rapid and efficient solution for managing water hyacinths in beels compared to traditional methods. It quickly decomposes these invasive plants in anaerobic environment. AAC not only reduces environmental impacts by improving water quality and promoting healthier ecosystems but also converts water hyacinths into valuable organic fertilizer. Additionally, it generates less methane and minimizes odors, making it a more sustainable and community-friendly option. Both AAC and normal composting aim to break down organic matter, but AAC differ in their approach and offer distinct advantages are listed in Table 6-2.

**Table 6-2. Comparison between normal composting and accelerated anaerobic composting**

| **Normal Composting** | **Accelerated Anaerobic Composting (AAC) (IICT's process for water hyacinths)** |
|---|---|
| **Process:** Relies on aerobic (oxygen-rich) conditions. Microbes that thrive in oxygen break down the organic material, generating heat and releasing CO2. Requires turning the pile regularly to ensure proper aeration and moisture balance.<br><br>**Time:** Can take several months to complete depending on factors like material size and pile management.<br><br>**Advantages:** Simple and low-tech, requires minimal equipment. Widely used for various organic materials.<br><br>**Disadvantages:** Slower process, requires ongoing maintenance (turning piles). May generate unpleasant odors due to volatile organic compounds released during decomposition. | **Process:** Occurs in an oxygen-limited (anaerobic) environment. Different microbial communities break down the material, producing biogas (methane and CO2) and organic acids. IICT's process utilizes water hyacinths with specific ratios of cow dung and bio-inoculant solution to optimize decomposition.<br><br>**Time:** Significantly faster than normal composting, taking around 4 weeks for IICT's AAC with water hyacinths.<br><br>**Advantages:** Faster decomposition, doesn't require constant turning, minimal odor production. IICT's process specifically addresses water hyacinth management, converting them into a valuable resource.<br><br>**Disadvantages:** Requires sealed containers/pits to maintain anaerobic conditions. May not be suitable for all organic materials. |

## 6.6. Alternative Analysis Summary

800. SWIFT Project provides an assessment of scenarios, sites, and methods to optimize environmental, social, and economic benefits. The analysis includes both "with project" and "without project" scenarios, highlighting significant benefits if the project proceeds and considerable negative impacts if it does not. Under the "with project" scenario, substantial improvements in floodplain wetland conservation, fisheries management, and community livelihoods are expected. Activities such as weed removal, silt control, habitat restoration, and the promotion of sustainable fisheries would result in increased fish production, improved water quality, strengthened institutional capacities, diversified community incomes, and enhanced resilience to climate change impacts.

801. The "without project" scenario predicts continued environmental degradation, such as unchecked siltation, invasive aquatic weed growth, and declining water quality. Persistent unsustainable fishing practices would lead to reduced fish populations and threats to local livelihoods and food security. Without interventions, communities would face increased vulnerability to climate-related events like flooding and drought, and there would be inadequate institutional frameworks for managing these valuable ecosystems, leading to ongoing socio-economic decline.

802. For site selection, an initial comprehensive screening assessed 191 beels across Assam based on environmental, hydrological, socio-economic, and conflict-related criteria. This rigorous evaluation process prioritized beels with optimal characteristics for sustainable management. Beels located in

protected areas, near the Brahmaputra River, or heavily infested by weeds were excluded from immediate consideration to avoid ecological risks. Ultimately, this selection approach aimed to maximize environmental benefits and minimize potential negative impacts.

803. Regarding alternative methods for sediment removal and weed management, dry excavation emerged as the preferred method over dredging, primarily due to its lower environmental impact, minimal disruption of aquatic habitats, and reduced operational complexity. Similarly, prioritizing the removal of floating weeds (e.g., water hyacinth) rather than submerged weeds was recommended, due to their significant negative impact on ecosystem health. For weed disposal, AAC was preferred over normal composting methods because AAC rapidly decomposes water hyacinth, reduces environmental impacts by generating minimal odors and methane, and produces valuable organic fertilizer, offering a sustainable and community-friendly approach to managing invasive aquatic plants.

# 7. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

## 7.1. Public Consultation

804. Public Consultation is a process of sharing project details with local communities and other relevant stakeholders, as well as gathering comments on the proposed project and the preferences of these communities and stakeholders. It can act as a means to enhance the implementation of the Project in order to better cater to the needs of the stakeholders. Additionally, it informs the community about the nature and goals of the subproject and encourages their involvement in the subproject's operations.

805. The meaningful consultation[106] and disclosure activities are ongoing processes that will be carried out throughout the stages of the subprojects under the SWIFT project. The consultation process has been carried out in two distinct phases: the planning phase and the design phase. Each phase aimed to gather valuable insights and feedback from stakeholders to ensure the project aligns with local needs and on-ground realities.

806. During the planning phase, various beels (wetlands) across different districts and under different ownerships were visited. These visits were conducted in collaboration with officials from the Department of Fisheries, District Fisheries Development Officers (DFDOs), and representatives from Village Development Committees (VDCs) and BDCs. Additionally, some model beels from the APART project were visited to assess the successes and challenges of beel fisheries and their management. These visits provided a detailed understanding of the socio-economic and environmental dynamics of various beels, both registered and unregistered.

807. In the design phase, the project team conducted extensive consultations to explain the objectives of the SWIFT project to stakeholders. These consultations aimed to address stakeholders' concerns, expectations, and potential apprehensions. The team provided a comprehensive overview of how the project intends to benefit local communities, improve the management of beel fisheries, and promote sustainable practices. Stakeholders were encouraged to share their opinions, insights, and suggestions for improving the proposed interventions.

808. Additionally, priority beels identified during the project readiness phase were assessed by the ADB safeguards consultant team, along with District Fisheries Development Officers (DFDOs), as part of the environmental and social due diligence process. These consultations were organized at the village level, facilitated by the DoF, in alignment with the objectives of ADB's SPS of 2009. During these discussions, members of BDCs, project beneficiaries, and nearby communities were informed about potential environmental impacts and proposed mitigation strategies. The meetings also covered important topics, such as Project Operation and Maintenance (O&M), the Grievance Redress Mechanism (GRM), and aspects related to project livelihoods.

[106]ADB SPS requires meaningful consultation to be a process that (i) begins early in the Project preparation stage and is carried out on as an ongoing process throughout the Project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of any socio-economic and cultural etc. pressure ; (iv) is gender inclusive and responsive, and is responsive to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

## 7.2. Objectives and Agenda of Public Consultation:

809. The key objectives of stakeholder consultations and public participation carried out under proposed project are to achieve the following:

- Share information about the subproject with the community, VDCs, BDCs, and other relevant stakeholders, and to gather their feedback on the proposed subproject.
- Promote active public and community participation in the project's environmental objectives and decision-making processes.
- Build public trust in the project's administration by clarifying the roles of the DoF and contractors in enforcing the EMP and the GRM.
- Provide the public with access to environmental data and information, thereby enhancing the quality of environmental management and compliance monitoring.
- Establish a basis for collecting primary and secondary data through engagement with nearby communities and other stakeholders.
- Initiate communication channels and mechanisms for resolving social and environmental issues at both the local and project levels.
- Ensure inclusive involvement of all project stakeholders
- Obtain feedback from primary stakeholders on measures for mitigating and enhancing the project's environmental and social impacts.

**Agenda of Public Consultation for Proposed Project**

810. SWIFT project aims to ensure transparency, inclusivity, and effective environmental and social management. For this public consultation, the following agenda items were considered:

- Providing detailed information about the SWIFT project interventions and the impacts of the proposed beel-specific subprojects.
- Inviting community members to share their ideas and suggestions and native knowledge.
- Assisting in identifying potential issues that may not have been previously considered
- Addressing and reducing any misconceptions or misunderstandings about the project.
- Ensuring community commitment and ownership of the final project decisions.
- Ensuring that gender equality and inclusive practices are integrated throughout the subproject cycle.
- Enhancing the relationship between the project and the community.
- Gaining a better understanding of local needs and concerns to align the project with community expectations.

## 7.3. Stakeholders and Methodology Adopted for Consultation

811. Stakeholders are defined as individuals and community organizations that are directly or indirectly affected by the project, as well as those who have an interest in the subprojects or the ability to influence their outcomes. Two categories of stakeholders were identified i) Primary stakeholders – those who will be directly impacted by the benefits or drawbacks of the subproject, ii) Secondary stakeholders – those who will experience indirect effects from the subproject.

812. During field surveys, a diverse range of individuals with specific stakes in the project were identified. These included villagers, project beneficiaries, members of the Village Development Committee (VDC), BDC, fishermen, members of Self-Help Groups (SHGs), farmers, government officials, and public representatives. Special attention was also given to ensuring female representation in every meeting and discussion.

813. The Department of Fisheries (DoF) maintained both formal and informal contact with these stakeholders. It engaged in discussions with various departments and groups, including the Assam State Space Application Centre, Revenue Department, NGOs, SHGs, local community-based organizations, the Forest Department, Water Resources Department, Central Inland Fisheries Research Institute (CIFRI), World Fish, Wetlands International South-East Asia (WISA), State Wetland Authority (SWA), and many other departments and NGOs, to ensure a coordinated approach to project planning and implementation, foster collaboration across different sectors, and gather diverse perspectives and expertise to enhance the effectiveness of the project interventions.

**Methodology**

814. To engage stakeholders effectively, a range of consultation methods were employed, including individual meetings, focus group discussions (FGDs), and community meetings. The project team adopted a strategic and flexible approach to ensure comprehensive stakeholder participation.

815. The process began with individual briefings for community members, BDC and Village Development Committee (VDC) to provide them with an initial understanding of the project. These briefings were followed by FGDs, where smaller groups of these members could discuss specific issues, share their insights, and express concerns. After these initial engagements, community-level meetings were organized to involve a wider range of stakeholders, including project beneficiaries, potentially affected persons, and other community members. Informal meetings were also conducted to foster open dialogue and gather additional feedback.

816. Additionally, representatives from various government departments were invited to participate in these consultations during each project mission to ensure inter-departmental coordination and input. A workshop titled "Sustainable Wetland and Inland Fisheries Management in Assam" was also organized in June 2024, where stakeholders were invited to discuss the project's interventions and provide suggestions for improvement.

817. This multi-tiered approach allowed for a comprehensive understanding of stakeholder perspectives and ensured that diverse voices were heard throughout the consultation process.

### 7.4. Consultation with Village Community, Development Committee and Beneficiaries

818. Project team had engaged in a series of comprehensive consultations to clearly communicate the objectives of the SWIFT project to all relevant stakeholders mentioned in the preceding sections of this chapter. These sessions were crucial for addressing any concerns, expectations, or apprehensions stakeholders might have regarding the project. The project team presented a detailed overview of the anticipated benefits for local communities, including improved management of beel fisheries and the promotion of sustainable practices. Stakeholders were actively encouraged to share their perspectives, provide insights based on their local knowledge, and suggest modifications or enhancements to the proposed interventions.

819. In parallel, priority beels identified under the project readiness phase were assessed by the ADB safeguards consultant team, in collaboration with the District Fisheries Development Officers (DFDOs). This assessment formed part of the IEE and other social due diligence activities. The list of beels visited during the pre-fact-finding mission and safeguards consultation mission is summarized in Table 7-1 while list of beels visited for public consultation after final selection process is provided in Table 7-2.

**Table 7-1. List of beels visited during the pre-fact-finding mission and safeguards consultation mission**

| S.No | Name of Beel | Village and District | Date of Site Visit | Number of Participants | |
|---|---|---|---|---|---|
| | | | | Male | Female |
| A) Site visited during PFF Mission | | | | | |
| 1 | Mariyampur Ecotourism Lake | Mariyampur, Goalpara | 20.06.2024 | 38 | 25 |
| 2 | Sagunbari Beel | Kashikhagra, Goalpara | 20.06.2024 | 17 | 15 |
| 3 | Rokapada, Singimari Beel | Singimari, Goalpara | 20.06.2024 | 20 | 13 |
| 4 | Dakra Group Beel | Baniyapara, Dubri | 21.06.2024 | 19 | 10 |
| 5 | Hakama Beel | Hakama, Dubri | 21.06.2024 | 19 | 14 |
| 6 | Udmari Chora Beel | Udmari, Dubri | 21.06.2024 | 12 | 8 |
| 7 | Purni Beel | Beltari, Dubri | 21.06.2024 | 12 | 5 |
| 8 | Chilli Beel | Amrikhawa, Barpeta | 22.06.2024 | 17 | 8 |
| 9 | Romari Beel | Dahudi, Nalbari | 22.06.2024 | 10 | 4 |
| B) Site visited during Safeguard Mission (Priority Beels) | | | | | |
| 10 | Bechamari Beel | Judgaon, Morigaon | 6.08.2024 | 31 | 32 |
| 11 | Sawguri Beel | Sawguri, Jorhat | 7.08.2024 | 49 | 38 |
| 12 | Moridesoi Beel | Kalbari, Jorhat | 8.08.2024 | 31 | 28 |
| 13 | Chalantapara Haripani Beel | Chalantapara Village, Bongaigaon | 10.08.2024 | 23 | 9 |
| 14 | Gojarala Beel | Gojarala Village, Sribhumi | 21.08.2024 | 24 | 8 |
| 15 | Tiayakuri Beel | Tiayakuri, Sribhumi | 21.08.2024 | Site was not reachable due to flood | |
| 16 | Mahara Anchalik Beel | Mahara Borasapori, Lakhimpur | 23.08.2024 | 21 | 14 |
| 17 | Dalpung Borbeel | Ger Geri, Dhimaji | 24.08.2024 | 16 | 16 |
| 18 | Lonkadeep Beel | 3 No. Borhonnllong viillage, Tinsukiya | 25.08.2024 | 19 | 12 |
| Beel in Autonomous District Council | | | | | |
| 19 | Kunjaduba Beel | Kunjaduba, Kokrajhar district | 9.08.2024 | 19 | 14 |

**Table 7-2 List of beels visited for public consultation after final selection process**

| Sl no | Name of Beel | District | Village | Date of Site Visit | No of Participants | | Total |
|---|---|---|---|---|---|---|---|
| | | | | | Male | Female | |
| 1 | Pitkati Beel | Kamrup (R) | Niz-Hajo | 13.02.2026 | 13 | 3 | 16 |
| 2 | Bhatiakhali Beel | Nagaon | 1 no. bhatiakhali | 28.07.2025 | 55 | 0 | 55 |
| 3 | Sara Beel | Nagaon | Sara Gaon | 28.07.2025 | 20 | 22 | 42 |
| 4 | Potali Bhatiakhali Beel | Nagaon | Pachim Bhoridhuwa | 10.03.2026 | 11 | 7 | 18 |
| 5 | Bhagamur Beel | Nagaon | Bajiagaon | 20.03.2025 | 19 | 0 | 19 |
| 6 | Borthol Beel | Nagaon | Uttar petboha | 23.3.2025 | 10 | 0 | 10 |
| 7 | Santijaan | Nagaon | Borhisha | 11.03.2026 | 18 | 9 | 27 |
| 8 | Sola Mikirbheta Beel | Nagaon | Chotorbori | 7.01.2026 | 40 | 3 | 43 |
| 9 | Na kalong | Nagaon | Baruabali | 7.01.2026 | 50 | 23 | 73 |
| 10 | Tihulia beel | Morigaon | Niz Mikirgaon | 23.12.2025 | 32 | 0 | 32 |
| 11 | Solmari Beel | Morigaon | 2nd No Solmari | 24.12.2025 | 24 | 21 | 45 |
| 12 | Samkata Beel | Morigaon | Samkata | 2.01.2026 | 5 | 22 | 27 |
| 13 | Morakollong Beel | Morigaon | Bonpara | 21.06.2025 & 16.02.2026 | 27 | 0 | 27 |
| 14 | Oram Beel | Morigaon | Kumarkuchi | 29.05.2025 &19.02.2026 | 22 | 16 | 38 |
| 15 | Bechamari Beel | Morigaon | Jurgaon | 06.08.2024 & 21.02.2026 | 27 | 78 | 105 |
| 16 | Borgoria Beel | Golaghat | Borgoria Gaon | 13.02.2026 | 10 | 19 | 29 |
| 17 | Doigrung Kordaiguri Nau Beel | Golaghat | Jothipothia gaon | 16.02.2026 | 7 | 17 | 24 |
| 18 | Borpathorua Beel | Golaghat | Disangmukh Village | 11.02.2026 | 7 | 21 | 28 |
| 19 | Moridesoi Beel | Jorhat | Kalbari Gaon | 09.02.2026 | 12 | 0 | 12 |
| 20 | Sawguri Beel | Jorhat | Sawguri Gaon | 10.02.2026 | 26 | 56 | 82 |
| 21 | Amguri Beel | Jorhat | Bahphala Gaon | 21.12.2025 | 18 | 8 | 26 |
| 22 | Jengoni Beel | Jorhat | Bahphala Gaon | 21.12.2025 | 17 | 6 | 23 |
| 23 | Charigaon Beel | Jorhat | Charigaon Village | 29.12.2025 | 14 | 14 | 28 |
| 24 | Tatinga Mekheli Barbeel | Majuli | Bonkhuwa Chuk Village | 14.03.2026 | 41 | 7 | 48 |
| 25 | Param Beel | Majuli | Sukan Sukti Pathar Village | 13.03.2026 | 11 | 10 | 21 |
| 26 | Tinsukia beel | Sivasagar | Disangmukh Village | 14.03.2026 | 14 | 7 | 21 |
| 27 | Mornoi Beel (Masmorani) | Sivasagar | Chan Bosa Handique Gaon | 12.03.2026 | 10 | 11 | 21 |
| 28 | Gabhoru Beel | Sivasagar | Gohan Gaon | 14.03.2026 | 11 | 7 | 18 |
| 29 | Kurekhona Beel | Sivasagar | Kathanipar Village | 11.10.2025 | 16 | 10 | 26 |
| 30 | Panikheti Beel | Sivasagar | Soraipora Gaon | 14.03.2026 | 28 | 10 | 38 |

| Sl no | Name of Beel | District | Village | Date of Site Visit | No of Participants | | Total |
|---|---|---|---|---|---|---|---|
| | | | | | Male | Female | |
| 31 | Hatihuria Beel | Sivasagar | Moiramoral Handique Gaon | 16.10.2025 | 23 | 17 | 40 |
| 32 | Gudhabil | Sivasagar | Gudhabil Gaon | 28.12.2025 | 10 | 29 | 39 |
| 33 | Burhi Beel | Tinsukia | Rajkhowa Gaon Village | 13.03.2026 | 12 | 8 | 20 |
| 34 | Toklong Beel | Tinsukia | Nepali No 1 Gaon | 10.10.2025 | 68 | 35 | 103 |
| 35 | Pera Beel | Tinsukia | Majgaon | 21.12.2025 | 21 | 7 | 28 |
| 36 | Sagarbera Beel | Charaideo | Deodhai Gaon | 28.12.2025 | 19 | 2 | 21 |
| 37 | Bamuni Beel | Dibrugarh | 1 No. Bamuni Beel Gaon | 22.12.2025 | 20 | 4 | 24 |
| 38 | Mirika Beel | Dibrugarh | 1 No. Dighalibeel Gaon | 22.12.2025 | 33 | 17 | 50 |
| 39 | Hatibondha Beel | Dibrugarh | 1 No. Hatibondha Gaon | 23.12.2025 | 26 | 22 | 48 |
| 40 | Natun Bolai Erahuti | Dibrugarh | Notun Bolai Gaon | 24.12.2025 | 20 | 10 | 30 |
| 41 | Mer Beel | Dibrugarh | Borbil No. 1 | 24.12.2025 | 21 | 12 | 33 |
| 42 | Kutuha Beel | Dibrugarh | Kutuha Borbeel Gaon | 23.12.2025 | 17 | 11 | 28 |
| 43 | Singimari Beel | Goalpara | Rokhapara | 20.6.2024 & 30.7.2025 | 48 | 18 | 66 |
| 44 | Borjong | Goalpara | Borjhora Pt-2 | 20.5.2025 | 17 | 1 | 18 |
| 45 | Mariampur Eco Tourisim Lake | Goalpara | Mariampur | 20.6.2024 & 29.5.2025 | 48 | 44 | 92 |
| 46 | Kaplimara Beel | Bajali | Baniagaon | 20.12.2025 | 33 | 6 | 39 |
| 47 | Nayachara Beel | Bongaigaon | Ghosamari chaprakata | 23.12.2025 | 22 | 9 | 31 |
| 48 | Borai Pani Khowa Beel | Bongaigaon | Nayagaon pt-1 | 22.12.2025 | 39 | 44 | 83 |
| 49 | Chalantapara Haripani Beel | Bongaigaon | Chalantapara Pt-1 | 10.8.2024 & 22.5.2025 | 43 | 12 | 55 |
| 50 | Deepor Pitoni | Bongaigaon | K. Pahar | 22.5.2025 | 25 | 16 | 41 |
| 51 | Khoribari Borbilla | Bongaigaon | Borbila | 23.12.2025 | 35 | 13 | 48 |
| 52 | Udmari Chora Beel | Dhubri | Udmari pt-3 | 21.6.2024 & 27.52025 | 29 | 20 | 49 |
| 53 | Airmara | Dhubri | Ratiadaha | 28.5.2025 | 35 | 0 | 35 |
| 54 | Bera na Beel | Dhemaji | Bera mej gaon | 08.3.2026 | 15 | 19 | 34 |
| 55 | Singra Beel | Dhubri | Barkhasua | 22.12.2025 | 18 | 45 | 63 |
| 56 | Goka Beel | Dhubri | Tolli pt-1 | 23.12.2025 | 48 | 26 | 74 |
| 57 | Ghritingerkuti beel | Dhubri | Ghritingerkuti | 21.12.2025 | 19 | 15 | 34 |
| 58 | Halowadal Beel | Kokrajhar | Halowadol pt-2 | 26.12.2025 | 18 | 8 | 26 |
| 59 | Bamunkura beel | Kokrajhar | Bamunkura | 27.122025 | 22 | 10 | 32 |
| 60 | Barkhang Beel | Kokrajhar | Barkhang | 27.12.2025 | 9 | 31 | 40 |
| 61 | Intibill | Kokrajhar | Intibil | 26.12..2025 | 21 | 11 | 32 |
| 62 | Amritpur Brahma | Kokrajhar | Anthaibari | 27.122025 | 23 | 14 | 37 |

| Sl no | Name of Beel | District | Village | Date of Site Visit | No of Participants | | Total |
|---|---|---|---|---|---|---|---|
| | | | | | Male | Female | |
| | Sewashram Beel | | | | | | |
| 63 | Kutnikuchi Beel | Nalbari | Khokhrishal | 12.7.2025 | 11 | 13 | 24 |
| 64 | Mugdi Beel | Nalbari | Mugdi | 30.7.2025 | 24 | 3 | 27 |
| 65 | Gandhi Beel | Barpeta | Patbaushi | 22.5.2025 | 18 | 1 | 19 |
| 66 | Burisuti Rikseng Beel | Dhemaji | Galighat Machkhowa | 08.3.2026 | 15 | 14 | 29 |
| 67 | Bhalukaguri Dambuk Randh Beel | Dhemaji | Bhalukaguri | 7.03.2026 | 26 | 3 | 29 |
| 68 | Gutung Bhattali Beel | Lakhimpur | 1/2 Gohai Chapori | 7.03.2026 | 16 | 10 | 26 |
| 69 | Mer Beel | Lakhimpur | Merkathoni | 7.03.2026 | 15 | 3 | 18 |
| 70 | Gamiri Beel | Biswanath | Miri Pathar Gaon | 17.02.2026 | 12 | 39 | 51 |
| 71 | Digholi Beel | Sonitpur | 2no Borpukhuri | 25.07.2025 | 41 | 8 | 49 |
| 72 | Borakata Beel | Sonitpur | Bordubia | 21.01.2026 | 16 | 2 | 18 |
| 73 | Kaupati gaon beel | Darrang | Kopati Gaon | 20.12.2025 | 23 | 8 | 31 |
| 74 | Bor Beel | Sribhumi | Patharkandi | 12.12.2025 | 5 | 5 | 10 |

**Purpose and Outcomes of Consultation Pertaining to Environmental Safeguards**

820. The safeguards consultations began with an introduction to the SWIFT Project, outlining its objectives, scope, and potential impacts. This was followed by an open discussion on how the project could affect both the environment and local communities. The aim was to gather participants' views on all environmental aspects that might directly or indirectly impact the local population, as well as the aquatic and physical environment.

821. Key environmental and social issues were thoroughly discussed with various stakeholders, including community members, Village Development Committees (VDCs), Beel Development Committees (BDCs, if any), and government officials. When engaging with the general public, the discussions focused specifically on issues most relevant to them. The consultations began with a simplified presentation of the subproject's objectives, components, and benefits in the local language to ensure clear understanding. The discussions then shifted to the potential impacts of the proposed subproject. Local residents were informed about both the positive and negative effects expected during the construction phase.

822. Community members expressed that they considered the negative impacts, such as noise and dust, to be minor and temporary compared to the positive benefits. They noted that the project would improve water quality and quantity through activities like weed removal, desilting, and bund construction, as well as provide alternative livelihood opportunities. The public consultation focused on several key points:

- Explanation of the extent of the subproject and its specific activities viz. de-weeding, desilting, bund construction, inlet and outlet management, fisheries infrastructure development etc.
- Discussion of probable impacts on the environment.
- Gathering input on community-specific interventions and alternative livelihood options.
- Overview of the expected benefits for the local communities.

- Review of the plan to mitigate environmental impacts.
- inquire about wildlife available in and around beel area and consideration of the impact on local biodiversity
- Understanding the socio-economic conditions of local people.
- Clarification of the roles of VDCs, BDCs, Department of Fisheries (DoF), contractors, and the community in project implementation and environmental management.
- Explanation of how grievances will be addressed.
- Encouraging community cooperation during project execution.
- Emphasizing the importance of community-led operations and maintenance for sustainability.

823. The participants, including villagers and members of the VDC, openly shared their views on the subproject. They understood that the subproject would enhance the condition of the village beel, increase fish production, and provide additional livelihood opportunities. At majority of subproject sites, participants were unanimous in their support for the subproject, recognizing its potential benefits.

824. Qualitative assessments conducted during the field survey indicated a strong willingness among the community members to contribute to the subproject's implementation by working as unskilled labor. However, they emphasized a preference for the contractor to hire only local residents for non-skilled work, ideally during the agricultural off-season.

825. A summary of consultations with village community, development committee and beneficiaries carried out at representative priority beels is provided in Table 7-3 & 7.4 and photographs of the same is also depicted in Figure 7-1, and Annexure A9. In addition to this, the lists of participants and photos of safeguard consultation are available in the PMU’s office.

**Table 7-3.Summary of consultation Carried out in representative priority beels**

| S.No | Name of Beel | Village and District | Date of Site Visit | Number of Participants | | Participants | Discussion of Issues, Concern and Suggestions |
|---|---|---|---|---|---|---|---|
| | | | | Male | Female | | |
| 1 | Bechamari Beel | Judgaon, Morigaon | 6.08.2024 | 31 | 32 | - VDC representative<br>- Project beneficiaries<br>- Farmers and fishermen<br>- community facilitators<br>- Officials of DoF<br>- ADB safeguards consultants<br>- Local NGOs<br>- Members of SHGs | • The Department of Fisheries (DoF) officials discussed the specific interventions, their scale, and areas of impact. environmental consultant from the Asian Development Bank (ADB) elaborated on potential environmental impacts and corresponding mitigation plans that will be integrated into the Environmental Management Plan (EMP).<br><br>• Based on feedback from the community and their local knowledge, certain interventions were included or modified in the project design such as raising the height of the bund and constructing bunds in critical sections of the some beels.<br>• Clear roles and responsibilities were explained for the upcoming contractor, the DoF, and Village or Beel Development Committees (VDC or BDC) to ensure all parties understand their roles in implementing the EMP and monitoring environmental compliance.<br><br>• DoF officials committed to providing technical support to the BDC for fisheries development and capacity building emphasizing the importance of sustainability and long-term benefits.<br><br>• The ADB consultant inquired about the presence of wildlife around the beel areas. The majority of the beels did not have any species of large mammals and threatened flora. However, some |
| 2 | Sawguri Beel | Sawguri, Jorhat | 7.08.2024 | 49 | 38 | | |
| 3 | Moridesoi Beel | Kalbari, Jorhat | 8.08.2024 | 31 | 28 | | |
| 4 | Chalantapara Haripani Beel | Chalantapara Village, Bongaigaon | 10.08.2024 | 23 | 9 | | |
| 5 | Gojarala Beel | Gojarala Village, Sribhumi | 21.08.2024 | 24 | 8 | | |
| 6 | Tiayakuri Beel | Tiayakuri, Sribhumi | 21.08.2024 | Site was inaccessible due to flooding | | | |
| 7 | Mahara Anchalik Beel | Mahara Borasapori, Lakhimpur | 23.08.2024 | 21 | 14 | | |
| 8 | Lonkadeep Beel | 3 No. Borhonnllong viillage, Tinsukiya | 25.08.2024 | 19 | 12 | | |

| S.No | Name of Beel | Village and District | Date of Site Visit | Number of Participants | | Participants | Discussion of Issues, Concern and Suggestions |
|---|---|---|---|---|---|---|---|
| | | | | Male | Female | | beels are visited by migratory birds in winter, and two beels were reported to have limited numbers of tortoises, prompting discussions on the project's potential impact on local flora and fauna.<br>• Villagers proposed that the subproject be implemented during the agricultural off-season to avoid conflicts with farming activities. They also requested that their rights over the beel remain intact.<br>• The role and importance of the GRM were explained to the community to ensure they understand how to raise their concerns and seek redressal in a time bound manner during the project.<br>• The community including SHGs requested training and infrastructure support to enhance their livelihood opportunities. Majority of them expressed a willingness to support the project during both construction and operational phases.<br>• The community indicated their readiness to contribute to periodic maintenance activities such as weed removal, cleaning of inlets and outlets, and minor repairs using revenue generated from beel fisheries. They also requested support for fisheries-related infrastructure for sustainable fish harvesting and selling. |

**Table 7-4 Summary of consultation Carried out in 74 beels after final selection**

| Sl no | Name of Beel | District | Village | Date of Site Visit | No of Participants | | Participants | Discussion of Issues, Concern and Suggestions |
|---|---|---|---|---|---|---|---|---|
| | | | | | Male | Female | | |
| 1 | Pitkati Beel | Kamrup (R) | Niz-Hajo | 13.02.2026 | 13 | 3 | - VDC/Panchayat representative<br>- Village Head<br>- Project beneficiaries<br>- Farmers and fishermen community facilitators<br>- Officials of DoF<br>- PMU & PIU Officials<br>- Revenue Dept. Officials<br>- Forest Dept. Officials<br>- Local NGOs<br>-Members of SHGs, Etc. | **Key Environmental Issues Across Selected Beels**<br><br>• Unregistered beels lack clear boundary demarcation, leading to encroachment for agriculture.<br>• Around **90% of selected beels** are heavily infested with aquatic weeds, mainly **Water Hyacinth, Alpinia nigra (Tora), Ipomoea carnea**, and grasses; **Ludwigia spp.** is dominant in **Shantijaan** and **Borthol Beels**.<br>• Inlet and outlet channels are degraded or blocked due to embankments, fish ponds, agricultural interventions, and heavy siltation, disrupting natural hydrological connectivity.<br>• Heavy sedimentation has reduced water-holding capacity; during the lean season (January–April), water remains in only about **50% of the beel area**.<br>• Invasive/exotic fish species such as **Piaractus brachypomus (Pacu/Rupchanda)** and **Ctenopharyngodon idella (Grass Carp)** are present in several beels, particularly near culture fisheries.<br>• Approximately **80% of selected beels** provide habitat for resident and migratory waterbirds; site-specific **Avifaunal Management Plans** are required for important bird habitats. |
| 2 | Bhatiakhali Beel | Nagaon | 1 no. bhatiakhali | 28.07.2025 | 55 | 0 | | |
| 3 | Sara Beel | Nagaon | Sara Gaon | 28.07.2025 | 20 | 22 | | |
| 4 | Potali Bhatiakhali Beel | Nagaon | Pachim Bhoridhuwa | 10.03.2026 | 11 | 7 | | |
| 5 | Bhagamur Beel | Nagaon | Bajiagaon | 20.03.2025 | 19 | 0 | | |
| 6 | Borthol Beel | Nagaon | Uttar petboha | 23.3.2025 | 10 | 0 | | |
| 7 | Santijaan | Nagaon | Borhisha | 11.03.2026 | 18 | 9 | | |
| 8 | Sola Mikirbheta Beel | Nagaon | Chotorbori | 7.01.2026 | 40 | 3 | | |
| 9 | Na kalong | Nagaon | Baruabali | 7.01.2026 | 50 | 23 | | |
| 10 | Tihulia beel | Morigaon | Niz Mikirgaon | 23.12.2025 | 32 | 0 | | |
| 11 | Solmari Beel | Morigaon | 2nd No Solmari | 24.12.2025 | 24 | 21 | | |
| 12 | Samkata Beel | Morigaon | Samkata | 2.01.2026 | 5 | 22 | | |
| 13 | Morakollong Beel | Morigaon | Bonpara | 21.06.2025 & 16.02.2026 | 27 | 0 | | |
| 14 | Oram Beel | Morigaon | Kumarkuchi | 29.05.2025 &19.02.2026 | 22 | 16 | | |
| 15 | Bechamari Beel | Morigaon | Jurgaon | 06.08.2024 & 21.02.2026 | 27 | 78 | | |
| 16 | Borgoria Beel | Golaghat | Borgoria Gaon | 13.02.2026 | 10 | 19 | | |
| 17 | Doigrung Kordaiguri Nau Beel | Golaghat | Jothipothia gaon | 16.02.2026 | 7 | 17 | | |
| 18 | Borpathorua Beel | Golaghat | Disangmukh Village | 11.02.2026 | 7 | 21 | | |
| 19 | Moridesoi Beel | Jorhat | Kalbari Gaon | 09.02.2026 | 12 | 0 | | |
| 20 | Sawguri Beel | Jorhat | Sawguri Gaon | 10.02.2026 | 26 | 56 | | |
| 21 | Amguri Beel | Jorhat | Bahphala Gaon | 21.12.2025 | 18 | 8 | | |

| Sl no | Name of Beel | District | Village | Date of Site Visit | No of Participants | |
|---|---|---|---|---|---|---|
| | | | | | Male | Female |
| 22 | Jengoni Beel | Jorhat | Bahphala Gaon | 21.12.2025 | 17 | 6 |
| 23 | Charigaon Beel | Jorhat | Charigaon Village | 29.12.2025 | 14 | 14 |
| 24 | Tatinga Mekheli Barbeel | Majuli | Bonkhuwa Chuk Village | 14.03.2026 | 41 | 7 |
| 25 | Param Beel | Majuli | Sukan Sukti Pathar Village | 13.03.2026 | 11 | 10 |
| 26 | Tinsukia beel | Sivasagar | Disangmukh Village | 14.03.2026 | 14 | 7 |
| 27 | Mornoi Beel (Masmorani) | Sivasagar | Chan Bosa Handique Gaon | 12.03.2026 | 10 | 11 |
| 28 | Gabhoru Beel | Sivasagar | Gohan Gaon | 14.03.2026 | 11 | 7 |
| 29 | Kurekhona Beel | Sivasagar | Kathanipar Village | 11.10.2025 | 16 | 10 |
| 30 | Panikheti Beel | Sivasagar | Soraipora Gaon | 14.03.2026 | 28 | 10 |
| 31 | Hatihuria Beel | Sivasagar | Moiramoral Handique Gaon | 16.10.2025 | 23 | 17 |
| 32 | Gudhabil | Sivasagar | Gudhabil Gaon | 28.12.2025 | 10 | 29 |
| 33 | Burhi Beel | Tinsukia | Rajkhowa Gaon Village | 13.03.2026 | 12 | 8 |
| 34 | Toklong Beel | Tinsukia | Nepali No 1 Gaon | 10.10.2025 | 68 | 35 |
| 35 | Pera Beel | Tinsukia | Majgaon | 21.12.2025 | 21 | 7 |
| 36 | Sagarbera Beel | Charaideo | Deodhai Gaon | 28.12.2025 | 19 | 2 |
| 37 | Bamuni Beel | Dibrugarh | 1 No. Bamuni Beel Gaon | 22.12.2025 | 20 | 4 |
| 38 | Mirika Beel | Dibrugarh | 1 No. Dighalibeel Gaon | 22.12.2025 | 33 | 17 |
| 39 | Hatibondha Beel | Dibrugarh | 1 No. Hatibondha Gaon | 23.12.2025 | 26 | 22 |

**Participants**

**Discussion of Issues, Concern and Suggestions**

- Large quantities of biomass generated from de-weeding necessitate a comprehensive **Weed Biomass Management Plan** for environmentally sound disposal and utilization.

**Site-Specific Environmental Issues**

- **Nayachara Beel (Bongaigaon):** Reported habitat of turtles and Indian python; detailed biodiversity assessment recommended.
- **Borjong Beel (Goalpara):** Located near Ajgar Hills; prone to wild elephant movement.
- **Singra Beel (Dhubri):** Traditional jute retting causes organic pollution and deteriorates water quality.
- **Morakollong Beel (Morigaon):** Severe weed infestation and jute retting practices.
- **Bechamari Beel (Morigaon):** Part of the beel lies outside the project area; integrated single-unit development approach recommended.
- **Chola Mikirbheta Beel (Nagaon):** Presence of otters and tortoises reported; specialized biodiversity and wildlife study recommended.
- **Borai Pani Khowa Beel (Bongaigaon):** Historical presence of tortoises and Indian

| Sl no | Name of Beel | District | Village | Date of Site Visit | No of Participants | | Participants | Discussion of Issues, Concern and Suggestions |
|---|---|---|---|---|---|---|---|---|
| | | | | | Male | Female | | |
| 40 | Natun Bolai Erahuti | Dibrugarh | Notun Bolai Gaon | 24.12.2025 | 20 | 10 | | python; rapid biodiversity and wildlife survey suggested. |
| 41 | Mer Beel | Dibrugarh | Borbil No. 1 | 24.12.2025 | 21 | 12 | | • **Deepor Pitoni Beel (Bongaigaon):** Sewage discharge from nearby settlements affecting water quality. |
| 42 | Kutuha Beel | Dibrugarh | Kutuha Borbeel Gaon | 23.12.2025 | 17 | 11 | | • **Burisuti Rikseng (Dhemaji):** Highly flood-prone due to proximity to the Brahmaputra River; lacks embankment protection along the Gali River. |
| 43 | Singimari Beel | Goalpara | Rokhapara | 20.6.2024 & 30.7.2025 | 48 | 18 | | • **Gomiri Beel (Biswanath):** Located near Kaziranga National Park; frequent movement of elephants, deer, and wild boar. |
| 44 | Borjong | Goalpara | Borjhora Pt-2 | 20.5.2025 | 17 | 1 | | • **Kutuha Beel (Dibrugarh):** Railway line divides the beel; degraded connecting channel requires restoration. |
| 45 | Mariampur Eco Tourisim Lake | Goalpara | Mariampur | 20.6.2024 & 29.5.2025 | 48 | 44 | | • **Jorhat District Beels:** Many are closed beels with lost hydrological connectivity to Brahmaputra tributaries; channel restoration is essential. |
| 46 | Kaplimara Beel | Bajali | Baniagaon | 20.12.2025 | 33 | 6 | | • **Na-Kollong Beel (Nagaon):** Municipal solid waste dumping observed near the beel; seasonal waterbird habitat. |
| 47 | Nayachara Beel | Bongaigaon | Ghosamari chaprakata | 23.12.2025 | 22 | 9 | | • **Amritpur Brahma Sewashram Beel:** Connectivity to the Joyma River blocked by road construction; integrated development with adjoining Joyma Beel recommended for long-term sustainability. |
| 48 | Borai Pani Khowa Beel | Bongaigaon | Nayagaon pt-1 | 22.12.2025 | 39 | 44 | | |
| 49 | Chalantapara Haripani Beel | Bongaigaon | Chalantapara Pt-1 | 10.8.2024 & 22.5.2025 | 43 | 12 | | |
| 50 | Deepor Pitoni | Bongaigaon | K. Pahar | 22.5.2025 | 25 | 16 | | |
| 51 | Khoribari Borbilla | Bongaigaon | Borbila | 23.12.2025 | 35 | 13 | | |
| 52 | Udmari Chora Beel | Dhubri | Udmari pt-3 | 21.6.2024 & 27.52025 | 29 | 20 | | |
| 53 | Airmara | Dhubri | Ratiadaha | 28.5.2025 | 35 | 0 | | |
| 54 | Singra Beel | Dhubri | Barkhasua | 22.12.2025 | 18 | 45 | | |
| 55 | Goka Beel | Dhubri | Tolli pt-1 | 23.12.2025 | 48 | 26 | | |
| 56 | Ghritingerkuti beel | Dhubri | Ghritingerkuti | 21.12.2025 | 19 | 15 | | |
| 57 | Halowadal Beel | Kokrajhar | Halowadol pt-2 | 26.12.2025 | 18 | 8 | | |
| 58 | Bamunkura beel | Kokrajhar | Bamunkura | 27.122025 | 22 | 10 | | |
| 59 | Barkhang Beel | Kokrajhar | Barkhang | 27.12.2025 | 9 | 31 | | |
| 60 | Intibill | Kokrajhar | Intibil | 26.12..2025 | 21 | 11 | | |

| Sl no | Name of Beel | District | Village | Date of Site Visit | No of Participants | | Participants | Discussion of Issues, Concern and Suggestions |
|---|---|---|---|---|---|---|---|---|
| | | | | | Male | Female | | |
| 61 | Amritpur Brahma Sewashram Beel | Kokrajhar | Anthaibari | 27.122025 | 23 | 14 | | |
| 62 | Kutnikuchi Beel | Nalbari | Khokhrishal | 12.7.2025 | 11 | 13 | | |
| 63 | Mugdi Beel | Nalbari | Mugdi | 30.7.2025 | 24 | 3 | | |
| 64 | Gandhi Beel | Barpeta | Patbaushi | 22.5.2025 | 18 | 1 | | |
| 65 | Burisuti Rikseng Beel | Dhemaji | Galighat Machkhowa | 08.3.2026 | 15 | 14 | | |
| 66 | Bera Na Beel | Dhemaji | Berana Gaon, Jonai | 08.3.2026 | 15 | 19 | | |
| 67 | Bhalukaguri Dambuk Randh Beel | Dhemaji | Bhalukaguri | 7.03.2026 | 26 | 3 | | |
| 68 | Gutung Bhattali Beel | Lakhimpur | 1/2 Gohai Chapori | 7.03.2026 | 16 | 10 | | |
| 69 | Mer Beel | Lakhimpur | Merkathoni | 7.03.2026 | 15 | 3 | | |
| 70 | Gamiri Beel | Biswanath | Miri Pathar Gaon | 17.02.2026 | 12 | 39 | | |
| 71 | Digholi Beel | Sonitpur | 2no Borpukhuri | 25.07.2025 | 41 | 8 | | |
| 72 | Borakata Beel | Sonitpur | Bordubia | 21.01.2026 | 16 | 2 | | |
| 73 | Kaupati gaon beel | Darrang | Kopati Gaon | 20.12.2025 | 23 | 8 | | |
| 74 | Bor Beel | Sribhumi | Patharkandi | 12.12.2025 | 5 | 5 | | |

| Consultations during Safeguard Mission for Priority Beels | |
|---|---|
|  |  |
| Consultation in Jurgaon village, Bechamari beel, Morigaon | |
|  |  |
| Consultation with people in Sawguri village, Sawguri beel, Jorhat | Consultation in Kalbari village, Moridesoi beel, Jorhat |
|  |  |
| Consultation with people in Kunjaduba village, Kokrajhar | Meeting with BDO in Kunjaduba, Kokrajhar |
|  |  |
| Consulation with people in Chalantara village, Bongaigaon | Religious performance for beel health in Chalantara beel |
|  |  |
| Consultation in Gujrola, Gujrola beel, Kareemganj . | Could not visit Taiyakuri beel in Sribhumi due to submergence of road. |

**Figure 7-1. Public Consultation organized during safeguard mission**

## 7.5. Consultations with Government Agencies and Non-Governmental Organization (NGOs)

826. The first round of meetings was held with officers of the executing agency at the divisional level to get ground level information about the subproject area, its characteristics and possible environmental issues which may arise during project execution. This helped to identify the consultation needs with other government departments. The district forest department, state biodiversity board and state pollution control board were mainly consulted to collect relevant information and data of the subprojects. The list of officials from various government departments contacted during IEE preparation and issues discussed are summarized in Table 7-5.

**Table 7-5. Summary of Consultation Held with Government Departments and Non-Governmental Organization**

| S. No | Department | Issues Discussed | Information Obtained/consultation outcomes |
|---|---|---|---|
| 1. | Ministry of Environment, Forests and Climate Change (MoEFCC), GoI, New Delhi<br>(meeting with Dr. Sujit Kumar Bajpayee, Joint Secretary and scientists of Wetland Division)<br>Date:<br>- 14/06/2024<br>Venue:<br>- MoEFCC, GoI, New Delhi | • Overview of the project's aims and objectives, highlighting the innovative approaches and strategies proposed for wetland conservation<br>• Ensuring alignment of the project with existing wetland laws and policies including to the Wetland (Conservation and Management) Rules, 2017.<br>• Support from SWA and MOEFCC in Wetland Notification: Request for the active support and collaboration of the State Wetland Authority (SWA) and MOEFCC in the process of wetland notification to enhance the project's effectiveness. | • Joint Secretary expressed support for the project's aims and objectives, emphasizing the importance of wetland conservation and sustainable management.<br>• MOEFCC team indicated that if the project proves successful, it could serve as a model for similar initiatives nationwide, advancing wetland conservation across India.<br>• The Joint Secretary highlighted the importance of community engagement in wetland conservation efforts and the wise use of wetland resources, suggesting opportunities for sustainable practices, such as growing foxnuts without compromising the ecosystem and promotion of ecotourism<br>• ADB was invited to participate in national and international workshops organized by MOEFCC on wetland conservation, to present the SWIFT model and share insights from the project's implementation.<br>• The Joint Secretary also suggested that future assignments should consider assessing the role of wetlands in greenhouse gas sequestration, recognizing their potential contribution to climate change mitigation. |
| 2. | Assam State Space Application Centre (ASSAC)<br>Date: | • Discussion focused on the demarcation of the boundaries of the beels (wetlands) and the challenges involved in accurately identifying the extent of these areas.<br>• Identified key issues such as encroachment, degradation, pollution, and habitat loss affecting the beels. | • ASSAC assisted in identifying beels located in ecologically sensitive zones, which require priority conservation and management efforts.<br>• ASSAC suggested a methodology and tools for accurate boundary demarcation of beels using high-resolution satellite imagery and |

**Table 7-5. Summary of Consultation Held with Government Departments and Non-Governmental Organization**

| S. No | Department | Issues Discussed | Information Obtained/consultation outcomes |
|---|---|---|---|
| | - 28/11/2023<br>- 18/06/2024<br>- 25/06/2024<br>Venue:<br>- ASSAC office, Guwahati<br>- Office of DOF, Meen Bhavan, Guwahati, Assam | • Explored the ecological and socio-economic sensitivity of the beel areas, particularly those located in high-conservation value zones.<br>• Discussed the availability and usability of satellite imagery and other geospatial data for accurate mapping and monitoring of beels | GIS techniques.<br>• Provided insights on the availability of historical and current imageries, which can be used for monitoring changes in the beels over time.<br>• Recommended a collaborative approach involving local stakeholders and the use of advanced geospatial technologies to address the challenges in beel management and to support sustainable conservation practices. |
| 3. | State Wetland Authority (SWA), Assam<br>Date:<br>- 18/06/2024<br>- 25/06/2024<br>Venue:<br>- Office of DOF, Meen Bhavan, Guwahati, Assam<br>Date:<br>- 18/06/2024<br>- 25/06/2024<br>Venue: | • Discussed the major concerns affecting wetlands in Assam, including degradation, encroachment, pollution, and biodiversity loss.<br>• Identified specific challenges in managing and conserving wetlands, such as inadequate monitoring, lack of awareness, and conflicts between conservation and developmental activities.<br>• Discussed the key provisions of the Wetland (Conservation and Management) Rules, 2017, including the prohibition of certain activities, guidelines for sustainable use, and procedures for notification of wetlands.<br>• Deliberated on the steps involved in the wetland notification process under the Wetland Rules 2017.<br>• Explored ways to streamline the identification, documentation, and notification of wetlands, ensuring | • The SWA provided a detailed explanation of the Wetland (Conservation and Management) Rules, 2017, covering the legal requirements, responsibilities of stakeholders, and the notification process for wetlands.<br>• Highlighted the importance of involving local communities and stakeholders in the wetland management process to ensure effective implementation.<br>• The SWA extended full support in implementing the Wetland Rules 2017, including wetland notification process. |

**Table 7-5. Summary of Consultation Held with Government Departments and Non-Governmental Organization**

| S. No | Department | Issues Discussed | Information Obtained/consultation outcomes |
|---|---|---|---|
| | - Office of DOF, Meen Bhavan, Guwahati, Assam | compliance with the legal framework. | |
| 4. | Assam Forest Department, Govt. of Assam<br><br>Date:<br>- 18/06/2024<br>- 20/06/2024<br>- 25/06/2024<br>Venue:<br>- Office of DOF, Meen Bhavan, Guwahati, Assam<br>- AAU International Guest House, Guwahati | • Importance of preserving the diverse species of flora and fauna in beels, which are critical habitats for various species, including aquatic fauna and birds.<br>• Availability of existing biodiversity data on beels, including data on flora, fauna, and aquatic life.<br>• Recognition of beels as essential habitats for a variety of aquatic species and their role in maintaining regional biodiversity. | – Forest Department informed that state and district level biodiversity information is available at open sources. However, catchment and village level specific information can only be collected by survey.<br>– Impact on the flora and fauna was also discussed with the forest department. DoF and ADB consultant informed that no beel will be considered Protected Area (PA) to minimize ecological impacts.<br>– Only the removal of invasive weeds will be undertaken to manage vegetation, ensuring minimal disturbance to the natural habitat.<br>– Underwater desilting activities will be avoided as much as possible to protect the aquatic environment and reduce habitat disruption.<br>– The Forest Department stated that relevant biodiversity data for the beels is available through online sources.<br>– Discussion on the role of macrophytes (aquatic plants) as vital resources for |

**Table 7-5. Summary of Consultation Held with Government Departments and Non-Governmental Organization**

| S. No | Department | Issues Discussed | Information Obtained/consultation outcomes |
|---|---|---|---|
| | | | bird populations, particularly in and around protected areas. |
| 5. | Centre Inland Fisheries Research Institute (CIFRI)- CSIR, Govt. of India<br>Date:<br>- 30/11/2023<br>- 18/06/2024<br>- 20/06/2024<br>- 25/06/2024<br>Venue:<br>- Office of DOF, Meen Bhavan, Guwahati, Assam<br>- AAU International Guest House, Guwahati<br>- Virtual meeting | - Discussion focused on the kind of support CIFRI could provide to SWIFT for fisheries and wetland conservation activities.<br>- Overview of CIFRI's research studies related to beel fisheries in Assam.<br>- Examination of CIFRI's publications and research work on weed management and the conservation of native fish species in Assam. | - CIFRI expressed readiness to provide support for SWIFT initiatives.<br>- Availability of extensive research articles and data with CIFRI on beel fisheries, weed management, and native fish species.<br>- CIFRI will provide technical support in establishing fish rearing ponds and other fisheries activities to minimize impacts on beels.<br>- The Director of CIFRI emphasized the importance of weed removal for enhancing fish production and wetland conservation. |
| 6. | College of Fisheries, under Assam Agriculture University | - Assistance in studying beel fisheries, including documentation and research.<br>- Development of strategies for weed management and conservation of native fish species in Assam. | - The College of Fisheries highlighted the importance of eco-modelling in the management of beels.<br>- They expressed readiness to provide support for the SWIFT project. |

**Table 7-5. Summary of Consultation Held with Government Departments and Non-Governmental Organization**

| S. No | Department | Issues Discussed | Information Obtained/consultation outcomes |
|---|---|---|---|
| | Date:<br>- 25/11/2023<br>- 18/06/2024<br>- 20/06/2024<br>- 25/06/2024<br>Venue:<br>- Office of DOF, Meen Bhavan, Guwahati, Assam<br>- AAU International Guest House, Guwahati | | - A substantial amount of research articles and data related to beel fisheries, weed management, and native fish species conservation are available and can be utilized.<br>- The College of Fisheries will provide technical support and training in establishing fish rearing ponds and other fisheries if needed. |
| 7. | Wetland International South East Asia (WISA), New Delhi<br>Date:<br>- 18/06/2024<br>- 20/06/2024<br>- 25/06/2024<br>Venue:<br>- AAU International Guest House, | - Discussed WISA's involvement and contributions in promoting the wise use of wetlands, aligning with the Ramsar Convention's principles and objectives.<br>- Explored WISA's potential to provide technical expertise and support in the implementation of Wetland (Conservation and Management) Rules, 2017.<br>- Identified areas where WISA's support is needed in the notification of wetlands, capacity building, and training of stakeholders. | - WISA agreed to provide technical support for wetland notification processes and assist in preparing technical documents in compliance with Wetland Rules, 2017.<br>- WISA emphasized the importance of promoting the wise use of wetland resources in line with the Ramsar Convention guidelines.<br>- WISA committed to supporting capacity-building initiatives for local stakeholders and government bodies to enhance the management and conservation of wetlands |

**Table 7-5. Summary of Consultation Held with Government Departments and Non-Governmental Organization**

| S. No | Department | Issues Discussed | Information Obtained/consultation outcomes |
|---|---|---|---|
| | Guwahati<br>- Virtual meeting | | |
| 8. | World Fish (International NGO)<br>Date:<br>- 29/11/2023<br>- 20/06/2024<br>Venue:<br>- Virtual meeting | – Discussed World Fish's extensive experience in managing wetland and beel fisheries in Assam (India) and Bangladesh, focusing on their past projects and the strategies they implemented to enhance fish production and ecosystem sustainability.<br>– Identified specific management actions and practices needed to improve fish production in beels and wetlands, such as habitat restoration, sustainable fishing practices, and improved water quality management.<br>– Emphasized the importance of involving local communities in the management of wetlands and fisheries.<br>– Discussed methods to increase community participation, capacity building, and the benefits of community-led conservation and management efforts. | – World Fish agreed to provide their research, outcomes, and lessons learned from their past projects in wetland and beel fisheries.<br>– Identified weed management and natural seeding and community involvement as key areas of focus for improving fisheries productivity in wetlands and beels.<br>– Committed to extending cooperation and support for the SWIFT project by sharing their expertise, resources, and best practices for sustainable wetland and fishery management. |
| 9. | Revenue Department (Govt. of Assam)<br>Date:<br>- 21/06/2024<br>Venue:<br>- Discussion during site visit | – Discussed the need for assistance from the Revenue Department in accurately demarcating the boundary of the beel (wetland) to ensure clarity and prevent future conflicts.<br>– Challenges identified in the demarcation process due to outdated and hardcopy records.<br>– Some areas of the beel boundary might have been encroached upon over time, leading to discrepancies.<br>– Highlighted the necessity to clearly define | – The local district Revenue Department expressed willingness to provide official boundary maps upon request, but noted that these are in hardcopy format need to be digitized.<br>– Acknowledgment of the possibility that some portions of the beel may have been encroached upon, necessitating ground verification to confirm the current boundaries.<br>– Need for collaborative efforts, including ground surveys, to accurately establish |

**Table 7-5. Summary of Consultation Held with Government Departments and Non-Governmental Organization**

| S. No | Department | Issues Discussed | Information Obtained/consultation outcomes |
|---|---|---|---|
| | in Dhubri district | and protect the beel's boundary to support enrichment and conservation efforts, ensuring the area's ecological integrity. | the beel's boundaries for effective management and conservation. |
| 10. | Assam Fisheries Development Corporation (AFDC)<br>Date:<br>- 29/11/2023<br>- 18/06/2024<br>- 20/06/2024<br>- 25/06/2024<br>Venue:<br>- Office of DOF, Meen Bhavan, Guwahati, Assam<br>- AAU International Guest House, Guwahati | - AFDC's involvement in sustainable aquaculture and fisheries management under the APART project.<br>- Key learnings and challenges from past fisheries management efforts.<br>- Enhancing market access and value addition for fish products.<br>- Review of current regulations impacting APART activities. | - AFDC's specific role within the APART project was clearly defined, including its functions in sustainable aquaculture promotion, capacity building, and resource management.<br>- Provide Documented key lessons learned and best practices from past experiences, which will be utilized to refine future strategies and improve project implementation.<br>- Based on past experience need to develop strategies to strengthen market linkages and add value to fishery products, aiming for better market access, fair pricing, and increased income for local fishers |
| 11. | Environment, Forest and Climate Change Department, Govt. of Assam<br>Date: 09/12/2024<br>Venue: | - Project Briefing and Confirmation of the Location of Mariampur Eco-Tourism Lake within the forest area.<br>- Discussion on the Forest Department's responsibilities, oversight, and support in facilitating eco-tourism development within the forest area.<br>- Exploring opportunities for inter- | - The Forest Department has expressed its willingness to collaborate with the Fisheries Department for the development of the beel. The Divisional Forest Officer (DFO), Goalpara District, has already issued a letter indicating this willingness to |

**Table 7-5. Summary of Consultation Held with Government Departments and Non-Governmental Organization**

| S. No | Department | Issues Discussed | Information Obtained/consultation outcomes |
|---|---|---|---|
| | Office of The Divisional Forest Officer, Goalpara Forest Division (T), Assam<br><br>Date 19/05/2025<br>Venue:<br>Forest Best office, Goalpara, | departmental coordination to promote sustainable development of the lake under SWIFT Project<br>- Process of Issuance of No Objection Certificate (NOC) for the subproject interventions | implement the project through a Joint Forest Management Committee (JFMC). (Refer to Annexure A21 for the DFO's letter).<br>- Forest fringe dwellers are already engaged in tourism and fisheries-related activities associated with the beel.<br>- As proposed by the Forest Department, a Joint Forest Management Committee (JFMC) will be formed to support the beel's further development under the SWIFT Project.<br>- A formal No Objection Certificate (NOC) will be required from the Forest Department to facilitate the implementation of project activities within the forest area.<br>- A joint meeting with the community and the Forest Department is scheduled to be held on 23.05.2025. The minutes of the meeting conducted at the Forest Department's Beat Office are provided in Annexure A21. |

### 7.6. Workshop conducted Sustainable development and management of floodplain wetlands (beels) in Assam"

Date-19/06/2024, Venue- AAU International Guest House, Guwahati, Assam






827. The workshop, titled "Sustainable Development and Management of Floodplain Wetlands (Beels) in Assam," was organized by the Department of Fisheries (DoF) on June 19, 2024. The workshop focused on various aspects of Sustainable Wetland and Inland Fisheries Transformation (SWIFT) project components. Particular emphasis was placed on the project's technical components, with the workshop serving as a crucial platform to delve into the specifics of Component 3: Wetlands (Beels) Conservation and Restoration. Through collaborative review and discussion, the workshop aimed to refine the proposed actions in the DPR to ensure their effectiveness in achieving the project's goals for sustainable wetland and inland fisheries management.

828. The workshop focused on three key objectives: gathering expert feedback on the draft DPR, identifying challenges and opportunities for implementation, and developing innovative solutions based on best practices for wetland and fisheries conservation. The event was attended by a diverse group of key stakeholders, including representatives from WISA, the Forest Department, university and college professors, CIFRI directors and scientists, the ADB mission team, the College of Fisheries, DFDOs, WorldFish Bangladesh, and ASSAC etc.

829. A consensus emerged among invited experts on the complete removal of invasive water hyacinth. However, other native macrophytes will be left undisturbed, with a target coverage of 10-20% of the total beel area as suggested MoEFCC framework. This balance is crucial to provide habitat for birds. Additionally, submerged macrophytes remain essential for fish and other aquatic life. Cleared water hyacinth can be utilized for composting and handicraft production.

830. Desilting will be targeted and peripheral, following a bathymetric survey to identify critical areas. Channels like inlets and outlets will be cleared of blockages. To prevent future siltation, silt traps will be installed at inlets. Excavated silt will be put to good use, either for strengthening existing bunds or creating earthen mounds at suitable locations that serve as bird habitats. These measures prioritize a sustainable approach that balances ecological needs with engineering solutions. This workshop marks a significant step forward for the SWIFT project. By leveraging the collective expertise of its participants, the DoF aims to refine the project's strategies and secure a sustainable future for Assam's wetlands and fisheries.

## 7.7. Consultations with Women

831. The purpose of these focused discussions, conducted under the SWIFT project, was to ensure that women were fully informed about the project and to understand their specific concerns and expectations. Women identified several potential benefits of the subprojects, such as increased

employment opportunities for local communities. However, they expressed concerns about job availability during the construction phase and emphasized the need for targeted training and capacity-building programs to enhance their livelihoods. To address these concerns, a Gender Action Plan will be prepared under SWIFT to ensure women's participation in all phases of the project. This plan will include measures to promote and guarantee women's involvement, along with training and capacity-building initiatives tailored to their needs.

### 7.8. Disclosure of Information and Stakeholder Engagement

832. Stakeholder consultations must be continued during the construction and operational stages of the subproject. The Project's executing agency will be responsible for the disclosure of this IEE in compliance to ADB's Communication Policy 2011 and ADB SPS 2009. The institutional responsibilities for construction and post-construction stage consultation lie with the executing agency through the contractor.

833. Translation of executive summary of the IEE will be made available at the offices of execution agency (DoF), PMU, CPIU and BDC. Hard copies of the IEE will be made accessible to citizens as a means to disclose the document and at the same time create wider public awareness. Electronic version of the IEE in English and its executive summary will be placed in the official website of the DoF website. Stakeholders will also be made aware of grievance register and redress mechanism.

834. Public disclosure meetings will be conducted at key project stages to inform the public of progress and future plans. Before the start of construction, the PMU/CIPU will issue notification on the start date of implementation in local newspapers or inform the VDC, BDC (if any) and community in advance. A board showing the details of the Project will be displayed at the construction site for the information of the general public.

835. Local communities will continue to be consulted throughout project implementation, particularly regarding the location of construction camps, access and hauling routes, scheduling of construction activities, and other potential disturbances associated with civil works. Public consultations were conducted during the beel selection process, environmental and social screening, and prior to the formation of the Beel Development Committees (BDCs) to ensure stakeholder participation in project planning and decision-making. The concerns, suggestions, and recommendations received from local communities and other stakeholders have been considered in project design and safeguard planning. Consultation activities will continue during construction and operation phases, and feedback will be provided to stakeholders on how their concerns have been addressed. Details of the consultation process and outcomes are presented in **Annexure - A9.**

836. Following the final selection through the screening process, separate public consultations were conducted for each beel to discuss environmental issues along with other relevant concerns. The draft DERs were also disclosed during the consultations, and the views and suggestions of the local communities were duly considered to ensure site-specific, environmentally responsive, and effective project design.

837. Recommendations: The Brahmaputra Valley in Assam comprises an extensive, highly fertile, and densely populated alluvial floodplain covering approximately 56,480 km². The selected beels are integral components of this floodplain and have primarily originated from abandoned braided river channels and dead river channels, while a few may have a tectonic origin. Historically, these wetlands formed an essential part of the Brahmaputra River system.

838. Over time, a combination of anthropogenic activities and natural geomorphological processes has resulted in the loss of hydrological connectivity in most of these beels. Consequently, the natural inflow and outflow mechanisms have been disrupted, leading to prolonged water stagnation, sediment

accumulation, and severe infestation of invasive aquatic weeds, thereby degrading the ecological integrity and productivity of these wetlands.

839. Restoration of hydrological connectivity should therefore be considered the highest priority for the ecological rehabilitation of these beels. Scientifically designed and sustainable interventions to restore the natural inlet and outlet channels, complemented by measures such as de-siltation, invasive weed management, habitat improvement, catchment conservation, and community-based management, will significantly enhance the ecological health and long-term sustainability of these wetlands. Such integrated restoration efforts will strengthen ecosystem resilience, improve biodiversity conservation, enhance fisheries and livelihoods, support groundwater recharge, regulate floods, and ensure the continued provision of valuable ecosystem services for present and future generations.

# 8. GRIEVANCE REDRESS MECHANISM

## 8.1. Need of the GRM

840. ADB SPS 2009 requires the establishment of a project specific, responsive, readily accessible and culturally appropriate grievances redress mechanism (GRM) capable of receiving and facilitating the resolution of affected persons' (AP) concerns and grievances about the physical, social and economic impacts of the Project. The GRM aims to:

(i) reduce conflict, risk of undue delay and complication in project implementation;
(ii) improve quality of project activities and outputs;
(iii) ensure that the rights of affected parties are respected;
(iv) identify and respond to unintended impacts of projects on individuals; and,
(v) Maximize participation, support and benefit to local communities.

841. The GRM will assist the affected persons in resolving queries and complaints. GRM will be an accessible and trusted platform for all the affected persons to seek solutions and relief for their project-related problems and grievances, without resorting to lengthy and costly judicial process. The GRM will not deal with matters pending in a court of law. Its success and legitimacy will depend on the affected persons' capacity for consultations and desire to resolve grievances through discussion and negotiation. The fundamental objectives of the GRM are:

(i) To reach mutually agreed solutions satisfactory to both, the Project and the APs, and to resolve any project-related grievance locally, in self-consultation with the aggrieved party;
(ii) To facilitate the smooth implementation of the social and environmental plan and prevent delay in project implementation;
(iii) To democratize the development process at the local level, while maintaining transparency as well as to establish accountability to the affected people;
(iv) To facilitate an effective dialogue and open communication between the Project stakeholders; and
(v) To have clear definition of roles and responsibilities of the various parties involved in consideration and resolution of grievances.

## 8.2. Grievance Redress Arrangements and Role Functions

842. A project based three-tier GRM arrangement is proposed to facilitate time-bound grievance resolution at each level. Responsible persons and agencies/offices are identified to address grievances and seek appropriate advice at each stage, as required. Institutional arrangements, including constitution of grievance redress committees (GRC) at various levels, will be ensured to function throughout the project duration. The PMU shall ensure the constitution of these committees and oversee the implementation of grievance redress processes, including adherence to time limits, record keeping, and documentation at each level.

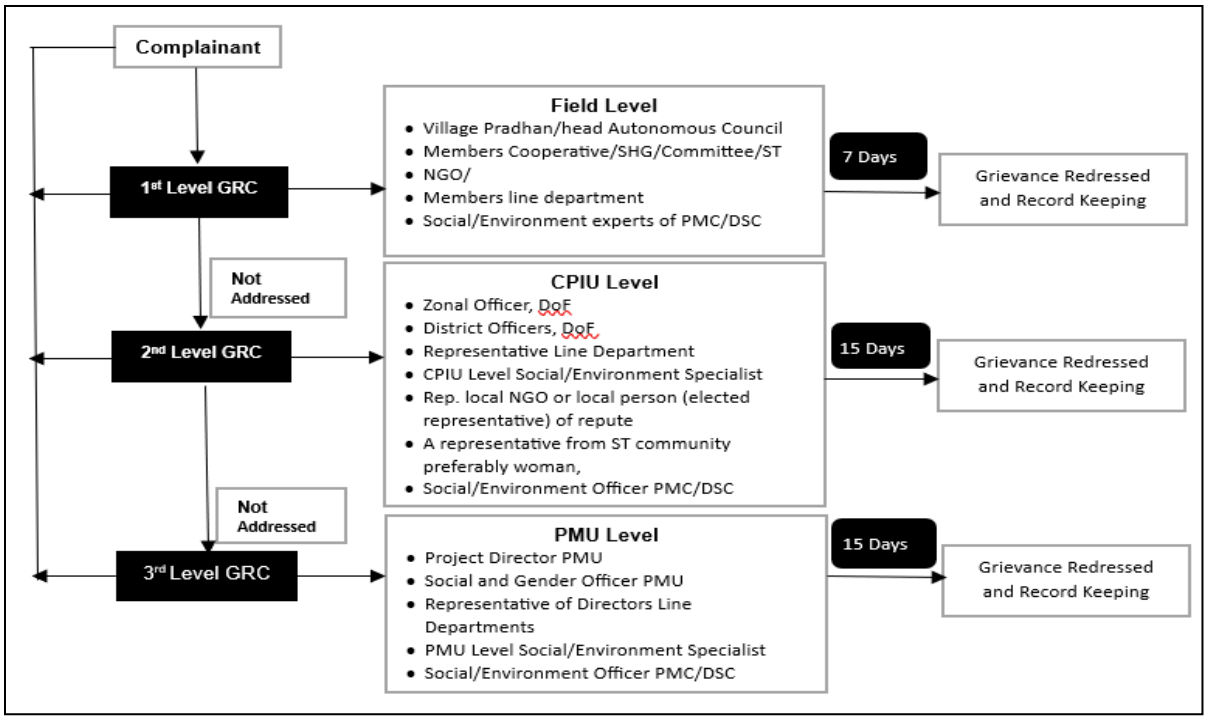



**Figure 8-1. Grievance Redress Mechanism**

843. **Field Level**: The first level of the GRM will function at the project location/site. The field-level arrangement will consist of ground implementation staff led by the village pradhan/head autonomous council, a , member of cooperative /SHG or committee, STs or a member from a locally existing indigenous grievance settlement mechanism, Social/Environment Expert of CSC and NGO. All minor issues and those perceived as immediate and urgent by the complainant will be resolved at the field level itself (within 7 days). In cases of larger issues that cannot be resolved at the field level, the matter will be escalated to the district/PIU level GRC, the second level arrangement. A summary of grievance records will be submitted to the PMU monthly. The PIU level Social Expert will monitor and provide guidance and support to the field staff in grievance redress and its record-keeping.

844. **Cluster PIU Level:** The second GRC will be established at the CPIU level, headed by the Zonal Officer DoF. The representative of line department like forest and revenue will be member of GRC. The social and environment expert of PIU will facilitate the process of grievance redressal. The committee will include a representative from the local body, or NGO as per the nature of the grievance. All grievances that cannot be resolved at the field level and those directly registered at this level will be addressed by this body within 15 days of complaint receipt. Proper documentation of grievances (including records of grievances redressed at the field level) will be maintained by the PIU. In cases where the GRC at this level is unable to resolve a grievance within the stipulated period, the case will be escalated to a higher level for resolution. The CSC level will also maintain follow-up for each grievance, periodically disseminate information to complainants on the status of their grievance and record their feedback (satisfaction/dissatisfaction and suggestions).

845. **PMU Level**: The arrangement at the highest level will involve the constitution of a project-level committee headed by the Project Director of the PMU as the chairperson. The committee will receive support from the Social Safeguard Officer/Environmental Safeguard Officer to grievances. Representative of line departments will be nominated as required based on the type of grievance. All grievances that cannot be resolved by the field level GRC will be brought to the attention of this body, seeking its advice or referral for resolution at this level. Grievances received or referred to this committee will be resolved within 15 days. Periodic information will be provided to complainants on the resolution status of their

grievance. The Social Safeguard Officer will be responsible for compiling grievance redress records, including project-level documentation and reporting.

846. The affected person/complainant shall have access to the country's legal system at any stage. Furthermore, accessing the country's legal system can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM.

**ADB Accountability Mechanism**

847. If the established GRM is not able to resolve a grievance, the affected person can also use the ADB Accountability Mechanism through directly contacting (in writing) the Complaint Receiving Officer at ADB headquarters or the ADB India Resident Mission (INRM). Before submitting a complaint to the Accountability Mechanism, affected/aggrieved person/s should make a good faith effort to solve the problem by working with the concerned ADB operations department. Only after doing so, and if they are still dissatisfied, will the Accountability Mechanism consider the compliant eligible for review.[107] The complaint can be submitted in any of the official languages of ADB's developing member countries. The ADB Accountability Mechanism information will be included in the project-relevant information to be distributed to the affected communities, as part of the project GRM.

## Consultation arrangements and information dissemination

848. The GRM will adopt a consultative and participatory approach to grievance resolution, which may, in some cases, require one-to-one consultation with individual complainants or the aggrieved community. Furthermore, the PMU and the PIU Social and Gender Specialist/Environmental Specialist will be responsible for disseminating information to affected persons on the grievance redressal procedure, ensuring that the host community understands the grievance redress process, and encouraging them to register complaints. Adequate consultations, meetings, and public awareness campaigns will be conducted to achieve this objective. Information on grievances received and responses provided will be documented and reported back to the affected persons. All grievances will be treated with utmost confidentiality, and the identity of the complainant will not be disclosed. A sample grievance registration form is provided in **Annexure A18**.

849. **Record Keeping.** The PMU with the support of PIU Social and Gender Specialist /Environmental Specialist will maintain the records of all grievances received, including contact details of complainant, date the complaint was received, nature of grievance, agreed corrective actions and the date these were taken, and outcome. As part of record-keeping and reporting practices, information on grievance tracking will also be maintained. Grievance reporting by PIU and PMU at their respective levels will include information for the reporting period and the cumulative data on select parameters such as total grievances received, redressed, pending, etc., since the project's inception. Summarized information will be included as part of periodic reporting by the PMU, with support from PIU, to ADB.

850. **Periodic review and documentation of lessons learned**. The PMU will periodically review the functioning of the GRM and record information on the mechanism's effectiveness, particularly in preventing and addressing grievances within the project.

851. **Costs**. All costs involved in resolving the complaints (meetings, consultations, communication, and reporting/information dissemination) will be borne by the project.

[107] http://www.adb.org/Accountability-Mechanism/default.asp.

# 9. ENVIRONMENTAL MANAGEMENT PLAN

## 9.1. Introduction

852. The Environmental Management Plan (EMP) for the beel SWIFT project is a comprehensive synthesis of all proposed mitigation and monitoring actions tailored to protect the beel ecosystem. It outlines specific time-frames, responsibilities, and follow-up actions, ensuring that the proponent, contractors, and regulatory agencies can effectively implement the project. The EMP provides clear guidelines to minimize environmental impacts on the beel, ensuring sustainable management practices throughout the project lifecycle.

## 9.2. Objectives of Environmental Management Plan

853. The main objectives of this EMP are:

- formulate avoidance, mitigation and compensation measures for anticipated environmental impacts during construction and operation, and ensure that environmentally sound, sustainable and good practices are adopted;
- ensure compliance with Asian Development Bank's applicable safeguard policies, and regulatory requirements of Govt. of Assam and the Government of India;
- stipulate monitoring and institutional requirements for ensuring safeguard compliance; and
- Proposed subproject should be environmentally sustainable.

854. The EMP outlines a comprehensive set of mitigation, monitoring, and institutional measures designed to avoid, minimize, and mitigate adverse environmental impacts while enhancing positive outcomes of the Project. It also details the actions required to implement these measures effectively. The key components of the EMP include:

(i) Mitigation of potentially environmental impacts;
(ii) Environmental monitoring during project implementation and operation;
(iii) Institutional capacity building and training;
(iv) Implementation schedule and estimated environmental management costs; and
(v) Integration of the EMP with project planning, design, construction, and operation phases.

855. The implementation of mitigation measures will depend on the nature, timing, and severity of the identified impacts. The implementation schedule is structured around a 12-month construction phase, commencing from the start of construction activities. Table 9-1 presents the potential environmental impacts, corresponding mitigation measures, and the responsible agencies for implementation and monitoring during the pre-construction, construction, and operation and maintenance phases. Copy of the EMP must be available at all work sites throughout subproject implementation. The EMP will be included in the bidding documents and incorporated into the civil works contracts to ensure it is legally binding for all contractors. It will be reviewed and updated during implementation, if necessary. Any non-compliance or deviation from the EMP provisions will be treated as a violation of environmental safeguards obligations.

856. Since the draft IEE is based on 74 surveyed beels with the remaining beels to be confirmed and detailed designed, it does not yet provide site-specific assessment for other or future developments or activities at all the subproject locations. To guide this future process, a guideline for site selection (criteria) and updating of the environmental assessment has been prepared and included in Part-B of the IEE to ensure all the subprojects still to be confirmed and subject to detailed design comply with environmental safeguards requirements under ADB SPS, 2009. As part of the EMP, the IEE report will be updated and finalized by the PMU in respect of each beel before any bidding documents are issued plus during or before construction if there is a change in the scope, design, or location of subproject activities or construction works once contractors are on board. If any unanticipated impacts or risks are identitied during this process,

the EMP will also be updated as required.

### 9.3. Environmental Monitoring Plan (EMoP)

857. Environmental monitoring is a vital tool for effective environmental management, as it provides the necessary data to support informed decision-making. To ensure that the mitigation measures and Environmental Management Plan (EMP) are effectively implemented during the construction and operation phases of the subproject, a well-designed and consistently followed Environmental Monitoring Plan (EMoP) is essential.

858. The primary objectives of the environmental monitoring program are to:

- Assess the effectiveness of the mitigation measures outlined in the EMP;
- Evaluate the adequacy of the environmental assessment process;
- Recommend ongoing improvements to the environmental management approach based on monitoring results and revise the EMP and monitoring strategies accordingly;
- Enhance environmental quality through proper and timely implementation of mitigation measures; and
- Ensure compliance with applicable environmental regulations and community-related commitments.

859. To determine the effectiveness of the environmental management program, regular monitoring of key environmental parameters will be carried out. Three types of monitoring will be undertaken under the EMP:

- **EMP Implementation Monitoring:** To be carried out by the contractor during the construction phase (for contractor-led components) and by the Beel Development Committee (BDC) during the operations phase, as per the project design.
- **(Environmental Quality Monitoring:** To be undertaken by a contractor-appointed testing agency or laboratory accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL) and/or the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, as specified in the EMP.
- **EMP Compliance Monitoring:** To assess whether the EMP measures are being properly implemented by the contractor or the BDC, conducted by the Environmental Safeguard Officer of the PMU and the Environmental Specialist of the CPIU.

860. Tables 9.3 and 9.4 present the environmental monitoring program, specifying the type of monitoring, parameters to be assessed, monitoring frequency, monitoring locations, and responsible institutions for implementation and supervision during the pre-construction, construction, and operation phases. Monitoring costs have been estimated based on experience from similar projects in Assam and prevailing market rates. ADB will oversee overall project compliance through review of the environmental monitoring reports submitted by the Department of Fisheries (DoF)/PMU.

861. Monitoring results will be compared against EMP requirements, site-specific management plans, and applicable environmental performance standards. Any non-compliance will be highlighted in the environmental monitoring reports. Contractual staff will assist the DoF in reviewing and assessing both the internal monitoring results submitted by contractors and BDCs, and the outcomes of the external environmental quality monitoring to ensure alignment with defined performance standards.

### 9.4. Performance Monitoring Indicators

862. Key physical, biological, and social components influencing the environment at subproject sites serve as overarching performance indicators for evaluating environmental performance. In addition to these broad indicators, specific environmental parameters have been selected for regular monitoring due

to their regulatory relevance, the existence of standardized assessment procedures, and the availability of technical expertise, as outlined in the Environmental Monitoring Plan (EMoP).

801. These specific environmental parameters can be quantitatively measured over time and serve as targeted performance indicators for monitoring subproject impacts, especially at critical locations. The selected parameters include:

- Water quality, assessed against Surface Water Quality Standards (IS:2296 - Class B) and the Wetland Health Report Card framework developed by the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, with supplementary parameters from CIFRI guidelines to capture factors affecting fish health.
- Ambient air quality, monitored using CPCB's National Ambient Air Quality Standards (NAAQS) and WHO guidelines for $PM_{2.5}$, $PM_{10}$, CO, $NO_x$, and $SO_2$.
- Ambient noise levels, measured in reference to CPCB Ambient Noise Standards and WHO limits.
- Extent of water hyacinth removal (de-weeding) from beel areas.
- Volume of silt removed from peripheral areas, inlets, and outlets of beels.
- Increase in water availability during the lean season, indicating improved hydrology.
- Increase in fish production and rejuvenation of native fish species populations.
- Improved sanitation and solid waste management around beel areas, particularly at fish landing sites, aggregation zones, and auction centers.
- Adoption of eco-friendly tourism practices, such as waste minimization, sustainable infrastructure, and environmental education initiatives.

## 9.5. Compliance monitoring

863. EMP compliance monitoring involves the systematic assessment of the implementation progress and effectiveness of the environmental mitigation measures outlined in the EMP. This evaluation will be conducted regularly by the contractor and the CPIU. The PMU will compile and report the status of EMP implementation, including contractor environmental performance and overall project environmental compliance, through quarterly project progress reports and annual environmental monitoring reports submitted to ADB.

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| **A. Pre-Construction phase** | | | | | | | | |
| Subproject Selection | Confirmation of beels and detailed design surveys | Lack of site-specific environmental assessment may mean impacts and risks at site level are overlooked | - Prior to confirmation of sites and approval of detailed designs, for each beel, the PIU and PMU must update and finalize the IEE (and EMP if required) in accordance with Part-B of the IEE<br>- Given the location of Bera Na Beel within the Dibru–Saikhowa Complex KBA, biodiversity due diligence is recommended prior to implementation. The IEE should be updated accordingly, and no physical works shall proceed until the applicable requirements of ADB SPS (2009) have been addressed.<br>- Updated IEE to be reviewed and cleared for disclosure on ADB and SWIFT websites | Pre-Construction phase | CPIU | Status of IEE and EMP | PIU/ PMU | Prior to issue of bidding documents |
| Subproject Designs | Prepare specific drawing and designs prior to start of onsite and off-site construction including building and construction | Lack of sufficient design and planning may affect long term sustainability and protection of assets created | - Prior to construction, Project Implementation Unit (PIU) and Project Management Unit (PMU) must review and validate the design for each site, which should be developed through detailed surveys and assessments to accommodate the unique characteristics of each individual beel area.<br>- Tailored designs must reflect these site-specific conditions while ensuring compliance with IS codes and other relevant standards. Engineering studies, including geotechnical, hydrological, and structural analyses, must be reviewed and confirmed to ensure the technical soundness of the designs.<br>- Additionally, engaging with local communities to gather insights and feedback on the proposed designs is essential. This participatory approach ensures that local knowledge and perspectives are integrated, promoting community acceptance and alignment with on-ground realities.<br>- Green building and energy conservation measures should be incorporated into the proposed office buildings, following the guidelines of the Indian Green Building Council and the Energy Conservation Building Code (ECBC) 2017 | Pre-Construction phase | CPIU | Status of Clearances and NOCs | PIU/ PMU | Prior to start of construction and renewed during civil works phase as necessary |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| Improvement of existing approach /link road | Design considerations for drainage, safety along the road alignment | - Inadequate design provisions may increase the chance of road damages and create maintenance issue<br>- Felling of Trees<br>- Safety issue for nearby community | - Provide subgrade as per approved design or Indian Road Congress (IRC) guidelines<br>- Provision of adequate no. of cross drainage structures<br>- Increased vent size and or clean of existing cross drainage structures having inadequate passage<br>- Provision of informatory signages, warning signboards near school, hospital and religious places (if needed)<br>- Provision of speed breakers in community areas and near sensitive receptors (if any), protection work as toe wall in hill sections if needed<br>- Geometric adjustments to minimize tree cutting | Pre-Construction phase | CPIU | Review of subproject design documents and site verification | PIU<br>PMU | Once prior to start of construction |
| Environmental assessment | - Pre-construction environment assessment<br>- Rapid wildlife survey (flora and fauna) prior to starts of work<br>- !Aquatic biodiversity survey will be done by the contractor | - Unidentified environmental risks and regulatory non-compliance.<br>- Impact on critical habitats (if any) and loss of biodiversity.<br>- Disruption of fish populations and decline in aquatic biodiversity. | - Baseline parameters for ambient air and noise, water quality and sediment quality have to be assessed prior to commencement of work.<br>- Wildlife Survey to be carried out by PIU through State Forest Department experts) to confirm presence of IUCN threatened species (if any)<br>- Aquatic biodiversity survey will be done by the contractor pre-construction, during construction and post construction stages. | Pre-Construction phase<br>Pre-Construction phase<br>Pre-construction, during construction and post construction stages. | CPIU | Environmental baseline Assessment and flora and fauna survey | PIU/ PMU | Prior to start of construction and renewed during civil works phase as necessary |
| Consents, Permits, Clearances, and NOCs | Acquire official permission from government authorities through Consents, Permits, Clearances, No Objection Certificates (NOCs) | Failure to obtain necessary official permission from government authorities may lead to environmental impacts and/or delay in subproject construction. | - NOC for tree cutting/Fire NOC/Building plan approval (if any) to be obtained by project proponent prior to construction. However, contractor will support the proponent if any NOC to be obtained during construction stage<br>- Before the disposal of the desilting materials/ silt waste, make an agreement with the DoF and Beel Development Committee (BDC) to dispose the additional silt/sediment remaining after reuse. | Pre-Construction phase | CPIU | Status of Clearances and NOCs | PIU/ PMU | Prior to start of construction and renewed during civil works phase as necessary |
| Construction Plan | Construction plan including sourcing, handling of materials and equipment's for | - Material from unauthorized/illegal sources may disrupt natural environment | - Acquire construction materials only from government approved source with prior approval of DOF<br>- PMU shall ensure that the | Pre-Construction phase | Contractor (after the appointment | Review and checking of material source | CPIU<br>PIU | Once prior to start of construction |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | construction and implementation of plans | - Construction quality may also be affected by using substandard materials<br>- Lack of specialized equipment's (viz. de-weeding and desilting equipment's) may delay the project<br>- Work-related injuries | necessary equipment's particularly for de-weeding and desilting, is available to the contractor. Proper sourcing of materials and equipment is essential to prevent disruption to the natural environment and ensure timely implementation of conservation activities.<br>- Employ manual or mechanical weed removal techniques that minimize disturbance to the surrounding environment. Machine or equipment should be small in size and should amphibious in nature that should do de-weeding and collect the macrophytes from shallow and deeper zone of beels.<br>- The harvester should have a shallow draft depth to operate effectively in water depths typical of shallow lakes<br>- Documentation (monthly) on material obtained from each source for the project Materials shall be stored and placed that will not create problem to the public, the workers or the adjoining property.<br>- Materials shall be stacked on well drained, flat and unyielding surface avoiding private properties and agriculture fields.<br>- Material stacks shall not impose any undue stresses on walls or other structures<br>- Materials shall be separated according to kind, size and length and placed in neat, orderly piles.<br>- High piles shall be staggered back at suitable intervals in height.<br>- Piles of materials shall be arranged so as to allow a minimum 800 mm wide passageway in between for inspection and removal.<br>- All passageways shall be kept clear of dry vegetation, greasy substance and debris<br>- Materials stored at site, depending upon the individual characteristics, shall be protected from atmospheric actions, such as rain, sun, winds and moisture, to avoid deterioration.<br>- Guidelines/procedure are in place for environmentally sound good-practice for Borrow Area Operations and Management **(provided in Annexure 6)** | | but prior to construction) | and quality checking | PMU | |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | - Guidelines/procedure to ensure environmentally sound good practice for Reuse and Disposal of desilted material is provided in **Annexure A3**.<br>- Guidelines/procedure to ensure environmentally sound good practice for disposal/reuse of weeds is provided in **Annexure A4.** | | | | | |
| Construction requirement | Hiring of workers | Issue related to labor influx, livelihood, conflict of cultural and regional bias | Early consultation shall be made by the contractor with the local community and/or Beel development committee (BDC) before hiring of workers.<br>- Employment for local labours should be encouraged to avoid setting of labour camp<br>- In case of setting of any labour camp, contractor shall provide labour camps with all basic facilities for all the migrant workers employed till completion of construction and maintenance work in accordance with the Building and Construction Workers (Regulation of Employment and Conditions of Service) Act, and Rules,1996<br>- Early consultations shall be made by the contractor with the local community/BDC to determine the appropriate location of labour camp<br>- All migrant workers will undergo workshop/ briefings to sensitize them on local culture and lifestyle awareness | Pre-Construction phase | Contractor | Review of hiring process | CPIU | At the time hiring of workers/labours |
| Construction requirement | Site access and transporting of machines, equipment and vehicles to the subproject site | The selection of machines and vehicles that are not suitable for the site conditions could result in operational problems.<br>Unmaintained machinery, equipment, and vehicles may hinder and delay the implementation of construction and restoration activities | - Contractor shall develop a site access route and submit it to CPIU and BDC. Contractor shall also use smaller, more maneuverable vehicles, if possible, to navigate narrow roads without causing damage.<br>- Engage with local residents and VDC early in the planning process to inform them of the project schedule and address any concerns they might have. This proactive communication can help in preventing conflicts.<br>- Implement protective measures, such as temporary road widening or reinforcement, to prevent damage to access roads and surrounding properties and crops<br>- Contractor shall ensure that all the construction machinery, equipment's and | Pre-Construction phase | Contractor | Review and checking of material source and quality checking | CPIU | Prior to start of construction and performed during civil works phase as necessary |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | vehicles are properly inspected and maintained before transferring at site<br>- The lack of specialized equipment, such as de-weeding and desilting machinery, may cause delays in the project timeline.<br>- Contractor shall select the machinery, equipment's and vehicles as per the site conditions and access road available at the site<br>- Access road shall be inspected and upgraded prior to transferring of any machinery, equipment's and vehicles at site<br>- Tree cutting shall be avoided for transferring of any machinery, equipment's and vehicles at subproject site<br>- Vehicles shall not move down the hill with the engine off or with the engine out of gear<br>- Contractor shall use only vehicles that are registered and have necessary Pollution Under Control Certificate (PUC)<br>- Only competent and licensed/trained persons shall drive the construction vehicles and operate construction machineries<br>- Construction parking shall be done at designated place only.<br>- Contractor shall submit all records for construction machineries, equipment's and vehicles for review and record of DPUM | | | | |
| Temporary accommodation for workers | Setting of Labour Camp and its operations (if any) | Issues may arise related to environmental pollution, sanitation, health and hygiene | - Employment for local labours should be encouraged to avoid setting of labour camp<br>- However, in case of setting of any labour camp, contractor shall provide labour camps with all basic facilities for all the migrant workers employed till completion of construction and maintenance work in accordance with the Building and Construction Workers (Regulation of Employment and Conditions of Service) Act, and Rules,1996<br>- Guidelines for Setting up of Labour Camp is provided in **Annexure A5** for ready reference. | Pre-Construction and<br><br>Construction phase | Contractor | Inspection of labour camp and facilities provided by contractor. CPIU will monitor compliance conditions mentioned in guidelines of Setting up of Labour Camp (**Given in Annexure A5 for ready reference**.) | CPIU | Prior to start of construction and throughout the construction period |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| Community utilities and structures | Shifting or dismantling of utilities and structures viz. (Electric lines, poles, telephone lines, water pipes, tank, access road, pathway etc.) before construction | Disruption of services and inconvenience to public | - During construction by any chance, any utility (Electric lines, poles, telephone lines, water pipes, tank, access road, pathway etc.) require shifting, prior permission and assistance shall be obtained from concerned agency. Alternate arrangement shall be made prior to any dismantling<br>- Nearby people will be informed before any shifting and dismantling activities<br>- Provide signages to inform people or community about shifting and/or dismantling activities. | Pre-Construction phase | Contractor | Inspection of shifting or dismantling of utilities | CPIU | Once prior to start of construction |
| Emergency response | Preparation of emergency response | Lack of emergency response plan may impact man, machinery and materials | - Contractor shall prepare emergency response plan for situations like flash flood, medical emergency, inundation, accident and community conflicts etc.<br>- Conduct drills and awareness on emergency response<br>- Contractor shall identify the relevant officials and institutions to be involved during emergency.<br>- Prepare a telephone directory of these officials for timely communication and support<br>- Adequate provisions shall be made in the engineering design to adapt to extreme meteorological and geo-physical events. | Pre-Construction phase | Contractor | Review of emergency response planning | CPIU<br>PMU | Once prior to start of construction |
| Selection and environmental assessment of upcoming beels, and other on-beel and off-beel infrastructures | - Selection of beels and other infrastructures based on site selection criteria<br>- Updating the IEE and EMP based on detailed assessment and meaningful consultation.<br>- Compliance to ADB SPS 2009 and national government safeguards planning document | - Undetermined environmental risks<br>- Non-compliance with ADB's Safeguard Policy Statement (SPS, 2009).<br>- EMP may not address site-specific impacts.<br>- Poor community consultation and increased grievances.<br>- Long-term environmental degradation. | - Environmental assessment shall be carried out for all beels and other infrastructures in full alignment with the Category B project requirements of ADB's Safeguard Policy Statement (SPS), 2009.<br>- Selection criteria will be followed in the selection process for unconfirmed beels. Accordingly, the CPIUs and PIU shall apply the following criteria to identify and prioritize beels under the project.<br>a) Any scheme or activity classified as Environment Category A under ADB's Safeguard Policy Statement (SPS), 2009, and included in ADB PIAL must not be considered under the Project.<br>b) The project will not include any areas that fall within Protected Areas (such as National Parks, Wildlife Sanctuaries, Tiger Reserves, or | Pre-construction phase (prior to any works commencing on site for upcoming 62 beels and other infrastructures (i.e., on-beel and off-beel, eco-tourism and government buildings) | CPIU and PIU | Updating IEE and EMP for upcoming 62 beels and other infrastructures (i.e., on-beel and off-beel, eco-tourism and government buildings) | PMU | Prior to start of construction and updating as necessary |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | Elephant Reserves), their notified Eco-sensitive Zones (ESZs), or within 10 km of their boundaries if no ESZ is notified. It will also exclude Ramsar Sites, World Heritage Sites, Key Biodiversity Areas (KBAs), and Important Bird Areas (IBAs) [this is with the exception of the two beels already selected and included in the draft IEE on Majuli island].<br>c) Located within Village Grazing Reserves (VGRs), Professional Grazing Reserves (PGRs), or similar areas protected through traditional practices or legal frameworks will be avoided.<br>d) No project components will be located within 300 meters of sites protected by the Archaeological Survey of India (ASI) or other historically significant monuments and areas.<br>e) Situated in locations with existing social conflicts or disputes over land use will not be considered.<br>f) Any project activities that require land acquisition will not be selected.<br>g) Locations that may result in disturbance to historical, cultural, or religious sites or values will be avoided.<br>h) Areas that are severely degraded and economically non-viable for rejuvenation will not be included.<br>i) Located in areas very close to the Brahmaputra River or its tributaries, where created infrastructure could face damage during floods, will be excluded.<br>j) Within areas inaccessible or remote locations where logistical challenges make project implementation impractical will not be considered.<br>k) Situated on private land or under unresolved ownership disputes will not be included.<br>l) Sites already covered under other ongoing development projects or | | | | |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | programs shall be excluded to avoid duplication.<br>- Existing Initial Environmental Examination (IEE) and Environmental Management Plan (EMP) will be updated to reflect site-specific risks and corresponding mitigation measures.<br>- Respective CPIUs, with support from PIU and PMU, shall be responsible for updating the existing IEE to incorporate the site specific aspects of the subprojects.<br>- Revised EMP will include any site specific considerations for impacts on biodiversity and natural resources.<br>- Updating of the environmental assessment will be conducted in compliance with both ADB safeguards and Government of India environmental regulations.<br>- Meaningful consultations will be conducted with protected area authorities, local communities, and other relevant stakeholders. Findings from consultations will be documented in the updated IEE.<br>- The PMU shall review and endorse the updated IEE/EMP which will be submitted to ADB for review and clearance for disclosure on the ADB website and SWIFT website.<br>- The detailed site selection criteria and environmental due diligence procedure for the beels is provided in Part-B of the IEE for ready reference.<br><br>**See Part-B of the IEE for more details** | | | | |
| **B. Construction Phase** | | | | | | | | |
| Construction EMP | Ensure safeguards documentation, availability of expertise, resources and GRM before start of construction | Lack of site-specific safeguards measures, expertise and resources prior to start of construction may increase environmental impacts | - Review and revise EMP to assess if the current mitigation measures need to be updated as per subproject site conditions, due to any changes in the final engineering designs, government requirements, community feedback and/or as a result of any preparatory work undertaken before loan agreement<br>- Ensure that staff with appropriate level of expertise for EMP implementation is appointed by the contractor.<br>- Ensure appropriate level of monitoring resources are in place before | Construction phase | Contractor<br><br>CPIU | Prepare Construction EMP (also called BSEHSMP) | PIU/ PMU | Prior to start of construction.<br>No construction will start without approval from PMU.<br>To be updated if any unanticipated impact occurred during construction. |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | subproject implementation<br>- Ensure that construction contracts are responsive to EMP provisions and that mitigation and monitoring measures are adequately budgeted<br>- Establish GRM in the DOF, and establish local access points<br>- Disclose GRM to community, project beneficiary, affected people before construction begins through signage, websites and notices in community centers<br>- Construction materials should only come from Government approved sources with prior approval of CPIU | | | | | |
| Consents, Permits, Clearances, and NOCs | Acquire official permission from government authorities through Consents, Permits, Clearances, No Objection Certificates (NOCs) | Failure to obtain necessary official permission from government authorities may lead to environmental impacts and/or delay in subproject construction. | - Contractor must secure all the relevant requisite approvals from government before starting works. contractor must ensure compliance with consents, permits, approvals, and NOCs.<br>- List of possible consents, permits, clearances, and NOCs (as applicable but not limited to) are:<br>- Consent to Establish (CTE) and Consent to Operate (CTO) for batching plants and DG sets from SPCB under Air Act 1981 and water Act 1974 and its amendments<br>- Authorization for storage and handling of hazardous waste such as used oil etc. from SPCB under Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016<br>- Approval required from local authorities regarding disposal of desilted material (if any), construction waste management under Construction and Demolition Waste Management Rules, 2016<br>- License to store petroleum beyond prescribed quantity (if applicable) from Deputy Commissioner /Concerned authority under Petroleum Rules, 2002<br>- Pollution under control (PUC) certificate for construction vehicles including de-weeding machineries, from Transport Department under Central Motor Vehicle Act 1988 and amendment<br>- Consent for borrowing. In case contractor opens own borrow area then prior NOC to be obtained from local | Construction phase | Contractor CPIU | Status of Clearances and NOCs | PIU/ PMU | Prior to start of particular activity and renewed during civil works phase as necessary |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | administration. Take advice from SPCB regarding prevailing statutory clearance in the district, if applicable obtain statutory clearance<br>- Consent for setting labour camp (if any) form local administration etc. | | | | | |
| Land and Soil Environment | Site or land clearing | Loss of vegetation and Impact on land cover and Soil erosion | - In consultation with BDC and CPIU, contractor to identify areas that should be protected and/or managed in a way that minimizes site clearing.<br>- Identifying vegetation that can stay on site for as long as possible to reduce damage. Vegetation protects soil, reducing erosion and sedimentation. Letting as much plants as possible stay on site to minimize erosion.<br>- Proper disposal of materials and debris at designated sites (away from rivers/streams and private lands) as prescribed by CPIU and community.<br>- Replanting should be done to help restore the vegetation and protect soil.<br>- During decommissioning, the construction sites shall be restored to its original condition before handing over | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Daily as needed |
| Land and Soil Environment | Excavation and Desilting | Change in topography, and conversion of land | - Disturbance of land surface contours shall be kept at a minimum according to scheme design<br>- Limit construction and material handling during rainy season<br>- Opening of borrow areas near the embankments shall not be done during monsoon season.<br>- CPIU and contractors should Identify potential erosion zones in the catchment during construction phase<br>- Stabilize all cut slopes, embankments, and other erosion-prone working areas while works are on-going<br>- All earthwork disturbance areas shall be stabilized within 30 days after earthworks have ceased at the sites<br>- Preserve existing vegetation where no construction activity is planned<br>- Use of uncultivated areas only for storage and/or handling of construction materials, and construction camp<br>- Land used for construction camp shall be rehabilitated and shall be | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Daily as needed |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | reusable/cultivable after closure<br>- Desilting will be carried out using suitable equipment's only, depending upon the terrain of the area to be desilted.<br>- Contractor in consultation with CPIU shall finalize the slope gradient to be maintained for the hydrological function of the beel and avoid haphazard ponding of water (after carrying out pre-excavation bathymetry survey).<br>- Channelized water flow and slope gradient would be maintained.<br>- In case silt is wet or charged with water need to be stored in Temporary Dumping Yard (TDY) for dewatering<br>- The loose silt may not be left longer at the shore or within fringe area of the lake<br>- Zone of fracture (hydro-geological) shall not be disturbed (to avoid leakage and spillage) due to de-silting operation. Therefore, Contractor by taking client in loop will consult, concerned Govt. Geological Department/University Geology Dept./Geologist to inquire about hydrological zone of fracture in Beels area prior to de-silting/wet excavation.<br>- Contractor shall avoid areas of spawning and nesting grounds, submerged macrophyte beds and bird nesting sites (if any) during desilting operation.<br>- Place silt in designated areas to avoid altering natural drainage patterns and prevent erosion.<br>- Store excavated silt temporarily in a contained area to prevent it from being washed away during rain events.<br>- The contractor and CPIU shall ensure the reuse of excavated material, such as silt or sediments. This material can be used for strengthening or constructing bunds, developing mounds, filling or leveling low-lying areas (away from flood-prone zones), and for agricultural or horticultural purposes. The reuse of excavated material must be carefully planned and investigated to prevent negative impacts, such as bund erosion or the re-entry of excavated silt into the beels. | | | | |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | - Excess soil shall be handled, transported, and disposed properly; before loading it shall be ensured that it is dried so no water spills during transport, and material also should be covered during transport to avoid spillage and dust.<br>- Design earthen mounds in larger beels to provide safe habitats for birds, ensuring they are stable and do not erode easily. | | | | | |
| Land and Soil Environment | Borrow area location and rehabilitation | Loss of vegetation and Land<br>Impact on land cover<br>Soil erosion | - The contractor will accurately determine the precise locations of the designated borrow areas. Typically, it is advisable to choose government-approved operational borrow locations in the vicinity for extracting earth materials for construction purposes. Nevertheless, if the contractor initiates the establishment of a new borrow area, it is imperative to adhere to the prescribed protocols for running the said borrow area.<br>- The choice and suggestions of borrowing sites will be determined by both environmental and civil engineering factors.<br>- All efforts shall be made to avoid or minimize tree loss due to borrowing. The trucks shall be covered while transporting the earth. While borrowing the earth topsoil shall be preserved<br>- The borrow pits shall be rehabilitated after borrowing the earth<br>- Opening any borrowing area without permission from the CPIU is strictly prohibited. Borrowing on cultivable lands is prohibited unless the CPIU determines that there are no other viable sources for obtaining resources<br>- Use of wasteland, excavation or enlargement of existing land or any hump above ground level for borrowing<br>- Indian Road Congress (IRC):10-1961 guideline will govern the selection of borrow pits. In all cases good engineering and construction practices shall be followed<br>- Guidelines/ procedure to ensure environmentally sound good-practice for selection of site for borrow area, its operations and management is provided in **Annexure A6**. | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Daily as needed |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| Land and Soil Environment | Generation of waste | Construction waste generation and littering of solid waste may create land pollution and un-hygienic conditions | - All of the construction activity shall be contained inside the preidentified construction area. Contractor shall prepare and implement a Waste Management Plan.<br>- To minimize environmental impacts and avoid disposal of earthwork materials, subproject shall maximize the reuse of excavated materials.<br>- Manage solid waste according to the following hierarchy: reuse, recycling and disposal. Include designated/approved disposal areas in waste management plan.<br>- Coordinate with BDC and CPIU for beneficial use of excavated materials or immediately dispose to designated areas.<br>- Recover used oil and lubricants and reuse; or remove from the site.<br>- Avoid stockpiling and remove immediately all demolished materials, excess construction materials, solid waste (removed weeds, wood, packaging materials, empty containers, oils, lubricants, and other similar items).<br>- Prohibit disposal of any material or wastes (including human waste) into drainage, nallah, agriculture fields and beels<br>- Management of construction wastes should be done as per Construction and Demolition Waste Management Rules 2016 **(Refer Annexure A10)**<br>- Construction contractor shall ensure daily collection and periodic disposal of construction waste generated debris, concrete, metal cuttings waste etc.<br>- Solid waste will be managed as per the Solid Waste Management Rules, 2016. Waste generated at site to be segregated onsite and recyclables sold off to vendors.<br>- During decommissioning, remove all wastes from the construction site and dispose of non-hazardous waste as per recommendation of CPIU and community, while any hazardous waste is to be disposed as the requirement of pollution control board | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Daily as needed |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| Land and Soil Environment | Site clearance, digging and construction | Soil Erosion | - Construction activities shall be scheduled such that soil particularly at borrow areas near the stream are not laid bare during the monsoon. will be scheduled to minimize bare soil surfaces, especially at borrow areas, during the monsoon<br>- Exposed surface ground shall be resurfaced and stabilized as soon as possible. This shall also be covered with straw or mulch to avoid soil loss<br>- Ground disturbances Construction shall be done in phased phases and only at allowed areas so that it is limited to workable size and minimize ground disturbances.<br>- Other slope stabilization measures like selection of less eroding materials around stream shall be adopted<br>- Check probable areas for soil erosion during construction. To control massive soil erosion, appropriate measures will be applied such as use of mulch, blankets, and wood binders, and/or dewatering<br>- Slope protection works (viz. stone pitching/or bioengineering measures) shall be implemented at strategic locations to avoid erosion/land subsidence | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Daily as needed |
| | Transportation of workers, machine, and materials around construction sites, link roads, haulage roads, construction camp | Soil Compaction | - Movement of construction vehicles, machinery and equipment shall be within the subproject site and pre-defined haulage road (by CPIU and VDC) to avoid compaction agriculture land and loss of standing crops. | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Daily |
| | Hazardous waste generation around construction sites, machine maintenance, use of fuels and lubricants on site, spill accidents, and production of construction wastes | Soil Contamination | - Fueling and maintenance of construction machinery and vehicles shall be carried out at designated place with proper arrangement of waste management.<br>- During servicing/repair of equipment and vehicles, suitable drip tray shall be used to prevent oil/grease spills onto the soil, especially in case of emergency repairs collection and disposal<br>- Fuel storage and refueling sites shall be kept away from drainage channel<br>- Unusable debris to be disposed in designated places assigned by CPIU and community<br>- Provision of oil interceptors at wash down and refueling areas, if needed | Construction phase | Contractor on daily basis | Review of implementation of mitigation measures | CPIU | Daily |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | - Ensure hazardous waste is properly labelled, stored onsite at a location provided with impervious surface, shed and secondary containment system as per in accordance with the Hazardous and Other Waste (Management and Trans boundary Movement) Rules, 2016<br>- Waste oil shall be sold off to recyclers authorized by SPCB/ MoEFCC, GoI | | | | | |
| Land and Soil Environment | On-site and off-site infrastructure development | Change in land-uses | - Prioritize using degraded or unused land for composting to avoid encroaching on productive agricultural land or natural habitats<br>- Ensure that the composting units are placed at an appropriate distance from the beel to minimize any direct impact on the beel ecosystem<br>- Establish buffer zones with native vegetation around the composting units to act as a barrier, reduce runoff, and improve the local ecosystem's resilience<br>- Engage with local communities and provide training on best practices for composting and waste management to ensure sustainable operations and minimize conflicts<br>- Limit the construction activities to designated areas to avoid unnecessary clearing or alteration of the surrounding land.<br>- Avoid the areas for fish landing and aggregation sites construction that are existing fish habitats and biodiversity<br>- Employ construction methods that minimize soil erosion, sedimentation, and other disturbances to the land. | Construction phase | Contractor on daily basis and CPIU | Review of implementation of mitigation measures | CPIU | Daily as needed |
| Hydrology and water Environment | Flooding during construction | Flood at construction site may impact construction equipment, machinery and materials and manpower | - DOF will provide adequate engineering design to cater extreme meteorological and geo-physical events.<br>- Provision shall be made for adequate size and number of cross drainage structures especially in the areas where land is sloping towards road alignment<br>- Access road level (if road located near pondage) shall be raised above HFL level wherever road located level is lesser than HFL<br>- Construct interception ditches and drains to prevent runoff entering construction | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU<br>PIU | During rainy seasons and at the time weather alerts |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | sites, and to divert runoff from sites to existing drainage<br>- Regularly clean and maintain ditches<br>- The Contractor must monitor meteorological forecasts and alerts issued by India Meteorological Department or IMD. | | | | | |
| Water Environment | Discharge of construction waste and washing (machinery and other related materials) and wastewater discharge from labor camp (if any)<br>Accidental discharge of engine oil/fuel used to run de-weeding and other machineries | Decline of water quality due to on-site and off-site activities | - To minimize disruption to aquatic life during desilting, CPIU will ensure desilting activity (dry excavation) will be carried out during low-flow periods only in peripheral areas and use silt curtains or barriers to contain sediment plumes and prevent their spread. Additionally, ensure that excavated material is either reused or properly disposed of in designated areas away from water bodies.<br>- The CPIU will ensure that weeds are removed manually or using mechanical methods to minimize the use of chemicals. Removed weeds will be disposed of properly, away from the beel, to prevent their decomposition in the water. Additionally, harvested weeds will be used for composting to reduce waste and promote sustainable practices.<br>- Removal of floating weeds such as water hyacinth will be preferred. Avoid large-scale removal of macrophytes in a single operation. Gradual and selective de-weeding can help manage nutrient release in smaller, manageable amounts.<br>- Install sediment traps to capture organic matter and nutrients released during de-weeding, preventing them from entering the water column and fueling eutrophication.<br>- CPIU shall ensure that non-toxic, low-impact construction materials will be use wherever possible, and minimize the entry of cement and concrete into beel while construction by adopting best management practices.<br>- Fueling and maintenance of construction machinery and vehicles shall be carried out at designated place with proper arrangement of waste management.<br>- During servicing/repair of equipment and vehicles, suitable drip tray shall be used to prevent oil/grease spills onto | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Daily as needed |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | the soil, especially in case of emergency repairs collection and disposal.<br>- Fuel storage and refueling sites shall be kept away from drainage channel. Unusable debris to be disposed in designated places assigned by CPIU and BDC. Provision of oil interceptors at wash down and refueling areas, if needed<br>- Contractor shall ensure hazardous waste (if any) is properly labelled, stored onsite at a location provided with impervious surface, shed and secondary containment system as per in accordance with the Hazardous and Other Waste (Management and Trans boundary Movement) Rules, 2016 to avoid any contamination. Waste oil shall be sold off to recyclers authorized by SPCB/ MoEFCC, GoI<br>- Stabilize mounds with vegetation or geotextiles to prevent erosion.<br>- Construct mounds during dry periods to minimize soil displacement.<br>- Plant vegetation along embankments to stabilize soil and reduce erosion<br>- Inspect and maintain pipes regularly to prevent blockages and water quality issues.<br>- Locate composting units away from the beel and on impermeable surfaces.<br>- To mitigate impacts on beel water quality, sustainable aquaculture practices should be adopted, including controlled feeding, waste removal, and avoiding chemical additives or antibiotics. Biofiltration or constructed wetlands can treat wastewater before it enters the beel, and harvested weeds can be used for composting to reduce waste.<br>- Proper water and sanitation facilities will be provided to the construction labors at construction sites. Provision of solid waste collection and disposal system at the construction sites.<br>- Septic tanks shall be provided to treat the domestic sewage from construction camp. Guidelines for setting of labour camp (if any) is provided in **Annexure A5** | | | | | |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | - Water quality to be monitored as envisaged in the environmental monitoring plan and results to be compared with relevant environmental regulatory standards/threshold limits for Water Quality provided in **Annexure A7**<br>- No cleaning, washing or maintenance activity shall be undertaken near any water body. equipment and vehicle shall be services in its designated workshops only<br>- To address the potential water pollution caused by the use of mechanical equipment's in Beel management, the following measures shall be implemented:<br>- Utilize machinery with low-emission engines that meet environmental standards.<br>- Ensure regular inspection and maintenance of machinery to prevent fuel leakage, oil spills, or engine malfunctions that may lead to water contamination.<br>- Equip machinery with spill-proof fuel tanks and secure lids to minimize the risk of leaks.<br>- Use absorbent mats or barriers around machinery to capture accidental spills.<br>- Refuel machinery away from water bodies in designated areas with spill containment systems.<br>- Train operators to handle fuel with care to avoid spills.<br>- Collect and dispose of waste oils, lubricants, and used filters following hazardous waste management guidelines.<br>- Prevent the disposal of any machinery waste into the Beel or surrounding areas.<br>- Train operators and workers on eco-friendly practices and the importance of preventing water pollution. | | | | |
| Water Environment | Alteration of Water Flow During Construction | - During construction of embankments, earthen mounds, and the installation of Hume pipes can significantly alter the natural flow of water in and | - Before construction, PMU shall ensure thorough site-specific survey and investigation to understand the natural water flow, flooding patterns, and seasonal dynamics of the beel. Design embankments, earthen mounds, and Hume pipes to minimize alterations to these natural flows | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Prior to rainy seasons and as needed |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | around the beel<br>- Alterations may change the hydrodynamics and ecology of the beel if not properly designed. | - Use spillways, sluice gates, and other structures to regulate water levels and flows, ensuring that natural flooding and drying cycles are preserved to support the beel's ecological functions.<br>- Ensure that the design of embankments, earthen mounds, and Hume pipes incorporates features such as controlled openings or culverts to allow for natural water flow and maintain ecological connectivity<br>- Schedule construction activities outside of critical periods, such as fish breeding seasons, to minimize disruption to the beel's ecological processes | | | | | |
| Ambient Air Environment and Noise | Construction activities including earthworks, stone quarrying, transportation of materials, storage pilling, stone soling, operation of DG Sets and vehicles movement etc. | - Emissions from construction equipment, diesel generator (DG) set and vehicles movement<br>- Dust emission during earthworks and from stone quarrying transportation and during improvement of link road<br>- Fugitive dust generation due to wind from stock piling of earth/sand or other loose construction material<br>Smoke from burning of waste or firewood | - All vehicles used at project including de-weeding machines shall have of valid 'Pollution under Control' (PUC) Certificates<br>- Hot mix plants, and batching plants (if any) should be operated after obtaining Consent-to Establish (CTE) and Consent to Operate (CTO) under Air Acts from the State Pollution Control Board (SPCB)<br>- Dust suppression measures such as sprinkling of water (to moist the dust prone area/construction site, link road) will be taken at regular intervals to control fugitive dust emissions during construction activities<br>- Stock piling shall be carried out at designated place located away from drainage or drain.<br>- If needed make provision of periodic water sprinkling and covering of trucks/dumper by tarpaulin sheets to prevent windblown dust (fugitive dust generation)<br>- Construction equipment should be properly maintained to minimize smoke in the exhaust emissions<br>- Diesel generators meant for emergency power supply to be optimally operated and regularly maintained to ensure that emissions from fuel combustion remain within standard or at baseline levels.<br>- The hot mix plants, crushers and batching plants to be sited at least 500 m in the downwind direction from the nearest | Construction phase | Contractor on daily basis | Review of implementation of mitigation measures | CPIU | Daily as needed |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | human settlement<br>- All slopes and embankments to be turfed as per best engineering practices to minimize the dust generation<br>- Speed restriction, surface improvement and surface treatment shall be taken as options for control of emissions from unpaved approach roads.<br>- Machinery to be turned off when not in use<br>- Monitoring of the exhaust gases and noise levels will be carried out by an NABL/MoEFCC accredited Environmental Monitoring agency during the construction phase. Results shall be compared with relevant environmental regulatory standards/threshold limits for Water Quality provided in **Annexure A7.** | | | | | |
| | Construction equipment and machinery, drilling and operation of DG set etc. | Increase of ambient noise levels/noise pollution | - Stationary equipment shall be placed away from inhabited area in accordance to the National Noise Quality standard, particularly for residential areas (Category C) and silence zones (Category D: hospitals, educational institutions, courts, religious places, etc.), keeping the distance at least 150 m (Category C) and 250m (Category D), to minimize objectionable noise impacts. In the event potential noise sensitive receptors are identified who will experience higher noise due to construction, appropriate temporary noise barriers will be established<br>- Operations will be scheduled when people wouldbe least likely to be affected. Construction activities shall be restricted between 10 p.m. and 6 a.m. near residential areas.<br>- Protection devices (ear plugs or earmuffs) will be provided to the workers operating in the vicinity of high noise generating machines<br>- Construction equipment and machinery shall be fitted with silencers and maintained properly. Noisy equipment, if any, will be provided in separate enclosures. Rubber padding will be used underneath high noise and vibration generating machines<br>- Noise measurements shall be | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Daily as needed |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | carried out along the vicinity as well as in nearby villages to ensure the effectiveness of mitigation measures<br>- Use of manual labor will be promoted | | | | | |
| Biological Environment | Vegetation clearance/ de-weeding and other construction activities impacting flora and fauna | Impact on terrestrial biodiversity<br>Impact on aquatic wildlife | - A beel-specific pre-construction biodiversity and wildlife survey will be carried out by the PMU with support from the Forest Department to reconfirm the presence of key flora and fauna, identify any spawning and breeding grounds (if present), and appropriately schedule site-specific construction activities. Special attention shall be given to beels located within Key Biodiversity Areas (KBAs), such as Paranm Beel,Tatinga Mekheli Barbeel on Majuli Island and Bera Na Beel of Dhemaji District as well as to those located near KBAs, such as Borthol Beel, and to sites situated within forest areas, such as Mariampur Eco-Tourism Lake, due to their ecological sensitivity.<br>- For Mariampur Eco-tourismLake, which is located within a forest area, the PMU shall obtain prior No Objection Certificate (NOC) from the Forest Department before initiating any work. The CPIU and PIU must maintain close coordination and regular consultations with the Forest Department to establish a clear implementation mechanism and ensure compliance with forest regulations.<br>- At the Mariampur site, all activities shall be strictly confined to the lake area and its immediate surroundings on the village-facing side to minimize potential impacts on the adjacent forest. Entry into the forested area will be strictly prohibited, and project execution will be limited to designated zones to avoid any ecological disturbance.<br>- Vegetation clearance should be restricted to the subproject activities. efforts shall be made to minimize the tree felling as much as possible<br>- If any tree needs to be fell, NOC from concerned authority shall be obtained by CPIU/contractor prior to cutting and also execute compensatory plantation as per Govt. norms | Construction phase | Contractor on daily basis | Review of implementation of mitigation measures | CPIU | Daily as needed |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | - Reduce the amount of work directly in the water, which can stir up sediment. Contractor shall also explore alternatives like working from platforms. If needed construct basins that trap sediment laden runoff before it reaches the water. These allow cleaner water flow through while the solids settle at the bottom<br>- Focus on removing only obnoxious or invasive weed species such as Water Hyacinth (*Eichhornia crassipes*), that threaten the health of the beel ecosystem. Avoid removing submerged macrophytes to prevent ecological and water quality impacts, such as increase turbidity, release of nutrients and sediments previously stabilized by the plants<br>- Employ manual or mechanical weed removal techniques that minimize disturbance to the surrounding environment<br>- No hunting or poaching by contractor/construction staff in the Project area and surroundings during construction<br>- Prohibition of fishing activities for construction workers/staff<br>- Minimize noise and artificial lighting at night during construction<br>- Cutting of trees for cooking and heating shall be prohibited<br>- Based on preconstruction biodiversity and wildlife survey, CPIU shall confirm the contractor about specific spawning and breeding ground and scheduling of site-specific construction activities to avoid impacts on biodiversity.<br>- Restriction of construction activities near the identified fish breeding and spawning grounds (if any) during the breeding period specified under Assam Fisheries Rules 1953.<br>- Implementing construction schedules that avoid critical periods for wintering birds and providing habitat buffers can help reduce the impact on these avian species.<br>- Impacts of project activities on tortoises, including habitat disruption, water quality degradation, increased human disturbance, collision risks, disruption of | | | | | |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | breeding sites, and altered food sources, can be mitigated through implementation of Tortoise and Avi-Fauna Management Plan mentioned in **Annexure A8.**<br>**-** Human–Animal Conflict Management Plan (HACMP), incorporating the recommendations of the Biodiversity Survey and Wildlife Survey and outlining measures for prevention, mitigation, monitoring, and emergency response, shall be provided as an integral part of the Environmental Management Plan (EMP). A tentative plan is ginen in **Annexure A22** | | | | | |
| Socio-economic and Cultural Environment | Labour Influx | Issue related to labor influx, livelihood, conflict of cultural and regional bias | - Maximum number of Maximum numbers of unskilled labors to be employed from local areas, having their residences in the nearby areas. If needed, the establishment of labor camps by construction contractor will be outside the Project site in consultation with VDC and BDC.<br>- All migrant workers will undergo workshop/briefings to inform them on local culture and lifestyle awareness.<br>- Contractor shall inform BDC prior to any labor influx from outside village area.<br>- If labor camp is required to be established, the contractor will be required to ensure provision of basic amenities of drinking water, adequate number of toilets, washrooms, sanitation and cleanliness, lighting, availability of provisions and groceries, and recreational facilities at the labor camp site as part of the contract agreements.<br>- CPIU shall monitor the contractors and sub-contractors in terms of resources, migrant workers, child labor and forced labor, health and safety, and payment of wages etc.<br>- Establish a grievance redress mechanism in place to allow the employees, workers and villagers to report any concern or grievance related to work activities.<br>- Checking of structural integrity and equipment before undertaking work. Use of PPEs and fall protection equipment shall be required<br>- Guidelines for setting of labour | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Monthly |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | camp is provided in **Annexure A5**. | | | | | |
| Socio-economic and cultural environment | Due to construction activities, occupational health and safety hazards to construction personnel and public | Occupational health and safety hazards to construction personnel and public | - Contractor shall comply with the safety protocols of "Building and Other Construction Workers Regulations" of GoI[1] and relevant Environment, Health and Safety (EHS) Guidelines of International Finance Corporation (IFC).[2]<br>- Shall provide suitable safety barricading at all construction sites<br>- Shall provide and ensure use of PPEs (Personal Protective Equipment) such as Helmets, Mask, gum boots, gloves Ear plug etc.<br>- Setting up of speed limits and speed breakers at strategic or accident-prone locations<br>- Adequate lighting and fluorescent signage shall be provided at construction sites.<br>- All vehicles and equipment shall have safety gear such as safety belt, reverse horn, etc.<br>- All electrical connections shall be provided earth link circuit breaker (ELCB) and earthing.<br>- Shall provide appropriate and adequate safety signage in local language and English at all project areas<br>- Shall deploy Environment, Health and Safety Officers at the construction sites<br>- Shall provide facilities for first aid and medical support on call at project sites<br>- Shall monitor and analyze all safety incidents/accidents and take appropriate preventive/ mitigative actions<br>- In case of COVID-19 spread, guidelines of GoI and local government on COVID-19 shall be followed at construction site (Refer **Annexure A11)** | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Daily as needed |
| Socio-economic and Cultural Environment | Chance find during construction | Chance find of items/materials of cultural and/or archaeological importance subproject | - The contractor will take reasonable precautions to prevent workers or any other persons from removing and damaging any PCR. Upon discovery thereof and before removal, acquaint the engineer from DoF of such discovery and carry out instructions<br>- Report to CPIU and relevant authorities to comply with Archeological sites and Remains Act, 1958 and as amended Act | Construction phase | Contractor | Review of implementation of mitigation measures | CPIU | Weekly |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | 2010 of GoI. | | | | | |
| **C. Defect liability period and Operational Phase** | | | | | | | | |
| Soil Environment | Composting and fishing culture | - Nutrient leaching and runoff from composting activities may also lead to soil contamination, affecting soil structure and fertility<br>- excessive use of fertilizers or improper handling of fish waste could lead to nutrient overload, resulting in soil contamination | - Establish buffer zones with vegetation around composting and fish-rearing sites to absorb excess nutrients and prevent them from reaching surrounding soil and water bodies.<br>- Ensure proper disposal of fish waste. Use fish waste as a resource (e.g., converting it into organic fertilizer) rather than allowing it to decompose on the ground.<br>- Use ground cover, terracing, or silt fences to reduce soil erosion and prevent contaminated runoff from spreading.<br>- Excessive composting or over-application of compost can lead to nutrient overload, which can adversely affect soil health, making it less suitable for plant growth<br>- Use only safe, uncontaminated organic materials in composting, avoiding materials with high heavy metal content or pathogens.<br>- Regularly testing of compost and soil quality to detect any adverse changes early and implement corrective measures as needed. | Operational phase | BDC | Review of implementation of mitigation measures and plan the monitoring | CPIU<br>PIU<br>PMC | Daily |
| Soil Environment | Operation of on-site and off-site beel infrastructure | - Unhygienic conditions and environmental issues may arise due to waste generation during the operations of rearing ponds, hatcheries, fish auction centers, fish landing and aggregation sites, and the operation of ecotourism infrastructure at pilot sites, which can produce solid waste | - Implementing waste management systems that include proper segregation, storage, and disposal of solid waste.<br>- Setting up designated waste disposal bins with necessary infrastructure to handle both organic and non-organic waste.<br>- Use organic solid waste for composting<br>- Ensuring regular collection and disposal of waste<br>- Educating workers and local communities about waste minimization and proper waste disposal practices to reduce the overall environmental footprint.<br>- Monitoring waste generation and disposal regularly to ensure compliance with environmental guidelines.<br>- | Operational phase | BDC | Review of implementation of mitigation measures and plan the monitoring | PIU /PMU | Daily as needed |
| Soil Environment | Erosion of bund during operational phase | - Erosion of bunds during flooding can lead to the inundation of nearby | - Use materials like geotextiles, stones, or riprap to reinforce bunds and prevent erosion. Construct bunds with gentle | Operational phase | BDC under supervision of CPIU | Review of implementation of mitigation | PIU<br>PMU | Six monthly |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | agricultural fields, causing soil loss and crop damage.<br>- Eroded soil and debris can enter the beel, increasing sedimentation, reducing water depth, and affecting the water quality by increasing turbidity and nutrient loads.<br>- Erosion and subsequent flooding can wash away fish stock, damage fish habitats | slopes to reduce water pressure and improve stability.<br>- Plant deep-rooted vegetation, grass species, on the bunds to stabilize the soil and provide natural protection against erosion.<br>- CPIU shall conduct regular inspections of bunds, especially before and after the monsoon season, to identify weak points or signs of erosion.<br>- Repair and maintain bunds promptly to prevent small damages from escalating during floods.<br>- Manage water levels in the beel using controlled release structures (e.g., spillways or sluice gates) to regulate the flow of water during floods and reduce pressure on bunds | | | measures and plan the monitoring | | |
| Water Environment | Sedimentation, alteration of water volume | - Deposition of soil particles from surface runoff can lead to sedimentation, impacting water quality and aquatic habitats<br>- Embankments, sluice gates, spillways, and hume pipes, if not properly managed, can alter the volume of water, affecting downstream flow.<br>- Improper operation of water management structures may block or redirect natural channels, exacerbating flooding | - Establishing vegetative buffer zones around the beel and silt traps can help trap sediments before they enter the water body.<br>- PMU shall ensure that designs of water retaining structures such as sluice gate etc. are adequately sized to handle anticipated peak flow conditions without causing erosion or damage. Design of embankment and water control structures should mimic natural flow patterns and seasonal flooding<br>- CPIU shall conduct routine inspections to check for inlet and outlet blockages, sediment build-up, or structural damage.<br>- During normal flow conditions, adjust the spillway to manage water levels effectively, maintaining the natural flooding and drying cycles of the beel.<br>- CPIU shall ensure removal of debris and vegetation regularly to prevent blockages that can restrict flow and cause overflow.<br>- Develop and implement plans to address potential issues related to water flow alterations, including localized flood management | Operational phase | BDC | Review of implementation of mitigation measures and plan the monitoring | CPIU<br>PIU<br>PMU | Six monthly |
| Water Environment | - Runoff from composting and agriculture fields | - Nutrient runoff and discharge of wastewater | - Use organic fertilizers and controlled composting methods to minimize nutrient leaching. | Operational phase | BDC | Review of implementation of mitigation | CPIU<br>PIU | Monthly |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | - Discharge of nutrients laden water from on-site and off-site infrastructures | - Eutrophication and agal blooms<br>- Weed regeneration and decay | - Establish vegetative buffer zones and silt traps to capture excess nutrients before they reach the beel.<br>- BDC under the supervision of CPIU shall adopt sustainable aquaculture practices, including controlled feeding and organic waste management to avoid risk of water contamination<br>- Regularly monitor water quality in fish-rearing ponds and implement natural or biological treatment systems to reduce pollution.<br>- No wastewater discharge on open land will be practiced and wastewater outlet, if any, shall be diverted away from pondage area or connected to soak pit.<br>- Construct a properly sized and designed septic tank to collect and treat wastewater generated by the office premises. Ensure it has adequate capacity to handle peak loads and complies with local environmental standards.<br>- Septic Tank Maintenance: routine cleaning and sludge removal to prevent overflow and contamination.<br>- Link the treated outflow from the septic tank to a municipal sewer line to ensure wastewater undergoes further treatment at a centralized facility, minimizing risks of pollution in nearby water bodies<br>- Consider treating and reusing greywater (e.g., water from handwashing sinks) for non-potable uses such as irrigation or toilet flushing.<br>- Sanitation facilities shall be provided and maintained by BDC. BDC will collaborate with nearby fish landing sites, aggregation areas, and auction centers to promote shared responsibility to avoid discharge of waste in nearby beels.<br>- BDC shall ensure regular maintenance of boats (if any) to prevent leaks, and encourage the use of eco-friendly fuels and lubricants. If possible, encourage battery operated or paddle boats for ecotourism (if any).<br>- Accidental discharge of solid waste shall be prevented by the application of waste management rules. | | | measures and plan the monitoring | | |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | - Nutrients and chemical intensive farming shall be controlled in catchments. Organic farming shall be encouraged by BDC<br>- BDC shall ensure periodic manual removal of weeds and Implement regular and targeted weed management practices to control their growth before they decay | | | | | |
| Ambient Air and Noise | Operations of Diesel Generators | - Air pollutants and noise emission from Diesel Generators | - Use newer, fuel-efficient, and low-emission diesel generator models that comply with local environmental standards.<br>- DG set will be regularly maintained to ensure emissions align with the designed output and comply with environmental standards.<br>- Stack height for DG sets will be provided as per CPCB guidelines, ensuring the height above the roof is calculated as $0.2\sqrt{KVA}$ to disperse emissions effectively.<br>- Conduct regular maintenance, including cleaning filters and servicing engines, to ensure optimal performance and reduce emissions.<br>- Transition to cleaner fuel alternatives or renewable energy sources, where feasible, to lower the environmental footprint.<br>- Install acoustic enclosures around the DG set to reduce noise levels to permissible limits.<br>- Use vibration isolation pads or mounts to minimize noise and vibrations during operation.<br>- Position the DG set away from sensitive areas, such as key workspaces to limit noise disturbance.<br>- Construct noise barriers, such as walls or fences, around the DG set to absorb and deflect sound.<br>- Schedule generator operations during non-sensitive hours to minimize the impact on nearby communities.<br>- Regularly maintain the DG set, including lubricating moving parts, to | Operational phase | CPIU<br>PIU | Review of implementation of mitigation measures and plan the monitoring | PMU | Monthly |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | prevent noise caused by mechanical wear and tear<br>- Install acoustic enclosures around the DG set to reduce noise levels to permissible limits.<br>- Use vibration isolation pads or mounts to minimize noise and vibrations during operation.<br>- Position the DG set away from sensitive areas, such as key workspaces to limit noise disturbance.<br>- Construct noise barriers, such as walls or fences, around the DG set to absorb and deflect sound.<br>- Schedule generator operations during non-sensitive hours to minimize the impact on nearby communities.<br>- Regularly maintain the DG set, including lubricating moving parts, to prevent noise caused by mechanical wear and tear | | | | |
| Ambient Air | - Operations of fish-rearing, fish landing and aggregation sites and auction centers<br>- Composting and waste generation | - Unpleasant odour from fish-rearing, landing and aggregation sites and auction centers including composting and waste generation sites | - BDC to implement prompt waste removal by collecting fish waste and organic materials immediately, using sealed containers for temporary storage, and segregating organic and inorganic waste for proper disposal or composting.<br>- Ensure frequent cleaning of work areas, equipment, and drainage systems with water and biodegradable disinfectants to prevent residue buildup, stagnant water, and odors.<br>- Treat wastewater effectively through well-maintained septic tanks before connecting it to municipal sewer systems for further processing.<br>- Upgrade infrastructure by installing cold storage to slow decomposition, providing covered odor-proof bins, and enhancing ventilation systems to minimize odors in enclosed spaces.<br>- Train staff on hygiene practices, cleaning protocols, and efficient waste management to maintain cleanliness and | Operational phase | BDC | Review of implementation of mitigation measures and plan the monitoring | CPIU | Monthly |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | reduce odor issues.<br>- Engage stakeholders, including fishermen and traders, to adopt odor control measures and promote a collaborative approach to maintaining a cleaner and more pleasant working environment. | | | | | |
| Biological Environment | Introduction of fish species | Displacement of existing fish species | • CPIU shall select only native fish species for introduction that should base on compatibility with existing species and ecosystem needs.<br>• CPIU/BDC shall stablish and enforce regulations on fishing practices to prevent overfishing. This includes setting limits on catch sizes, implementing seasonal fishing bans, and regulating fishing gear to protect fish stocks.<br>• - CPIU shall conduct regular assessments of the beel's ecological health, including monitoring fish populations, species distribution, and overall ecosystem conditions. Use this data to inform management decisions and adapt practices as needed.<br>• Maintain an updated inventory of species present in the beel to track changes in species distribution and abundance. | Operational phase | BDC and CPIU | Review of implementation of mitigation measures and plan the monitoring | PIU PMU | Six Monthly |
| Land, water and Socio-economic Environment | Operation and Maintenance activities | Lack of maintenance of Beel, unequal distribution of share/profits and waterborne disease | • BDC will Implement a scheduled maintenance program that includes regular inspections of infrastructure and habitat conditions. Address any issues promptly to prevent long-term damage.<br>• O&M activities viz. de-weeding, desilting, erosion control, cleaning of inlet and outlet channels and small repair works etc. shall be taken periodically to maintain sustainability and maximize the subproject benefits<br>• BDC shall ensure adequate resources and funding are allocated for maintenance activities. Prioritize critical infrastructure and ecological areas for regular upkeep.<br>• BDC shall establish and communicate a clear and equitable profit-sharing framework that ensures fair distribution among all stakeholders. Include community representatives in decision-making processes.<br>• BDC will ensure prevention the | Operational phase | BDC and CPIU | Review of implementation of mitigation measures and plan the monitoring | PIU PMU | Six monthly l |

**Table 9-1. Environmental Management Plan for Sustainable Wetland and Integrated Fisheries Transformation Project**

| Environment Aspects or Project Activities | Civil work/ Project activities | Potential Environmental impacts | Mitigation/Remedial Measures | Time Frame | Institutional Responsibility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Responsibility | Monitoring Action/ Indicator | Supervision | Frequency of Monitoring |
| | | | breeding of mosquitoes by using appropriate measures removal of algae and weeds, keeping the beels surroundings clean | | | | | |

**Table 9-2.Environmental Monitoring Plan for Pre-Construction and Construction Phase**

| Parameters | Environment Indicators/ Construction Activities | Standards | Frequency | Responsibility | Location | Supervision |
|---|---|---|---|---|---|---|
| Detailed drawing and designs based on engineering survey and investigation | Beel specific detailed drawings and designs | As per engineering best practices IS Norms | Once | CPIU/PIU | Subproject Beel location | PMU |
| Preparation for Site specific EMP and other site management plan to be approved by PMU | Pre-Construction and Construction Phase | Nonspecific but as per lot condition | Prepare prior to start of construction stage and implement through the construction phase | Contractor<br>CPIU | Subproject beel location | PMU |
| − Contractor shall work within identified areas to avoid unnecessary access to nearby village area<br>− Identify site for weed dumping prior to composting and to store excess weeds<br>− Site for composting<br>− Site for storage of material and equipment's<br>− Labor camp site (if any)<br>− Silt dumping and reuse sites | Marking project sites & footprints area | As per DPR and/or bidding document complying engineering best practices | Prior construction | Contractor | Subproject beel location | CPIU |
| Ensure implementation of guidelines for Borrow Area Operations and Management | − Borrow Area management (if any) | As per guidelines | Daily during borrowing of earth materials (earth/sand/ stone etc) | Contractor | Borrow area | CPIU |
| Adequacy of dust suppression techniques | Dust generation | None specific but as per site condition | Daily | Contactor | Construction site/Beel area | CPIU |
| Visual check landslides/ erosion prone area, stability of bank | Soil erosion & Siltation | - | Before monsoon | Contactor | Near Construction site, inlet channels and access routes etc. | CPIU |
| Record of C&D wastes, solid waste, Hazardous waste, if any | Waste generation | - | Daily | Contractor | Construction site or labour camp (if any) | CPIU |
| Records of de-weeded quantity/area | De-weeding | As per DPR | Daily during de-weeding operation | Contractor | Beel | CPIU |

| Parameters | Environment Indicators/ Construction Activities | Standards | Frequency | Responsibility | Location | Supervision |
|---|---|---|---|---|---|---|
| Records of de-silted quantity/area | Desilting | As per DPR | Daily during desilting operation | Contractor | Beel | CPIU |
| Records of weed composted and their utilization | Composting | As per DPR | Daily during composting operation | Contractor/ BDC | Beel | CPIU |
| Check clogging of drains, ensure no logging of water, ensure contours levels are restored | Drainage | - | Monthly | Contractor | Construction site | CPIU |
| General cleanliness, periodic removal of garbage, inspection of toilets and other | Sanitation and Hygiene | | Weekly | Contractor | Construction site and labour camp | CPIU |
| General heath check-up, identification of water-logged areas having disease vector carrier like mosquitos etc. | Labour Health check-up | - | Monthly | Contractor | Subproject site and labour camp | CPIU |
| Usage of PPEs, Ensure public and labours safety | Occupational Health and safety | - | Daily | Contractor | Subproject site | CPIU |
| General Security Prevent unwanted access to site | Security | - | Daily | Contractor | Subproject site/ storage area | CPIU |
| Ensure traffic and Parking management plan | Traffic management | - | Daily | Contractor | Project sites located at Road and to access road | CPIU |
| Reporting of chance find to concerned agency and implement cultural properties management plan | Physical Cultural Resources | - | During chance find | Contractor | Subproject site | CPIU |
| Match implementation schedule, ensure record keeping of materials and photography of construction update including pre and post pictures of de-weeding operations | Photography and record keeping of construction progress | - | Weekly | Contractor | Subproject site | CPIU |

| Parameters | Environment Indicators/ Construction Activities | Standards | Frequency | Responsibility | Location | Supervision |
|---|---|---|---|---|---|---|
| $PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$, CO (24-hr Sampling) | Air Quality | Ambient Air Quality Standards (given in **Annexure A7**) | Once before start of construction works as baseline<br>Once during implementation and once after completion of construction | Contractor through third party MOEFCC/ NABL accredited laboratories | One location near beel | CPIU |
| Ambient and occupational exposure. Equivalent noise levels on dB (A) scale for day and nigh | Noise levels | Noise Standards (given in **Annexure A7**) | Once before start of construction works as baseline<br>Once during implementation and once after completion of construction | Contractor through third party MOEFCC/ NABL accredited laboratories | One location near beel | CPIU |
| Key polluting indicating parameters in surface water as l**isted in Annexure A12** | Water Quality | Surface Water Quality Standards (as per IS: 2296 and designated best use criteria for Class B) (Given in **Annexure A7**) | Once before start of construction works as baseline<br>Once during implementation and once after completion of construction | Contractor through third party MOEFCC/ NABL accredited laboratories | One location near beel | CPIU |
| Monitoring of nutrients and metals as listed in **Annexure A12** | Sediment/Soil Quality | MOEFCC soil quality standards for screening of contamination and soil fertility ratings | Once before start of construction works as baseline.<br>Once during implementation and once after completion of construction | Contractor through third party MOEFCC/ NABL accredited laboratories | One location near beel | CPIU |
| Aquatic biodiversity including fish species, macrophytes, avi-fauna **Details can be referred Annexure A12** | Aquatic Biodiversity | Refer IUCN Red Data list/Schedule I species as pdr WPA 1972 | Once before start of construction works as baseline<br>Once during implementation | Contractor through third party MOEFCC/ NABL accredited laboratory | One location near beel | PMU |
| Wildlife Survey to confirm IUCN threatened species | Wildlife Survey to confirm IUCN threatened species if any | Refer IUCN Red Data list/Schedule I species as pdr WPA 1972 | Once Prior to construction | PMU through State Forest Department | Each beel | PMU/ CPIU |

**Table 9-3. Environmental Monitoring Plan for Operational Phase**

| Environment Indicators | Parameters | Standards | Frequency | Responsibility | Monitoring Location | Supervision |
|---|---|---|---|---|---|---|
| **Weeds/Macrophytes growth** | - Area covered by weeds/macrophytes species<br>- Periodic removal of weeds | | Quarterly | BDC | Beel Pondage area | CPIU/PIU/<br>ARIS |
| **Availability of native fish species and fish production** | - Availability of native fish species<br>- Increase of fish production | - | Six monthly | CPIU | Beel Pondage area | CPIU/PIU/<br>ARIS |
| **Water quality** | - Pollution indicating parameters from and eutrophication assessment<br>**Listed in Annexure A12.** | Surface Water Quality Standards (as per IS: 2296 and designated best use criteria for Class B and water quality guidelines for fish health)<br>(Given in **Annexure A7 and A12**) | Monthly | BDC through application of Field-Testing Kit | Beel water | CPIU/PIU/ARIS |
| **Sedimentation** | Sedimentation to be checked | - | Annual or in two years | CPIU through third-party survey agency | Beel pondage area | CPIU/PIU/ARIS |
| **Checking of Inlets and outlets** | Visual check of clogging in inlets and outlets including condition of sluice gate, pipes/valves | - | Before monsoon | BDC | Beel pondage and fringe area | CPIU/PIU/ARIS |
| **Bund erosion** | Progress and impact soil erosion control measures | - | Annual | CPIU | Shoreline area | CPIU/PIU/ARIS |
| **Sanitation and Hygiene** | General Cleanliness,<br>Periodic removal of leaflitter/garbage around beel area | - | Monthly | BDC | Beel pondage and fringe area | CPIU/PIU/ARIS |
| **Emergency Response** | Reporting to flood and other emergency situation | Nonspecific but as per site requirement | At time of event | BDC | Beel pondage and fringe area | CPIU/PIU/ARIS |

## 9.6. Institutional Arrangement

864. The project's executing agency is the Government of Assam, represented by the Assam Rural Infrastructure and Agricultural Services (ARIAS) Society. The Directorate of Fisheries (DoF), Government of Assam, serves as the implementing agency. The Project Management Unit (PMU), based in Guwahati

and hosted by the ARIAS Society, will be led by the State Project Director (SPD) of the ARIAS Society. The Project Implementation Unit (PIU), hosted by the DoF and headed by the Director of Fisheries, will manage the activities of five Cluster Project Implementation Units (CPIUs). Each CPIU will be led by a Zonal Project Coordinator (Deputy Director, Zonal Office) and include the District Fisheries Development Officer (DFDO) of the respective district as part of its team. Roles and responsibilities of the proposed project units and partners are summarized below in Table 9-4.

**Table 9-4.Roles and Responsibilities of Project Agencies**

| Project Implementation Organization | Management Roles and Responsibilities |
|---|---|
| **Executing Agency:** ARIAS Society | Conduct overall coordination of project implementation, including timely submission of reports to ADB |
| **SWIFT project steering committee (SPSC)** (under the EA) | • Provide overall guidance for the project implementation, coordination and management<br>• Oversee and monitor project implementation as well as the adequacy of overall project funding<br>• Ensure smooth interdepartmental coordination for timely and key policy/governance decisions<br>• Hold meetings as necessary but at least quarterly to discuss the overall status and project issues<br>• Address any other matters related to project implementation as and when they arise |
| **Project procurement committee** (under the EA) | Review and clear evaluation reports and awards of contracts |
| **Project Management Unit**: ARIAS Society | • Responsible for all aspects of coordination and management of project implementation on behalf of the EA<br>• Prepare annual work plan and budget for each calendar year, and have it approved from PSC and ADB<br>• Responsible for compliance with loan covenant, financial management, safeguards as per ADB and national requirements<br>• Enter into bilateral Memoranda of Understanding (MoU) with key and requisite project partners on behalf of the Executing Agency<br>• Approve tendering documents and oversight of project procurement<br>• Responsible for PMU contract management and for monitoring and supervision of PIU's contract management<br>• Performance monitoring<br>• Progress reporting through preparation and submission of periodic progress reports, consolidated annual audit reports, and other reports meeting government and ADB requirements<br>• Conduct needs assessment and organize project management capacity building trainings for PMU, PIU and CPIUs<br>• Maintenance of the Project Management Information System<br>• Maintain project accounts and complete loan financial records<br>• Procure goods and works of the overall project during project readiness stage (until loan signing)<br>• Procure goods and works related to PMU activities<br>• Maintain separate books and records by funding source for all expenditures incurred on the project following the cash-based accounting principles in accordance with applicable financial rules, accounting standards and guidelines of GoAS<br>• Prepare and consolidate withdrawal applications and submit to ADB<br>• Consolidate project financial statements and submit to ADB<br>• Ensure timely conduct of audit |

| Project Implementation Organization | Management Roles and Responsibilities |
|---|---|
| **Implementing Agency**: Department of Fisheries (DoF) | Participate in the SPSC and provide guidance for project implementation and PIU's activities |
| **Project Implementation Unit:** Directorate of Fisheries (DOF) | • Conduct day-to-day project implementation and management on behalf of the IA<br>• Review and clear cluster-based implementation plans which includes district-level plans<br>• Prepare project progress reports, consolidating inputs from CPIUs and partner agencies, and submit to PMU<br>• Procurement of goods, works, consulting and non-consulting services – including tender and award of contracts as relevant to PIU<br>• Under the guidance of PMU, supervise CPIU's management of construction supervision firms<br>• Project financial management<br>• Prepare PIU withdrawal applications, consolidate CPIU withdrawal applications, and submit them to PMU<br>• Maintain PIU accounts and complete loan financial records<br>• Prepare and submit PIU's own financial statements to PMU<br>• Maintain separate books and records by funding source for all expenditures incurred on the project following the cash-based accounting principles in accordance with applicable financial rules, accounting standards and guidelines of GoAS<br>• Consolidate the PIU and CPIUs project financial reports and submit to PMU |
| **Cluster-based Project Implementation Unit:** Zonal Offices of DOF | • Beel restoration related construction supervision<br>• Prepare withdrawal applications and submit to PMU in copy to PIU, or to PIU, following the financial management plan<br>• Authorize payments at the CPIU level<br>• Maintain separate books and records by funding source for all expenditures incurred on the project following the cash-based accounting principles in accordance with applicable financial rules, accounting standards and guidelines of GoAS<br>• Submit financial reports to PIU<br>• Approve district implementation plans on an annual basis (based on the beel assessment) and prepare cluster-based implementation plans (for submission to PIU)<br>• Recommend individual beel implementation and management plans to the PIU for approval |
| **ASRLM** | The ASRLM will be a key project partner under in the implementation of activities for sustainable livelihood diversification of beel communities (Output 2.3), through ASRLM's network of self-help groups (SHGs) as an entry point, and in convergence with ASRLM's existing programs.<br><br>PMU will establish an MoU with ASRLM outlining respective responsibilities and convergence opportunities. ASRLM will also be specifically tasked to:<br>• Encourage systematic savings across the SHG network<br>• Facilitate internal lending mechanisms<br>• Undertake membership drive for SHG inclusion<br>• Undertake awareness campaigns for SHG benefits<br>• Undertake assessment of defunct SHGs<br>• Develop the revitalization plans for SHGs<br>• Monitor and prepare progress reports |
| **WISA** | Wetlands International, South Asia will be a key technical partner in the institutional capacity building for sustainable beel management, beel health monitoring in close collaboration with CIFRI, and wetland management |

| Project Implementation Organization | Management Roles and Responsibilities |
|---|---|
| | guidelines and communication of such guidelines. More specifically, WISA will be taksed to:<br>• Develop training program for public institutions such as DoF and SWA by prepare training materials and conducting training in effective conservation and beel ecosystem management<br>• Develop training program for BDCs, animators and local communities to promote sustainable wetland management<br>• Prepare practical tools (setland management guidelines, manuals, communicationa materials)<br>• Support beel animators to facilitate community-led beel management and conservation efforts<br>• Support beel animators in the development of concise documentation for wetland notification and health report cards<br>• Collaborate with the CIFRI to enhance water quality monitoring initiatives |
| **CIFRI** | Central Inland Fisheries Research Institute will be a key technical partner in the advisories to beel fisheries productivity enhancement. More specifically, CIFRI will be tasked to:<br>• Develop and implement training of trainers program/modules on sustainable beel fisheries production, including protocols and best practices<br>• Conduct trainings for public institutions as well as selected BDCs<br>• Undertake scientific/research of beel fisheries productivity enhancement<br>• Support beel quality monitoring and update fisheries operational guidelines as required<br>• Provide technical guidance to PMU and PIU related to the following:<br>a. Preparation and analysis of the baseline survey on aspects of morpho-hydrographic, biodiversity and other biological features of the selected beels.<br>b. Construction and preparation of nurseries, cages and pens under a culture-based capture fishery model.<br>c. Production and quality of seed, including rearing of fry to fingerling, fingerling to seed and release of seed.<br>d. Stocking density and strategy.<br>e. Growth monitoring and harvesting strategy.<br>f. Macrophyte management.<br>g. Fish biodiversity/ species enhancement and conservation of SIFs. |
| **Other supporting government agencies** | Establish Memoranda of Understanding amongst the EA, IA and supporting government agencies, such as AFDC, SWA, and Revenue Department, outlining support and cooperation to facilitate project activities on the following aspects:<br>• Harmonizing leasing arrangements<br>• Agreement on wetlands rules and notification<br>• Other policy issues under output 1 |
| **ADB** | Monitor and review overall project implementation in consultation with the executing and the implementing agencies, including<br>• Project implementation schedule;<br>• Actions required in terms of poverty reduction, environmental impacts, and resettlement plans if applicable;<br>• Timeliness of budgetary allocations and counterpart funding;<br>• Project expenditures, progress with procurement and disbursement, and statement of expenditure when applicable;<br>• Compliance with particular loan covenants; and<br>• Likelihood of attaining the project's immediate development objective |

## 9.7. Environmental Responsibilities

865. **Executing Agency (EA):** The executing agency for the project is the Government of Assam, represented by the Assam Rural Infrastructure and Agricultural Services (ARIAS) Society. EA responsibilities will mainly be focused on addressing national and state level environmental safeguards issues and decisions concerning the subprojects regulatory compliances. Executing agency will also oversee implementation of environmental safeguards measures, documentation and compliance of ADB SPS 2009.

**Project Management Unit (PMU)**

866. The PMU of the project is responsible for ensuring that the project fully conforms with the loan agreement, ADB's SPS 2009, IEE and all applicable government legal and regulatory requirements. Safeguards compliance will be required for the project to be on track, timely identification of any safeguard issues and implementation of corrective action is a performance indicator that is monitored by ADB. To ensure compliance with the environmental safeguards provided in this PAM and IEE, the PMU will seek the support of the environmental safeguards specialist of the PIU. The PMU shall:

(i) adhere to all government regulations, standards, and other environmental-related legal requirements for the project;
(ii) ensure compliance with national and local laws, ADB SPS 2009, loan covenants, and IEE and EMP;
(iii) coordinate closely with state and district-level agencies and line departments to streamline environmental clearances, permit processes, and ensure adherence to local environmental policies;
(iv) ensure compliance with international good practices per the following the requirements of the International Finance Corporation's General EHS Guidelines, their guidelines on agribusiness/food production/forestry/water and sanitation, and the International Labour Organization's Code of Practice on Safety and Health in Construction;
(v) with the support of an environmental safeguards specialist of the PIU , review and approve IEE/s and EMP(s), before submitting to ADB for concurrence and review and disclosure respectively;
(vi) ensure grant recipients with category B subprojects prepare and (as required) update IEEs and EMPs of their subprojects and have capacity for EMP implementation;
(vii) with the support of an environmental safeguards specialist of the PIU, review and approve environmental safeguard related clauses and sections to be included in tender documents and civil works contracts of contractor(s);
(viii) with the support of an environmental safeguards specialist of the PIU, evaluate and approve the construction environmental management plan (CEMP) that the contractor(s) have prepared;
(ix) ensure that the project and all contractors obtain permits, licenses, etc. for activities before the implementation of the respective construction activity;
(x) be in charge of applying for important documents and sending them to government offices for the processing of permits and clearances, such as environmental clearance certificates, tree-cutting permits, and other pertinent licenses and permits;
(xi) ensure environmental clearances obtained for subprojects before issuing bidding documents and awarding any work contracts to any contractors;
(xii) with support from PIU, conduct training and workshops on environmental management and site induction for all staff and workers involved in the project implementation;

(xiii) carry out regular (at least quarterly) field verification and review environmental compliances and contractor during project implementation, in coordination with the PIU, CPIUs and the contractor's environmental focal person;
(xiv) carry out regular (at least quarterly) field verification and review environmental compliances by the grant recipients during project implementation, in coordination with the PIU, recipients and their contractors.
(xv) close supervision and monitoring of all components during the implementation with a zero-tolerance approach to health and safety risk management, ensuring adequate health and safety supervision.
(xvi) make sure that EMRs are prepared, reviewed, and submitted for publication locally and on the ADB website as specified in the loan agreement;
(xvii) implement effective environmental monitoring during the pre-construction, construction, and operation phases, guided by the IEEs submitted to ADB. This includes, but is not limited to, inspections, reviews of monitoring forms prepared by the PIU, CPIUs, contractors, and documentation of the issues received through GRM;
(xviii) provide and record environmental observations during any site visits that may include, but are not limited to, excessive dust, loud noises, improper disposal of waste, chemical or oil spills, camp hygiene, health and safety, and improper borrow area management;
(xix) in case of potential risks and hazards to health, environmental quality, and properties that may result from poor EMP implementation, immediately guide PIU, CPIUs or grant recipients to cease the construction or operational activities that pose risk and conduct immediate containment and mitigation activities;
(xx) take proactive and timely measures to address any environmental safeguards-related challenges at the national, state, or district levels, such as (a) delays in the processing of clearances during the pre-construction stage and (b) significant grievances during the construction and operation stages;
(xxi) review and approve corrective action plans (CAPs) for environmental safeguard noncompliance;
(xxii) coordinates and facilitates public consultations to engage stakeholders, ensure transparency, and integrate community feedback into project planning and implementation;
(xxiii) inform ADB of any unanticipated environmental impact(s) that occurred during the project implementation phase;
(xxiv) ensure GRM, as envisaged in the IEE, is in place and fully operational from the onset of project implementation; and
(xxv) perform other tasks relevant with environmental safeguards of ADB and Government of India.

**Project Implementation Unit and Cluster Project Implementation Unit (PIU and CPIU)**

867. The Project Implementation Unit (PIU) will be hosted by the DOF and headed by the Director of Fisheries. The PIU will oversee and manage the activities of five Cluster Project Implementation Units (CPIUs), each led by a Zonal Project Coordinator (Deputy Director, Zonal Office). Under the PIU, the CPIUs will support the project to perform environmental safeguards activities, including:

(i) CPIUs will select beels and other infrastructures based on subprojects selection criteria, with support from environmental safeguards coordinators. The proposed selections will then be submitted to the PIU for review;
(ii) PIU will identify on-beel and off-beel infrastructures, ecotourism and matching grant subprojects by using the selection criteria with the support from an environmental safeguards specialist of the PIU and submit to PMU for review and approval;

(iii) PIU, with CPIUs' support, will prepare and update IEE and EMPs of subprojects through, but not limited to, reconnaissance survey, collecting data from the proposed subproject sites, government requirements and public consultations;
(iv) PIU will ensure grant recipients with category B subprojects prepare and (as required) update IEEs and EMPs of their subprojects and have capacity for EMP implementation;
(v) CPIUs will ensure that the project, and all contractors obtain permits, licenses, etc. before the implementation of the respective construction activity;
(vi) CPIUs will ensure environmental safeguard clauses are included in bidding documents and contracts, in coordination with the PMU, to hold contractors and grant recipients accountable for EMP compliance;
(vii) CPIUs will maintain a site-specific environmental compliance file for each subproject, including permits, inspection records, consultation minutes, and environmental observations;
(viii) PIU will assist in identifying and addressing unanticipated environmental impacts, including recommending adjustments to mitigation measures in coordination with the PMU;
(ix) PIU will support PMU in the preparation of CAPs in case of non-compliance, and ensure follow-up implementation at the field level;
(x) PIU and CPIUs will monitor the implementation of climate adaptation and disaster risk reduction measures integrated into the EMP, particularly for flood-prone beel areas;
(xi) PIU and CPIUs will facilitate coordination with local government bodies and regulatory agencies at the district level to streamline permitting and address location-specific environmental issues;
(xii) CPIUs will carry out regular field verification and review of environmental compliances by contractors, in coordination with the CPIUs and the contractors' environmental focal person, and report to PMU on the results and findings;
(xiii) PIU will ensure that the project, and all grant recipients obtain permits, licenses, etc. before the implementation of the respective construction activity;
(xiv) PIU will carry out regular field verification and review of environmental compliances by grant recipients, in coordination with the CPIUs and the recipients, and report to PMU on the results and findings;
(xv) with support from an environmental safeguards specialist, PIU will conduct training and workshops on environmental management and site induction for all staff, workers and grant recipients involved in the project implementation;
(xvi) PIU and CPIUs will implement effective environmental monitoring during the pre-construction, construction, and operation phases. This includes, but is not limited to, inspections, reviews of monitoring forms prepared by the contractors and grant recipients, and documentation of the issues received through GRM;
(xvii) With support from contractual staff, PIU and CPIUs will gather information from the implementation of the EMP to be included in the EMR preparation by the PMU;
(xviii) PIU and CPIUs will provide and record environmental impact observations during any site visits;
(xix) in case of potential risks and hazards to health, environmental quality, and properties that may result from poor EMP implementation, PIU will immediately guide CPIUs and grant recipients to resolve construction activities that pose risk and conduct immediate containment and mitigation activities;
(xx) PIU will take proactive and timely measures to address any environmental safeguards-related challenges at the national, state, or district levels, such as (a) delays in the processing of clearances during the pre-construction stage and (b) significant grievances during the construction and operation stages;

(xxi) CPIUs and PIU support the PMU by organizing, facilitating, and documenting public consultations at the local level, ensuring meaningful participation of affected communities and stakeholders, and integrating community feedback into the project design, planning, and implementation processes;
(xxii) PIU and CPIUs will be part of the process and operations of GRM as envisaged in the IEE; and
(xxiii) PIU and CPIUs will perform other tasks relevant with environmental safeguards of ADB and Government of India.

868. Comprising various experts, contractual staff of the ARIAS Society will support the capacity and operational effectiveness of the PMU, PIU and CPIUs including for environmental safeguard matters. The environmental safeguards experts (contractual staff) will support the project on supervision, compliance, and monitoring of environmental safeguards and preparation of IEE and EMP. Contractual staff will support the review of matching grant components as well as setting up the systems for supervision, compliance and monitoring of environmental safeguards, providing capacity building to the PMU, PIU, and CPIUs. Also, contractual staff will support supervision and monitoring activities; and undertake quality assurance role for safeguards documents. Particularly, the contractual staff shall:

(i) ensure schemes and subprojects will conform to national policies and ADB's requirements for environmental safeguards;
(ii) ensure schemes and subprojects are following social, technical, environmental and economic criteria;
(iii) provide support to PMU, PIU and CPIUs for the collection of environmental information to be used in the feasibility assessment and IEE/EMP of proposed subprojects;
(iv) provide technical expertise, implement and monitor environmental safeguard requirements;
(v) assist PIU and CPIUs on the updating and preparation of IEE and EMPs of beels and other category B subprojects;
(vi) assist PMU with the review of IEE and EMPs prepared by PIU and grant recipients;
(vii) support the PMU, PIU, CPIUs, contractors and community to implement EMPs, the recommendations of IEE/s;
(viii) support the project on monitoring of environmental safeguards at subproject sites;
(ix) provide technical expertise to PMU, PIU, CPIUs in the preparation of environmental safeguard requirements;
(x) support PMU, PIU and CPIUs to (a) conduct environmental site inductions to contractors, and (b) ensure understanding of EMPs, government's environmental laws and requirements, and ADB SPS requirements;
(xi) assist the PMU to prepare the environmental monitoring reports for timely submission to ADB;
(xii) participate and/or lead public consultations; and
(xiii) provide support on any environmental management and safeguards matters of the project.

869. In the event that there is a change in scope or unexpected environmental effects arise during project execution, the PMU will update the IEE and EMP(s) with assistance from an environmental safeguards specialist of the PIU . ADB will examine both documents and make them available on its website once reviewed and cleared for disclosure.

**Contractor**

870. The contractor is the main body to implement the EMP and environmental quality monitoring during the pre-construction and construction stages. Specifically, the contractor shall:

(i) appoint environment, health, and safety focal person and attend the site induction workshop to be organized by the PMU, PIU, and CPIUs;
(ii) oversees environmental management activities on the construction site, including pollution prevention, waste management, and environmental monitoring;
(iii) obtain the necessary environmental license(s), permits, etc. from relevant agencies;
(iv) ensure the construction site complies with all relevant environmental, health, and safety regulations, standards, and codes of practice;
(v) as part of a detailed survey, collect baseline data on the environmental quality of the construction sites before the start of physical works and continue the collection of information (e.g., air quality, noise level, and water quality) during civil works as specified in the approved EMP;
(vi) conducts risk assessments and hazard identification to identify potential environmental, health, and safety risks associated with construction activities. This involves assessing workplace hazards, environmental hazards, and potential exposure pathways for workers and the surrounding community;
(vii) based on risk assessments, develops safety plans, procedures, and protocols to mitigate identified risks and hazards. The contractor will revise and finalize the construction EMP and environmental quality monitoring plan based on site-specific conditions;
(viii) implement and document all mitigation measures in the EMP and environmental quality monitoring plan;
(ix) ensure that all workers and site agents, including site supervisors and management, participate in all environmental safeguard related training sessions;
(x) provides training and awareness sessions to construction workers, sub-contractors, and other staff on environmental, health, and safety practices and procedures;
(xi) conducts regular inspections and audits of the construction site to monitor compliance with environmental, health, and safety requirements.
(xii) ensure compliance with environmental statutory requirements and contractual obligations;
(xiii) conducts investigations to determine the root causes and contributing factors in the event of accidents, incidents, or near misses. This includes documenting incidents, analyzing data, and developing corrective actions to prevent recurrence. Contractor will ensure that all incidents are documented and reported to relevant authorities as required by regulations;
(xiv) maintain an on-site environmental logbook and records, documenting inspections, training, EMP implementation, and grievance redress actions for review by the PIU, and CPIUs;
(xv) participate in resolving issues as a member of the GRM;
(xvi) respond promptly to grievances raised by the local community or any stakeholder and implement environmental corrective actions or additional environmental mitigation measures as necessary and inform PIU and CPIUs;
(xvii) based on the results of EMP monitoring, cooperate with CPIUs and PIU to implement environmental corrective actions plans, as necessary;
(xviii) develop and implement health promotion and wellness programs to support the physical and mental well-being of construction workers;
(xix) engages with local communities, regulatory agencies, and other stakeholders to address concerns, communicate project related information, and promote transparency and accountability;
(xx) promotes a culture of continuous improvement in environmental, health, and safety performance on the construction site; and
(xxi) provide other environmental safeguards activities as indicated in the contract.

871. To ensure EMP implementation, it is crucial to embed specific clauses within the civil works and contracts that mandate adherence to the EMP. This includes outlining clear responsibilities for all parties and cost-related items. The full EMP must also be provided in the bidding document and contract agreement. Contractors are required to submit a construction EMP, making it a fundamental part of the contractual agreement from the onset. The PIU and CPIUs will oversee this process, ensuring that the EMP clauses are effectively incorporated into all contracts and are consistent with the approved/adopted local BIMP or community-based beel ecosystem and fishery management plan. The contractors must always be required to follow the current version of the EMP, which is the version disclosed on ADB's website. Inclusion of the EMP in the contract documents and satisfactory EMP implementation is a performance indicator that will be monitored by ADB.

872. The contractors and workers should be trained on EMP requirements and implementation procedures. Conducting training sessions for civil works contractors ensures they are well-versed in the necessary protocols. Similarly, engaging and training the civil works contractors on EMP monitoring and implementation support can foster a collaborative approach and enhance compliance. The PIU and CPIUs will be responsible for organizing and facilitating these training sessions, leveraging their expertise and resources to ensure comprehensive education on EMP requirements.

873. Contractors will submit regular reports on EMP compliance. The PIU and CPIUs will play a key role in coordinating these monitoring activities by conducting site inspections. The civil works contractors will actively participate in monitoring, providing valuable on-ground insights and feedback on construction activities. Further, maintaining detailed records of all activities related to EMP implementation is essential. This includes training records, monitoring reports, and audit findings. Ensuring that all documentation is easily accessible for review by relevant stakeholders promotes transparency and facilitates continuous monitoring and evaluation. With guidance from PMU, the PIU and CPIUs will oversee the documentation process, ensuring that all records are accurately maintained and accessible, and will regularly review these records to assess compliance and performance.

874. **Construction contractor** will be responsible for ground-level implementation of mitigation measures indicated in EMP. Contractor needs to follow environmental, health and safety (EHS) provisions mentioned in the various sections of bid /contract documents. With the support from CPIU, and, the contractor will be required to develop a Beel Specific Environmental, Health and Safety Management Plan (BSEHSMP) and will recruit qualified full-time environment and health safety officer (EHS officer) responsible for environment, health and safety related actions during implementation of the project. The contractor will ensure to implement the ADB-cleared EMP and BSEHSMP during construction stage of the Project. Both will work under supervision of the environment staff focal and other staff, under the PIU and CPIU.

875. The responsibilities of the EHS officers will include the following:

(i) Directly reporting to the Project Manager of the Contractor, and Environmental Specialists of CPIU and PIU on safeguard matters
(ii) Prepare BSEHSMP, fill construction site checklist for implementation and monitoring, prepare traffic management plan (if needed), health and safety plans for workers another relevant plans to manage the risks on environment, health and safety as part of their work program;
(iii) Ensure contractor's compliance with the BSEHSMP stipulations and conditions of relevant government bodies
(iv) Discussing various environmental issues and environmental mitigation, enhancement and monitoring actions with all concerned directly or indirectly

(v) Ensure contractor's compliance with borrow and quarry area operation and management
(vi) Assist contractor/ project manager to ensure environmentally sound and safe construction practices
(vii) Assist contractor in setting of labor camp particularly for compliance of Building and Construction Workers (Regulation of Employment and Conditions of Service) Act, and Rules,1996
(viii) Assist contractor/ project manager to ensure the timely procurement of materials that are included in the Bill of Quantities relating to environmental mitigation and enhancement measures
(ix) Conducting periodic environmental and safety training for contractor's engineers, supervisors and workers
(x) Preparing a register for material sources, labour and public complaints etc.
(xi) Ensure timely environmental monitoring activities.
(xii) Preparation and submitting of reports to CPIU on status of implementation safeguard measures.
(xiii) Perform other functions to support PIU and CPIU on implementing environmental safeguards activities of the subproject.

876. The implementation of health and safety measures is critical in civil works and community subprojects under the matching grant. The PIU and CPIUs will ensure that contractors adhere to health protocols and safe work practices. Contractors must maintain records of health and safety incidents reporting any lost time or fatalities to CPIUs and upwards to PMCU within 24 hours with an incident report. Training sessions on health and safety will be conducted for both workers and community members. Through the health and safety staff, civil works and community contractors' role includes adhering to health and safety guidelines, organizing safety drills, and reporting any health and safety concerns to the CPIUs.

877. PIU will have Environmental Safeguards Specialist (ESS) at the head office while each CPIU will have a cluster level Environmental Safeguards Coordinator (ESC) to be stationed at cluster office to supervise the effective implementation of the EMP and to coordinate the GRM. Safeguard Coordinators and specialist will be appointed on fulltime basis till successful implementation of the subprojects.

878. In addition, PIU and CPIUs will assist in preparing the environmental sections for the Project progress reports. PMU (through CPIU) will have overall leadership, control, monitoring and supervision of project activities including EMP implementation. The PMU will also ensure that bidding and contract documents include specific provisions requiring contractors to comply with EHS, EMP and relevant labour laws. It will also play a key role in ensuring project and matching grant meet environmental standards. The environmental safeguards specialist of shall ensures the project design adheres to relevant environmental regulations and ADB's SPS 2009. The specialist oversees and provide guidance to CPIU in the implementation of safeguard plans, conducting site visits and audits to verify compliance.

879. **Grant Recipients.** The recipient will be responsible to implement the EMP and environmental quality monitoring as needed during the pre-, construction, and operation stages with any responsibilities needing to be cascaded down to their own contractor as above.

880. **ADB's Responsibilities:** ADB is responsible for the following:
(i) review updated IEE including EMP for direct investment components and disclose draft and final reports on ADB's website;
(ii) provide approval for matching grant subprojects based on the review of IEE reports and safeguard categorization;

(iii) undertake environmental safeguard monitoring, including review of EMP and environment and social management system (ESMS) implementation during regular review and monitoring missions;
(iv) provide assistance to the EA; and PMU, PIU, CPIUs on subprojects environmental compliances (if required), carrying out its responsibilities under ADB's SPS, and for building capacity for safeguard compliance;
(v) monitor overall compliance of the project with ADB's SPS, loan covenants, and agreed environmental safeguard measures;
(vi) review and provide comments on environmental monitoring reports (EMRs) submitted by the PMU, ensuring timely feedback;
(vii) disclose environmental monitoring reports on ADB's website;
(viii) provide assistance to the EA, PMU, PIU and CPIUs in ensuring that the GRM is functioning and responsive;
(ix) advise on corrective actions in coordination with the PMU, in case of major non-compliance or unanticipated environmental impacts, including requiring additional assessments or revisions to safeguard documents;
(x) support knowledge sharing and capacity development by offering guidance notes, training opportunities, and technical advice on environmental safeguard issues; and
(xi) If necessary, provide further guidance to the content, and scope of the IEE report and annual and/or semi-annual monitoring reports for submission to ADB.

### 9.8. Environmental Safeguards Reporting Requirements

881. Environmental monitoring, inspection activities and findings shall be documented for purposes of reporting, recording, verifying, referring to and evaluating the environmental performance of the Project. The documentation shall also be used as basis in correcting and enhancing further environmental mitigation and monitoring.

882. CPIUs and PIU will support the PMU in monitoring environmental safeguards compliance through regular site inspections. This involves scheduled and unscheduled visits to subproject sites to ensure that all EMP provisions are being followed by contractor. The visits will be taken by the environment safeguard coordinators of the CPIUs on a weekly basis completing checklists developed by the environment staff and making a photographic record, PIU on a monthly basis with more detailed review again using checklists and keeping a photographic record, with quarterly checks to all active subprojects by PMU. For category B grant-funded subprojects, the PIU shall conduct monthly inspections, while the PMU will undertake quarterly visits for verification and support. The CPIUs will prepare and submit reports to the PMU on a quarterly basis, summarizing monitoring activities, findings, incidents of non-compliance, and relevant environmental safeguards matters. The PIU will prepare and submit reports to the PMU for the grant-funded subprojects reporting on the grants approved and categories as well as summarizing monitoring activities, findings, incidents of non-compliance, and relevant environmental safeguards matters.

883. PMU, with support from environmental safeguards specialist of PIU, will prepare the EMRs based on the inputs received from PIU and CPIUs, and their quarterly site visits, then submit them to ADB on a semi-annual basis to document the progress of the EMP implementation. When all subprojects are in the operation stage, the EMRs will be prepared and submitted to the ADB on an annual basis. The contractual staff will support the PMU, PIU and CPIU to monitor the EMP implementation (pre-, during-, and post-construction) as well as supporting them with IEE compliance.

884. An outline of the EMR is provided in **Annexure A16**. This outline is a template, but additions, such as additional text, tables, charts, and figures, may be made to ensure appropriate documentation of (i) project implementation progress, (ii) compliance with safeguard measures

and their progress, and (iii) necessary corrective actions. Health and safety incident statistics and grievance records will be included, along with evidence of consultations, trainings etc. The semi-annual EMRs will be due for submission to ADB within one month following the end of the EMR period (e.g. on 30 July for Jan-Jun period and 30 January for Jul-Dec period). Until such time that ADB issues the project completion report, EMR submission to ADB will continue. The EMRs will be disclosed locally and on the ADB's websites after review and acceptance by the ADB. Timely submission of the EMRs is a performance indicator that is monitored by ADB.

885. The environmental reporting plan for the Project is at Table 9-5 and the environmental safeguards reporting requirements are defined below.

**Table 9-5.Environmental Safeguards Reporting Plan**

| Reports | From | To | Frequency |
|---|---|---|---|
| **Pre-construction Phase** | | | |
| Project Readiness | ARIAS Society | ADB | 1st Environment Monitoring report |
| **Construction Phase** | | | |
| **Contractor record keeping and reporting**: Safeguard specialist of contractor will fill construction Site Checklist for BEMP implementation maintain records of emissions, spills, accidents and complaints, and provide copies to the CPIU as part their monthly progress report (Site Checklist for EMP implementation given **Annexure A13**) | Contractor | CPIU | Monthly |
| Environmental monitoring as per monitoring plan given in EMP/BEMP and Environmental Monitoring Report Format given in **Annexure A14** | PIU/PMU | ARIAS Society | As per frequency mentioned in EMP |
| Quarterly Environmental Progress and Monitoring reports (Format given **Annexure A15**) | CPIUs | PMU | Quarterly |
| Semi Annual Environment progress and monitoring reports (EMR) (Format given **Annexure A16**) | PMU/ ARIAS Society | ADB | Semi-Annually |
| **Operational Phase** | | | |
| Environment progress and monitoring reports (EMR) (Format given **Annexure A16**) | PMU/ ARIAS Society | ADB | Semi-Annually |
| Project Closure Report | PMU/ ARIAS Society | ADB | Annually until PCR |

## 9.9. Institutional strengthening and training

886. Concerned CPIUs, PIU and PMU staff, contractor's Environmental Health and Safety Supervisors and BDCs representative will require training in the management of environment and social safeguards issues. The training program is to be coordinated and anchored by an environmental safeguards specialist and PMU with support from agencies/individuals experienced in safeguard aspects on conducting training programs. The formal training will cover EHSMP implementation, supervision, and reporting, and the Grievance Redress Mechanism (Table 9-6).

**Table 9-6. Training Program for Safeguards Compliances and Reporting**

| Training/ Workshop | Attendees | Contents | Timeline | Total Days |
|---|---|---|---|---|
| Beel (Wetland) Conservation and Management | - Members of PMU, PIU, CPIUs and BDC<br>- Contractor's Environmental Health and Safety Supervisors/Staff | – Concept of Beel Conservation and Management<br>– Wetland Conservation and Management Rules 2017<br>– Beel Monitoring<br>– Regulatory compliances | – Once- prior to implementation for subproject<br>– Twice during implementation or as per requirement | 1 day for each |
| EMP Implementation and Compliance of National and ADB SPS 2009 requirements | - Members of PMU, PIU, CPIUs and BDC<br>- Contractor's Environmental Health and Safety Supervisors/Staff<br>- | – Training on identifying environmental risks and mitigation measures.<br>– EMP/EHSMP measures,<br>– Roles and responsibilities of Agencies to comply ADB SPS 2009<br>– Community health and safety, and emergency planning | – Once- prior to implementation for subproject<br>– Twice during implementation or as per requirement | 1 day for each |
| EMR- Reporting Procedure | - Contractor's Environmental Health and Safety Supervisors<br>- Concerned Environmental officer and specialist of CPIU | – Env. Monitoring Reporting Requirements<br>– Roles and responsibilities of agencies for EMP implementation, supervision, reporting procedure<br>– data collection methods, monitoring protocols, and reporting requirements | – Once- prior to implementation for subproject<br>– Twice during implementation or as per requirement | 1 day for each |
| Grievance Redress Mechanism | - Contractor's Environmental Health and Safety Supervisors/officers<br>- Concerned Environmental officer and specialist of CPIU/PMU | Grievance Redress Mechanism-Roles and responsibilities, GRM procedures | – Once- prior to implementation for subproject<br>– Twice during implementation or as per requirement | 1 day for each |

## 9.10. Environmental Management Budget

887. This section provides an estimate of the cost of implementing the EMP. Most of the mitigation measures require that the contractors adopt good site practice, which should be part of

their normal procedures already, so there are unlikely to be major costs associated with compliance. There are some of the provisions in bid documents like compliance of the requirements of health and safety during construction works as per applicable labour laws, labour insurance, equipment fitness, provision of labour welfare facilities, healthcare facilities etc. which are unanimously bound to contractor bidding for the Project. Therefore, it is understood that costs for such requirements are bound to contractor and no need to consider as cost of EMP implementation. However, costs for the monitoring and training are also estimates based on the experience in similar projects. Cost of EMP for the specific subproject needs to be estimated based on cost provided in Table 9-7.

**Table 9-7. Cost Estimates to Implementation of EMP**

| Sl. No. | Particulars | Stages | Unit | Total Number | Rate (INR) | Cost (INR) | Costs Covered By |
|---|---|---|---|---|---|---|---|
| A. | **Mitigation Measures** | | | | | | |
| 1. | Obtaining and submission of copies (to CPIU/PMU) all consents, permits, clearances, Consent-to Establish (CTE) and Consent to Operate (CTO), no objection clearances or NOCs, other relevant permits from various authorities before the start of construction | Pre-Construction | - | 102 Beel Sites | - | Its contractor's responsibility and cost covered under contract cost | Civil works contract |
| 2. | Reuse and disposal desilted material or construction wastes/weeds to designated locations. | Construction | - | 102 Beel Sites | - | Its contractor's responsibility and cost covered under contract cost | Civil works contract |
| 3. | Shifting of utilities (if any) including alternate arrangement and provision of signages and traffic management (if needed) | Pre-Construction and Construction | | 102 Beel Sites | - | Part of routine duty of contractor | Civil works contract |
| 4. | Provision of all requisite facilities (i.e. drinking water supply, sanitation, domestic solid waste collection and disposal, fuel supply etc.) at construction camp (if any). Decommissioning of construction camp before handling over the subproject. | Construction | - | 102 Beel Sites | -- | Its contractor's responsibility and cost covered under contract cost | Civil works contract |
| 5. | Water sprinkling for dust suppression, barricading, temporary noise barriers, and provision of personal protective equipment such as boots, ear plugs/ muffs, etc. and First aid boxes and health checkup for labours | Construction | - | 102 Beel Sites | - | Its contractor's responsibility and cost covered under contract cost | Civil works contract |
| 6. | General cleanliness, inspection of sanitation work and Check clogging of drains and visual check of landslides/erosion prone areas and mitigation measures taken | Construction | - | - | - | Part of routine duty of contractor | Civil works contract |
| 7. | Photography and record keeping of construction progress and Reporting | Construction | - | - | - | Part of routine duty of contractor | Civil works contract |
| 8. | Cost of implementation of specific mitigation measures suggested in EMP Table 9-1 | Construction Phase | - | - | - | Its contractor's responsibility and cost covered under contract cost | |
| **Subtotal (A)** | | | | | | **Nil** | |
| **B. Monitoring Measures during Construction Phase** | | | | | | | |

| Sl. No. | Particulars | Stages | Unit | Total Number | Rate (INR) | Cost (INR) | Costs Covered By |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 1. | Air quality monitoring (refer Table 9-2) | Pre-Construction and Construction | Per sample | 306 | 10,000 | 30,60,000 | The cost of monitoring has already been budgeted under Project Output-1 as part of Beel Health Monitoring. |
| 2. | Noise levels monitoring (refer Table 9-2) | Pre-Construction and Construction | Per sample | 306 | 2,000 | 6,12,000 | |
| 3. | Surface water monitoring (refer Table 9-2) | Pre-Construction and Construction | Per sample | 306 | 8000 | 24,48,000 | |
| 4. | Sediment/Soil monitoring (refer Table 9-2) | Pre-Construction and Construction | Per sample | 306 | 4000 | 12,24,000 | |
| 5. | Aquatic Biodiversity (refer Table 9-2) | Pre-Construction and Construction | Per sample | 204 | 10000 | 20,40,000 | |
| 6. | Wildlife Survey to confirm IUCN threatened species if any (refer Table 9-2) | Pre-construction | LS | To be carried out of each subproject beel | | 53,16,000 | |
| **Subtotal (B)** | | | | | | **1,47,00,000** | |
| **EMP implementation and Monitoring Measures during Construction Phase (A+B)** | | | | | | | |
| **C. EMP implementation and Monitoring Measures during Operational Phase** | | | | | | | |
| **1** | Cost of implementation of Mitigation measures suggested for the operational phase mentioned in EMP Table 9-1 and Cost of implementation of Monitoring suggested for Operational Phase (Table 9-3) | Operational Phase | Per Beel | **102** | **-** | Financial support for Beel management activities has already been provided to the BDC under the project cost. The BDC is responsible for O&M activities under the supervision of the CPIU/DoF | |
| **D. Capacity Building on Environmental Safeguard matters** | | | | | | | |
| 1 | Training Program for Safeguards Compliances and Reporting (refer Table 9-6) | Pre-construction and Construction | - | - | - | The training program will be conducted by subject matter experts from the contractual staff, Wetlands International, or other relevant service providers engaged under the project. The | |

| Sl. No. | Particulars | Stages | Unit | Total Number | Rate (INR) | Cost (INR) | Costs Covered By |
|---|---|---|---|---|---|---|---|
| | | | | | | training and capacity development program, along with its associated costs, have already been accounted for under Component-1.<br><br>The PMU shall ensure that the Terms of Reference (ToR) for safeguards training, as outlined in Table 9.6, are integrated into the overall ToR, Wetlands International, or other relevant service providers. | |
| **Grand Total of EMP Implementation for SWIFT Total (A+B+C+D)** | | | | | | **1,47,00,000*** | |
| ***All of EMP items are already budgeted under the Project Cost.** | | | | | | | |

888. Contractors will bear the costs of all mitigation measures and monitoring during construction, which shall be budgeted in the bids. Project proponent will bear the costs related to setting up and running the GRM and mitigation measures during operation.

### 9.11. Mechanism for feedback and adjustment

889. Based on environmental monitoring and reporting systems in place, the PIU/PMU shall assess whether further mitigation measures are required as corrective action, or improvement in environmental management practices are required. The effectiveness of mitigation measures and monitoring and inspection plans will be evaluated by a feedback reporting system. If the DoF identifies a substantial deviation from the EMP, or if any changes are made to the Project scope that may cause significant adverse environmental impacts or increase the number of affected people, then the PIU/PMU shall immediately consult ADB to identify EMP adjustment requirements.

# 10. CONCLUSIONS AND RECOMMENDATIONS

890. The Department of Fisheries, Govt. of Assam has planned to cover 102 beels (wetlands) across 32 districts as part of the SWIFT (Sustainable Wetland and Fisheries Transformation) project. This initiative aimed to enhance the sustainable management and utilization of these wetlands for fisheries, benefiting local communities and promoting biodiversity conservation. It is designed to bring positive changes to both people and the local environment. However, interventions may have unintended impacts that can affect people and the environment if not properly managed.

891. For phase 1, Total 74 beels were selected for project processing and due-diligence, and with similar interventions, such as desilting, de-weeding, construction of earthen mounds, cleaning of inlets, embankment construction, installation of Hume pipes, composting, and the development of fish-rearing ponds. Given the uniformity of these interventions, the impact assessment was conducted based on a detailed evaluation of 15 priority beels located in 8 districts across all 5 clusters. The assessment focused on the specific impacts of these interventions, which were then extrapolated to estimate the potential impacts on the remaining beels that had not yet been identified at the time of project approval.

892. Environment assessment resulted that the proposed subprojects are not likely to have any severe negative impact on the environment and people of the subproject area. The type and extent of activities anticipated for implementation would be well within the principles of wetland conservation and promote sustainable fishery practices. Project aims to deliver positive environmental impacts by enhancing floodplain wetlands or beels conservation and promoting sustainable fishery production and marketing. Key activities include removal of unwanted aquatic weeds, restoring beel connectivity to rivers, protection against siltation, installation of silt traps to reduce turbidity, conserving habitats and indigenous fish species, and monitoring beel health. These measures are expected to benefit both the environment and local communities. However, some civil works and fisheries activities such as the establishment of hatcheries, rearing tanks, fish landing sites, and pen culture may cause temporary and localized environmental impacts. Potential impacts include release of nutrient-rich water from fish-rearing ponds and hatcheries, waste discharge from worker camps, and temporary degradation of water quality from desilting and de-weeding activities. For the rehabilitation of beels, use of vehicles for desilting and transporting materials may result in minor noise and air pollution, primarily from dust and particulate matter. Construction activities also pose occupational health and safety risks. The operations stage will focus on preserving the ecological health of the beels by implementing sustainable management practices, monitoring water quality, and ensuring the conservation of aquatic habitats.

893. Most of environmental impact and risks are predicted to be of minor to moderate, short-term, and localized that will be avoided (adhering with national and/or international design standards and construction planning), minimized to acceptable levels or mitigated through implementation of appropriate measures during the design, construction, and operation phase of the project. Further, the environmental monitoring plan will also provide adequate opportunity for course correction to address any residual impacts during construction or operation stages.

894. In accordance with ADB's Safeguard Policy Statement (2009), an initial environmental examination (IEE) including an environment management plan (EMP) is prepared to cover all

project components. The specific management measures laid down in the IEE will successfully address any adverse environmental impacts due to the proposed subprojects. Implementation of appropriate measures during the design, construction, and operation phases will minimize negative impacts to acceptable levels. To ensure that these mitigation measures are implemented and negative impacts avoided, the measures will be included in the contract specification. Contractors' conformity with contract procedures and specifications and implementation of the approved EMP during construction will be carefully monitored. Further, the environmental monitoring plans are also providing adequate opportunities towards course correction to address any residual impacts during construction or operation stages.

895. With implementation of proposed mitigation measures, most of the impacts will be minimized, and no residual and cumulative impact is expected. On the other hand, the project will rejuvenate degraded beels and protect crucial habitats of native fish species, ensuring the long-term health of the ecosystem. By fostering ecological balance and providing better habitats, the project will also contribute to increased fish stocks and enhance livelihood opportunities and income generation.

896. Contractual staff, additional manpower and financial resources are also suggested at PMU, PIU and CPIUs level to strengthen technical capacity and support in subprojects design engineering, supervision, monitoring, review and reporting of environment due diligence and safeguard compliance.

897. Based on the findings of the IEE, the project is appropriately classified as Category B in accordance with the ADB SPS (2009). Accordingly, this IEE fulfills ADB's environmental safeguard requirements for the proposed subprojects, and no further environmental assessment is required at this stage. However, Bera Na Beel, located within the Dibru-Saikhowa Complex KBA, requires additional biodiversity due diligence. Detailed biodiversity surveys, habitat assessments, and environmental due diligence shall be undertaken prior to commencement of any physical works. The IEE shall be updated and disclosed, where necessary, based on the findings of these studies, and no physical works at Bera Na Beel shall commence until the required biodiversity due diligence has been completed and all applicable safeguard requirements under the ADB SPS (2009) have been adequately addressed.

897. This IEE and EMP have been prepared based on the current subproject designs, site conditions, and available baseline information. During project implementation, the SWIFT PMU shall update the IEE, as necessary, to reflect changes in project design, scope, or location; incorporate findings from additional field investigations, biodiversity assessments, and stakeholder consultations; and address any unanticipated environmental impacts. The updated IEE shall be submitted to ADB for review and clearance, where applicable, prior to commencement of the relevant construction activities. Throughout project implementation, the environmental safeguard requirements of the ADB SPS (2009) and all applicable national and state environmental regulations shall be fully complied with.

# Annexures

## Annexure A1: Environment Risk Analysis

The matrix on probability and consequence is one the most commonly used qualitative environment risk analysis. It is based on the two components of environmental risk, particularly (i) probability of occurrence and (ii) consequence or level of magnitude, if it occurs. To perform this analysis, a matrix is used to show two-dimensional grid that rates environmental risks' occurrence and their magnitude. For the proposed subprojects, environmental risk analysis was carried out after review of documents, site visits and interaction with stakeholders. Location, extent and scope of pre-construction, construction and post-construction activities were also taken into consideration in this environmental risk analysis to define the environmental risks.

Environmental risk analysis entails the computation of both the likelihood (levels of probability) and consequence (levels of magnitude) of potential undesirable outcomes. In order to account for probability and consequence, relative values are necessarily involved for both. The following paragraphs show the values set for probability and consequence.

Probability or likelihood is the possibility of a risk event to occur. The probability or likelihood can be expressed in qualitative manner in terms of likely, unlikely and rare. See table below:

**Likelihood or level of probability**

| Likelihood | Definition | Rating |
|---|---|---|
| Likely | Potential to occur more than twice during construction and/or operations | 3 |
| Unlikely | May occur once or twice during construction and/or operations | 2 |
| Rare | Highly unlikely to occur during construction and/or operations | 1 |

Consequence is the magnitude of the impact. It considers the severity of environmental risks. The table below show the definition and values for "Consequence".

**Consequence or level of magnitude**

| Consequences | Definition | Rating |
|---|---|---|
| Major | Significant damage or impact on the natural environment or communities. | 3 |
| Moderate | Limited adverse impact on natural environment or communities | 2 |
| Minor | No or minimal adverse impact on natural environment or communities. | 1 |

A shown above, ratings have been assigned for different levels of likelihood and consequence to determine the level of environmental risks. When all environmental risks are assigned with likelihood and consequence ratings, then the risk formula is to be applied to conclude the results. Environmental risk is a function magnitude of potential consequences (i.e., levels of magnitudes) and likelihood of these consequences to occur (i.e., levels of probability of occurrence). To quantify the environmental risks, the formula is:

**Risk = Likelihood x Consequence**

Following is the matrix used for the subproject to score and categorize the environment risks of the proposed subproject activities.

**Environment Risk Scoring Matrix**

| **Likelihood (A)** | **Impacts/Consequences (B)** | | |
|---|---|---|---|
| | Minor (1) | Moderate (2) | Major (3) |
| Likely (3) | 3 | 6 | 9 |
| Unlikely (2) | 2 | 4 | 6 |
| Rare (1) | 1 | 2 | 3 |
| Risk Scoring (A x B) | | | |
| High | Score 9 | | |
| Moderate | Score 3-6 | | |
| Low | Score 1-2 | | |

Definition of environmental risk level pertains to high, medium and moderate has been presented below:

**Definition of Environmental Risk level**

| | |
|---|---|
| **High**<br>**Score 9** | - Large number of receptors affected<br>- Significant adverse environmental impacts that are irreversible, diverse, or unprecedented<br>- Community and ecosystem receptors highly sensitive<br>- Substantial deterioration, nuisance or harm to receptors expected<br>- Relevant thresholds often exceeded<br>- Significant public concern expressed during stakeholder consultation |
| **Medium**<br>**Score 3-6** | - Some receptors affected<br>- Site specific potential impact but can be mitigated<br>- Receptors slightly sensitive and/or of moderate conservation importance<br>- Measurable deterioration nuisance or harm to receptors<br>- Relevant thresholds occasionally exceeded |
| **Low**<br>**Score 1-2** | - No or limited receptors within the zone of impact<br>- Receptors not sensitive to change<br>- Minor deterioration, nuisance or harm to receptors and can be mitigated easily by adopting best management practices<br>- Change not measurable or relevant thresholds never exceeded |

Based on the above criteria, the level of risk and their respective rating has been estimated. The level of risk on ambient air, water, soil, noise, land is anticipated as low to moderate level and specific and confined during construction stage. Based on the above criteria, following table shows subproject impacts and environmental risk categorization.

**Subproject Impacts and Environmental Risk Categorization**

| S. No | Potential Environmental Impacts | Likelihood | Consequence | Risk |
|---|---|---|---|---|
| **1. Land and Soil Environment** | | | | |
| Construction Phase | | | | |
| 1.1 | Site or land clearing | 3 | 1 | 3 |
| 1.2 | Impact of Excavation and Desilting | 3 | 2 | 6 |
| 1.3 | Impact due to handling of construction materials and machineries at site | 3 | 1 | 3 |
| 1.4 | Impact due to waste generation | 3 | 2 | 6 |
| 1.5 | Soil erosion, compaction and contamination | 3 | 2 | 6 |
| 1.6 | Change in topography and borrowing of Earth | 3 | 2 | 6 |
| 1.7 | Change in land uses | 3 | 1 | 3 |
| Operational Phase | | | | |
| 1.8 | Impact due to solid waste generation | 3 | 1 | 3 |
| 1.9 | Soil contamination | 3 | 1 | 3 |
| 1.10 | Bund erosion during flooding | 3 | 2 | 6 |
| **2. Water Environment** | | | | |
| Construction Phase | | | | |
| 2.1 | Decline of water quality due to on-site activities | 3 | 2 | 6 |
| 2.2 | Alteration of Water Flow | 3 | 2 | 6 |
| Operation Phase | | | | |
| 2.4 | Siltation, Alteration of Water Volume and Hydrology | 3 | 2 | 6 |
| 2.5 | Degradation of Water quality | 3 | 2 | 6 |
| **3. Air Environment and Noise** | | | | |
| Construction Phase | | | | |
| 3.1 | Air quality decline | 3 | 1 | 3 |
| 3.2 | Noise level increase | 3 | 1 | 3 |
| Operational Phase | | | | |
| 3.3 | Unpleasant odour | 3 | 1 | 3 |
| 3.4 | Emission of air pollutants and Noise from Diesel Generators | 3 | 1 | 3 |
| **4. Biological Environment** | | | | |
| Construction Phase | | | | |
| 4.1 | Terrestrial and Aquatic Habitat Disruption | 3 | 2 | 6 |
| 4.2 | Displacement of fish species | 2 | 1 | 2 |
| **5. Socio-economic and Cultural Issues** | | | | |
| Construction Phase | | | | |
| 5.1 | Labor influx, conflict of cultural and regional bias | 1 | 1 | 1 |
| 5.2 | Occupational health and safety risk to construction personnel | 3 | 2 | 6 |
| 5.3 | Chance find of items/materials of cultural and/or archeological importance | 1 | 1 | 1 |
| Operational Phase | | | | |
| 5.4 | Lack of maintenance of Beel, unequal distribution of share/profits and waterborne disease | 3 | 2 | 6 |

## Annexure A2: IBAT Assessment Report

IBAT assessment was performed to access critical information about biodiversity data and carryout biodiversity risk screening. Strategically, one subproject location (Tatinga Mekheli Barbeel) which is also capturing entire Majuli island within a 50 km radius was selected for IBAT assessment (Figure1). The likely presence of Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) species (if any), occurrence of restricted range and migratory species were evaluated in an approximate range of 50 km (radius) from the selected subproject location. Distance from protected areas and key biodiversity areas (KBA) were also determined.

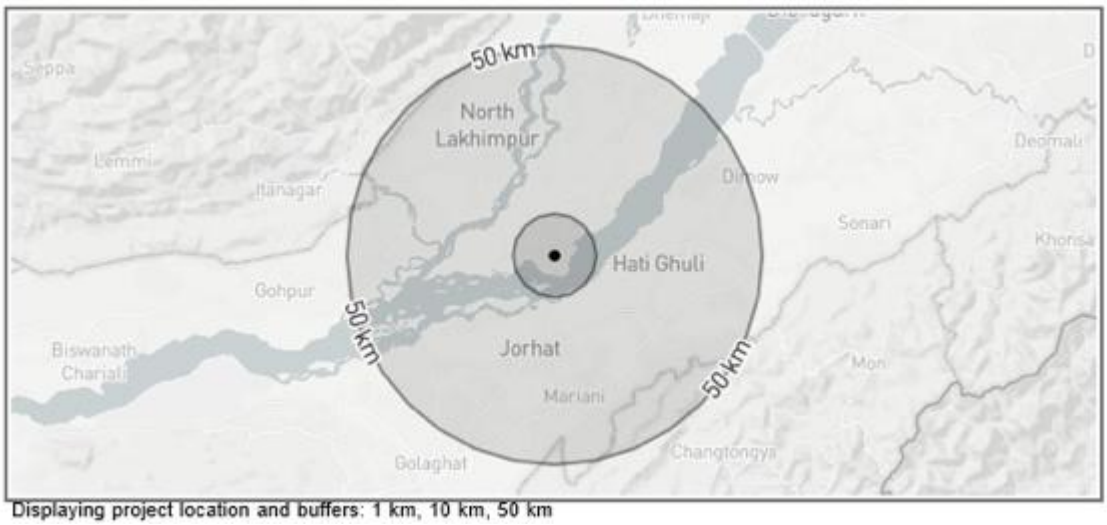



**Figure 1: 50-km radius from Tatinga Mekheli Barbeel**

As per the information made available from IBAT[108], 46 IUCN red listed CR/EN species found within 50-km radius of the subproject location. This includes 17 CR and 29 EN as listed in Table 1. In addition to this 9 KBA viz. Majuli (located within 1 Km), Jhanjimukh – Kokilamukh (within 10 km), Bordoibam-Bilmukh Bird Sanctuary, Bordoloni – Sampora, Gibbon (Hollongapar) Sanctuary, Kuarbari Dalani, Pabho Reserve Forest, Pani-Dihing Bird Sanctuary and Sibsagar Tanks are situated within 50 km radius from the subproject location.

Based on the biodiversity data collected by primary survey, INaturalist and IBAT assessment, critical habitat assessment is caried out. The area of analysis (AoA) for assessing critical habitat is assigned for the beel (i.e. submergence area and 0.5 km from boundary of beel). Although impacts will be restricted within the beel location.

[108] IBAT PS6 & ESS6 Report. Generated under licence 6436-45871 from the Integrated Biodiversity Assessment Tool on 6 july 2023 (GMT). www.ibat-alliance.org

**Table 1: Summary of IUCN Red List Species (CR/EN) in 50 Km radius**

| Species Name | Common Name | Taxonomic Group | IUCN Category | Population Trend | Biome |
|---|---|---|---|---|---|
| Nilssonia nigricans | Black Softshell Turtle | REPTILIA | CR | Decreasing | Terrestrial, Freshwater |
| Gavialis gangeticus | Gharial | REPTILIA | CR | Increasing | Terrestrial, Freshwater |
| Pangshura sylhetensis | Assam Roofed Turtle | REPTILIA | CR | Decreasing | Terrestrial, Freshwater |
| Asarcornis scutulata | White- winged Duck | AVES | CR | Decreasing | Terrestrial, Freshwater |
| Aythya baeri | Baer's Pochard | AVES | CR | Decreasing | Freshwater |
| Ardea insignis | White-bellied Heron | AVES | CR | Decreasing | Terrestrial, Freshwater |
| Emberiza aureola | Yellow-breasted Bunting | AVES | CR | Decreasing | Terrestrial, Freshwater |
| Cuora amboinensis | Southeast Asian Box Turtle | REPTILIA | EN | Decreasing | Terrestrial, Freshwater |
| Geoclemys hamiltonii | Spotted Pond Turtle | REPTILIA | EN | Decreasing | Terrestrial, Freshwater |
| Hardella thurjii | Crowned River Turtle | REPTILIA | EN | Decreasing | Terrestrial, Freshwater |
| Morenia petersi | Indian Eyed Turtle | REPTILIA | EN | Decreasing | Terrestrial, Freshwater |
| Nilssonia gangetica | Indian Softshell Turtle | REPTILIA | EN | Decreasing | Terrestrial, Freshwater |
| Nilssonia hurum | Indian Peacock Softshell Turtle | REPTILIA | EN | Decreasing | Terrestrial, Freshwater |
| Platanista gangetica | Ganges River Dolphin | MAMMALIA | EN | Decreasing | Freshwater |
| Axis porcinus | Hog Deer | MAMMALIA | EN | Decreasing | Terrestrial, Freshwater |

| | | | | | |
|---|---|---|---|---|---|
| Cuora mouhotii | Keeled Box Turtle | REPTILIA | EN | Decreasing | Terrestrial, Freshwater |
| Amblyceps arunchalensis | | ACTINOPTERYGII | EN | Unknown | Freshwater |
| Rynchops albicollis | Indian Skimmer | AVES | EN | Decreasing | Terrestrial, Freshwater |
| Sterna acuticauda | Black-bellied Tern | AVES | EN | Decreasing | Terrestrial, Freshwater |
| Haliaeetus leucoryphus | Pallas's Fish-eagle | AVES | EN | Decreasing | Terrestrial, Freshwater |

| Species Name | Common Name | Taxonomic Group | IUCN Category | Population Trend | Biome |
|---|---|---|---|---|---|
| Laticilla cinerascens | Swamp Grass-babbler | AVES | EN | Decreasing | Terrestrial, Freshwater |
| Tor putitora | | ACTINOPTERYGII | EN | Decreasing | Freshwater |
| Manis pentadactyla | Chinese Pangolin | MAMMALIA | CR | Decreasing | Terrestrial |
| Manouria emys | Asian Giant Tortoise | REPTILIA | CR | Decreasing | Terrestrial |
| Magnolia gustavii | Champi Doi | MAGNOLIOPSIDA | CR | Decreasing | Terrestrial |
| Perdicula manipurensis | Manipur Bush-quail | AVES | CR | Unknown | Terrestrial |
| Houbaropsis bengalensis | Bengal Florican | AVES | CR | Decreasing | Terrestrial |
| Gyps bengalensis | White- rumped Vulture | AVES | CR | Decreasing | Terrestrial |
| Sarcogyps calvus | Red-headed Vulture | AVES | CR | Decreasing | Terrestrial |
| Gyps tenuirostris | Slender- billed Vulture | AVES | CR | Decreasing | Terrestrial |
| Nardostachys jatamansi | Indian Nard | MAGNOLIOPSIDA | CR | Decreasing | Terrestrial |

| | | | | | |
|---|---|---|---|---|---|
| Cinnamomum champokianum | Pati-hunda | MAGNOLIOPSIDA | CR | Unknown | Terrestrial |
| Cuon alpinus | Dhole | MAMMALIA | EN | Decreasing | Terrestrial |
| Elephas maximus | Asian | MAMMALIA | EN | Decreasing | Terrestrial |

| Species Name | Common Name | Taxonomic Group | IUCN Category | Population Trend | Biome |
|---|---|---|---|---|---|
| | Elephant | | | | |
| Manouria impressa | Impressed Tortoise | REPTILIA | EN | Decreasing | Terrestrial |
| Melanochelys tricarinata | Tricarinate Hill Turtle | REPTILIA | EN | Decreasing | Terrestrial |
| Panthera tigris | Tiger | MAMMALIA | EN | Decreasing | Terrestrial |
| Sloanea tomentosa | XIn Ye Hou Huan Xi | MAGNOLIOPSIDA | EN | Decreasing | Terrestrial |
| Nycticebus bengalensis | Bengal Slow Loris | MAMMALIA | EN | Decreasing | Terrestrial |
| Trachypithecus pileatus ssp. brahma | Capped Langur | MAMMALIA | EN | Decreasing | Terrestrial |
| Hoolock hoolock | Western Hoolock Gibbon | MAMMALIA | EN | Decreasing | Terrestrial |
| Magnolia pealiana | | MAGNOLIOPSIDA | EN | Decreasing | Terrestrial |
| Trillium tschonoskii | Keun-yeon-yeong-cho | LILIOPSIDA | EN | Decreasing | Terrestrial |
| Aquila nipalensis | Steppe Eagle | AVES | EN | Decreasing | Terrestrial |
| Ploceus megarhynchus | Finn's Weaver | AVES | EN | Decreasing | Terrestrial |
| Trachypithecus pileatus ssp. pileatus | Blond-bellied Langur | MAMMALIA | EN | Decreasing | Terrestrial |

## Annexure A3: Guidelines/procedure to ensure environmentally best practice for Desilting Operation, Reuse and Disposal of desilted material

Assam's beels, critical for the state's freshwater ecosystem, are under threat from siltation. Accumulating sediment, muck, and dead organic matter degrade their ecological health. This rising sedimentation not only reduces the beels' ability to retain water but also increases nutrient loads, fostering excessive weed and macrophyte growth. Siltation shrinks the beels' littoral zones (shallow water areas) over time. Furthermore, increased nutrients fuel weed growth, which decomposes and accumulates on the bottom, further reducing water depth, diminishes water quality and harming the entire ecosystem. Therefore, removing silt and sediment through strategic desilting efforts is essential to restore these vital wetlands.

**Rational of Desilting Proposed under SWIFT**

This section outlines the compelling reasons for desilting beels as part of the SWIFT project:

I- Ecosystem Degradation: Siltation reduces water depth in beels, impacting aquatic life. Sunlight penetration is hampered, affecting plant growth and the production of oxygen. This disrupts the food chain, leading to fish kills and a decline in biodiversity.

II- Loss of Wetland Functions: Beels play a crucial role in floodwater control, acting as natural sponges. Siltation reduces their storage capacity, increasing the risk of floods and impacting downstream communities.

III- Loss of Habitat and economic value: Assam beels are home to a diverse range of flora and fauna, including many endemic species. Siltation destroys breeding grounds of many fish species and critical habitats, threatening the survival of these species. It also reduces the fish production and revenue.

**Strategic De-silting Approach**

By strategically targeting these priority areas, desilting efforts under the SWIFT project can maximize the ecological, hydrological, and socio-economic benefits. Based on data collected during the survey and information received from various stakeholders, it indicates that over 40-60% original depth of the beels have been lost due to siltation. Since de-silting can be a costly undertaking, therefore, a strategic approach is essential to maximize its impact and reduce cost. Following are the consideration adopted to decide priority area for desilting:

- **Area Near Inlet and Outlet Channels:** Desilting near inlet and outlet channels is crucial for maintaining proper water flow and hydrological gradient in the beel. This ensures a healthy exchange of water, preventing stagnation and promoting oxygen levels.
- **Shallow Littoral Zones:** These areas are crucial for nutrient cycling, plant growth, and fish breeding. Prioritizing desilting in these shallow regions can have a significant ecological impact.
- **Areas with Highest Sedimentation Rates:** Based on ground verification and survey, area was identified within the beel that experience the most rapid siltation. Focusing desilting efforts in these zones could help mitigate future problems and extend the effectiveness of the project.

**Areas Prone to Flooding:** Consider desilting in areas where overflowing beels pose a significant flood risk to nearby infrastructure. This can help mitigate flood damage and protect communities

**Proposed Method**

Desilting methods depend on factors like water depth and availability. Considering the typical characteristics of beels, including their shallow depth and exposed areas during dry seasons, a dry excavation approach is recommended for this project. This method is simple and efficient for removing silt and sediment. However, wet excavation might be necessary in specific locations. This could be required to maintain the natural slope of the beel bed and to remove deeper pockets of accumulated muck. For wet excavation in these targeted areas, the project proposes using long-arm excavators or potentially diverting water to other sections of the beel during the process.

**Line of Actions**

1. Pre-Work Bathymetry Survey on 5-10 meters grid in beel area/or area identify by DoF and taking approval client on silt quantity and material to be excavated
2. Desilting/excavation is to be done in the lean season preferably in the summer months for efficient and timely completion of desilting.
3. De-silting and wet excavation work to maintain the desired water depths in shallow and deeper zone of Beels
4. If needed, all the collected wet de-silted matter will be temporary stored at shore in identified temporary dumping yard (TDY) for de-watering which allow water content/supernatant to flow back in to the beel
5. Primarily, Desilted material will be used to re-strengthening the existing bund, maintain slope and edges of the bund and to develop island.
6. If additional excavated silt needs to be transported at permanent dumping yard or any low-lying area for surface application, it will be transported though a lined and covered truck/dumper/other transportation vehicle for complete and safe disposal or to transport it to a place for its utilization as decided by engineer in-charge/Client.

**Precautions**

1. Slope gradient finalized after Pre excavation Bathymetry survey is to be maintained for the hydrological function of the beel and avoid haphazard ponding of water
2. Channelized water flow and slope gradient would be maintained.
3. In case silt is wet or charged with water need to be stored in TDY for dewatering
4. The loose silt may not be left longer at the shore or within fringe area of the lake
5. Important: **Zone of fracture (hydro-geological) shall not be disturbed** (to avoid leakage and spillage) due to De-silting operation. Therefore, Contractor by taking client in loop will consult, concerned Govt. Geological Department/University Geology Dept./Geologist to inquire about hydrological zone of fracture in Beels area prior to de-silting/wet excavation.

**Area to be avoided during desilting**

- **Spawning and Nesting Grounds:** Beels serve as breeding grounds for fish, amphibians, and reptiles. Identify and avoid disturbing these areas during the breeding season (which can vary depending on species). Look for signs like submerged vegetation beds or known historical spawning areas.

- **Submerged Macrophyte Beds:** These underwater plant communities are vital for oxygen production, nutrient cycling, and providing habitat for fish and invertebrates. Minimize disruption to these areas as they are crucial for a healthy ecosystem.

- **Bird Nesting Sites:** Many bird species utilize beels for nesting, particularly on emergent vegetation or small islands. Avoid de-silting activities near these areas, especially during nesting seasons. Surveys can help identify critical nesting locations.

**Proposed Utilization of De-silted/Excavated material**

After suitable engineering tests of excavated material, following could be possible options for the utilization of de-silted/excavated materials:

| Proposed Utilization of De-silted/Excavated material | Remarks |
|---|---|
| Strengthening of Bund | Excavated material can be used to strengthening of existing bund and to maintain it's slope and edges. |
| Island/Mound Development within the Lake | There is one small island located within the lake thus possibility of strengthen and increase the size of existing bund to utilize excavated/desilted material. |
| Filling or levelling of Low-Lying areas | After dewatering and drying, Desilted and excavated material could be used in Filling or leveling of low-lying areas. With the support of contractor and community, client will identify low lying areas available nearby so lead and lift cost could be minimized. |
| Agricultural/Horticultural Activities | Upper layer or loose sediment/silt is always nutrient rich in nature. Therefore, after proper chemical characterization, it may be used in Agricultural/Horticultural activities. |
| Compaction of Roads and Building base | After suitable texture analysis, de-silted material may be used for compaction of Roads and Building base |

- De-silted/Excavated material could be made available at free of cost for uses if any. However, lead and lift cost would be borne by the recipient.
- Contractor will prepare final disposal plan and utilization of excavated silt in consultation with PMU.

**Measures to mitigate the potential impacts of de-silting:**

The following measures will be adopted to mitigate the potential impacts from excavation and de-silting and when reusing the silt and sediments.

- Desilting will be carried out using suitable equipment's only, depending upon the terrain of the area to be desilted.

- Use techniques (e.g., silt curtains[109]), to minimise adverse impacts on aquatic life from the re-suspension of sediments
- Contractor in consultation with CPIU shall finalize the slope gradient to be maintained for the hydrological function of the beel and avoid haphazard ponding of water (after carrying out pre-excavation bathymetry survey).
- Channelized water flow and slope gradient would be maintained.
- In case silt is wet or charged with water need to be stored in TDY for dewatering
- The loose silt may not be left longer at the shore or within fringe area of the lake
- Zone of fracture (hydro-geological) shall not be disturbed (to avoid leakage and spillage) due to De-silting operation. Therefore, Contractor by taking client in loop will consult, concerned Govt. Geological Department/University Geology Dept./Geologist to inquire about hydrological zone of fracture in Beels area prior to de-silting/wet excavation.
- Contractor shall avoid areas of spawning and nesting grounds**, s**ubmerged macrophyte beds and bird nesting sites (if any) during desilting operation.
- Place silt in designated areas to avoid altering natural drainage patterns and prevent erosion.
- Store excavated silt temporarily in a contained area to prevent it from being washed away during rain events.
- The contractor and CPIU shall ensure the reuse of excavated material, such as silt or sediments. This material can be used for strengthening or constructing bunds, developing mounds, filling or leveling low-lying areas (away from flood-prone zones), and for agricultural or horticultural purposes. The reuse of excavated material must be carefully planned and investigated to prevent negative impacts, such as bund erosion or the re-entry of excavated silt into the beels.
- Excess soil shall be handled, transported, and disposed properly; before loading it shall be ensured that it is dried so no water spills during transport, and material also should be covered during transport to avoid spillage and dust.
- Design earthen mounds in larger beels to provide safe habitats for birds, ensuring they are stable and do not erode easily.

[109] Silt Curtains are constructed to meet different waterway conditions with the objective to provide a settling time and allow the dispersed silt or sediment time to fall to the bottom. The purpose of a Silt Curtain is to control the migration of suspended silt and sediment and facilitate localised settling.

## Annexure A4: Guidelines/procedure to ensure environmentally sound good practice for De-weeding operation and disposal/reuse of weeds

Beels is the freshwater wetland ecosystems found in the floodplains of Assam and vital for maintaining ecological balance and supporting local livelihoods. However, excessive growth of invasive macrophytes, particularly water hyacinth, is a major concern and critical challenge for these beels. These invasive macrophytes plants (weeds), while appearing innocuous, disrupt the delicate balance of the beel, ultimately leading to a decline in fish production. Therefore, understanding the mechanisms of this threat and implementing effective control measures is vital for preserving these vital ecosystems and the communities that depend on them. To ensure ecological sustainability, this guideline outlines best practices for weed management and reuse/disposal of de-weeded biomass in Assam's beels under the SWIFT project.

1. **Assessment and Planning:**

Before de-weeding operation, conduct a preliminary survey to identify weed species (e.g., water hyacinth) and their density in the beel. Schedule de-weeding in accordance with seasonal growth patterns, targeting peak growth times to maximize effectiveness. Avoid weed removal during breeding seasons of aquatic and bird species to minimize habitat disturbance.

It's also important to remember that macrophytes are a natural part of the beel ecosystem. Therefore, during weed removal (de-weeding), project should aim to leave 10-20% of the existing macrophytes to maintain a healthy balance in the beel ecosystem. However, a consensus emerged among invited experts (for Workshop "Sustainable development and management of floodplain wetlands (Beels) of Assam" held on 19th June 2024 at Guwahati, Assam Under SWIFT Project) on complete removal of invasive water hyacinth. However, other native macrophytes will be left undisturbed, with a target coverage of 10-20% of the total beel area as suggested MoEFCC framework. This balance is crucial to provide habitat for birds. Additionally, submerged macrophytes remain essential for fish and other aquatic life. Cleared water hyacinth can be utilized for composting and handicraft production.

2. **Selection of De-weeding Methods**

- Both manual and mechanical methods have their place in macrophytes control and weed removal. However, considering both advantages and limitations of each method, implementing an integrated and adaptable strategy combined with both manual and mechanical methods could be best solution under the SWIFT project.
- Manual removal could play a role in comparatively smaller beels (up to the size 10-15 Ha) while for larger areas (size >15 Ha), combination of both manual and mechanical methods could be a more efficient solution.

Advantage and disadvantage of both manual and mechanical weed removal methods are summarized below:

| **Manual Method** | |
|---|---|
| **Advantages:**<br>• **Targeted Removal:** Manual methods allow for selective removal of specific weed species, minimizing damage to native plants. | **Disadvantages:**<br>• **Labor Intensive:** Manual removal can be time-consuming and labour-intensive, especially for large areas.<br>• **Potential for Disruption:** Both manual and mechanical methods can disturb the bottom |

| | |
|---|---|
| • **Suitable for Smaller Areas:** Manual removal is efficient for controlling weeds in small, localized areas.<br>• **Low-Tech Approach:** These methods often require minimal equipment and are readily available to local communities. | sediment, potentially releasing nutrients that can further promote weed growth.<br>• **Inefficient for larger beels** |
| **Mechanical Method by using Weed Harvester** | |
| **Advantages**<br>• **Scalability:** Mechanical harvesters can efficiently clear large areas of weeds in a shorter timeframe compared to manual labor. This is particularly beneficial for tackling extensive weed infestations that manual methods might struggle with.<br>• **Reduced Labor Costs:** While requiring skilled operators, mechanical methods significantly reduce the manpower needed for weed removal, leading to cost savings in the long run.<br>• **Selective Removal:** Modern harvesters can be equipped with specialized attachments for targeted weed removal, minimizing damage to native plants. This selective approach is crucial for maintaining a healthy ecosystem within the beel.<br>• **Composting potential:**<br>Harvested weeds can be composted and reused as fertilizer, transforming them from a nuisance into a beneficial resource. | **Limitations:**<br>• **High Initial Investment:** Purchasing and maintaining mechanical harvesters requires a significant upfront investment, which might be a hurdle for smaller beel management authorities.<br>• **Sediment Disruption:** The mechanical harvesting process may disturb the bottom sediment of the beel, potentially releasing nutrients trapped within. Mitigation strategies like adjusted harvesting techniques or sediment management plans are necessary.<br>• **Limited Access:** Depending on the design of the harvester, navigating shallow areas or areas with dense weed growth can be challenging. This might necessitate combining mechanical methods with manual removal in specific locations |

3. **Selection of Appropriate Mechanical Weed Harvesters:**

Selecting an appropriate weed harvester is crucial to ensure efficient, environmentally sensitive removal of weeds from Assam's beels. The following recommendations for machinery that can effectively handle floating and emergent weeds in both shallow and deeper zones. Site conditions may warrant adjustments, and final decisions should be taken by the Department of Fisheries (DoF) based on features of individual beels.

1. **Compact and Amphibious Design**: Select equipment that is compact and possible amphibious in nature (not complulsary) to navigate shallow and deeper zones with ease. The harvester should have dual functionality-capable of de-weeding and collecting macrophytes from both shallow and deep-water areas. Equipment that can be easily transported and assembled onsite reduces logistical challenges, especially in remote beels with limited accessibility.

2. **Shallow Draft Depth**: To operate effectively in the shallow conditions typical of Assam's beels, aim for a draft depth (<1m). A shallower draft depth reduces disruption to sediments and helps protect delicate aquatic ecosystems.
3. **Non-Intrusive Propulsion System**: Propellers that disturb the lakebed or increase sediment suspension should be avoided.
4. **Adjustable Weed Removal Height**: The ability to adjust cutting height is essential for targeting only surface weeds while avoiding unnecessary disruption to submerged vegetation. Equipment should ideally allow operators to select specific cutting depths, optimizing control over weed removal without harming native aquatic plants.
5. **Efficient Weed Collection System**: The harvester should be equipped with a built-in mechanism for transporting harvested weeds to a collection hopper. The collection system should have an adjustable discharge height, facilitating efficient transfer of weeds onto barges, trucks, or shore-based holding areas.
6. **Low Noise and Low Emission**: Choose equipment with low noise and emissions to minimize disturbance to wildlife and locals.
7. **Safety**: Ensure the selected machine meets all local safety and environmental regulations. The contractor should conduct training sessions for operators to ensure safe and effective use of the machinery while protecting the beel's ecosystem.

4. **Safeguards Measures**

To address the potential water pollution caused by the use of mechanical equipment in Beel management, the following measures shall be implemented:

- Utilize machinery with low-emission engines that meet environmental standards.
- Ensure regular inspection and maintenance of machinery to prevent fuel leakage, oil spills, or engine malfunctions that may lead to water contamination.
- Equip machinery with spill-proof fuel tanks and secure lids to minimize the risk of leaks.
- Use absorbent mats or barriers around machinery to capture accidental spills.
- Refuel machinery away from water bodies in designated areas with spill containment systems.
- Train operators to handle fuel with care to avoid spills.
- Collect and dispose of waste oils, lubricants, and used filters following hazardous waste management guidelines.
- Prevent the disposal of any machinery waste into the Beel or surrounding areas.
- Train operators and workers on eco-friendly practices and the importance of preventing water pollution.

By adopting these measures, the risks associated with mechanical equipment use can be effectively minimized.

5. **Potential Uses of Harvested Weeds from Assam Beels**

Harvested weeds, particularly water hyacinth, can be repurposed into valuable products and resources through sustainable practices. Utilizing these weeds helps manage waste effectively while generating benefits for local communities.

**Composting of Harvested Water Hyacinth and Weeds**

Water hyacinth is nutrient-rich, containing nitrogen, phosphorus, and potassium are key components of fertile compost. Composting these weeds reduces waste and creates a nutrient-rich product that enhances soil fertility, aiding agricultural productivity in areas surrounding the beels.

**Composting Methods:**

**a- Vermicomposting**: This method uses earthworms to decompose organic matter into vermicompost, which is highly nutrient-dense. It is ideal for small-scale composting and results in a valuable soil amendment.

**b- Accelerated Anaerobic Composting (AAC)**: Water hyacinths (Eichhornia crassipes) are fast-growing aquatic plants that has become critical problem for Assam beels. Their rapid reproduction can disrupt ecosystems, hinder water utilization and fish production. Accelerated Anaerobic Composting (AAC) of Organic Waste, a technology developed by the Indian Institute of Chemical Technology (IICT) CSIR Hyderabad". AAC has successful applied for preparing manure from water hyacinth and offers a solution by transforming this problematic plant into a valuable resource. This method reportedly breaks down organic waste in just 28-40 days, significantly faster than vermicomposting. IICT and their technology partner have successfully used water hyacinth in the AAC process to generate compost. AAC also seems to be a cost-effective option that communities could manage to generate revenue as well.

**AAC Process:**

1. **Harvesting and Pre-treatment:** Water hyacinths to be collected from beel. Large equipment may be used to move them to shore, where roots are separated from stems and leaves. Chopping the plant material into smaller pieces increases surface area and accelerates decomposition.
2. **Composting Pit Preparation:** Pits are dug and lined with an optional impermeable material or constructed by RCC to retain moisture and prevent leachate contamination.
3. **Mixing and Inoculation:** The chopped water hyacinth (around 90% by weight) is mixed with additional organic matter like cow dung (8%) and a bio-culture liquid containing beneficial bacteria (2%). This inoculant helps jumpstart the composting process.
4. **Anaerobic Digestion:** The mixture is compacted in the pit and sealed to create an oxygen-depleted environment. Microbes that thrive in these anaerobic conditions break down the organic matter, generating heat and releasing biogas (methane and carbon dioxide).
5. **Monitoring and Curing:** The temperature within the pit is monitored. During the initial stages, temperatures can rise significantly due to microbial activity. Turning the compost occasionally helps maintain aeration and temperature control.
6. **Maturity and Use:** After 4-6 weeks, the high temperatures subside, indicating the compost has matured. The final product is a nutrient-rich soil amendment that can be used in agriculture and horticulture.

**Handicrafts from Weeds**

The fibrous stems of water hyacinth are ideal for crafting, offering a sustainable and income-generating option for local artisans. This practice not only reduces waste but also empowers local communities by providing a source of livelihood. Harvested water hyacinth can be woven into

baskets, mats, bags, and other handicrafts. Crafting workshops can be organized for local artisans, allowing them to create marketable goods and develop new skills that support economic growth.

## Annexure A5: Guidelines for Setting up of Labour Camp

Employment for local labours should be encouraged to avoid setting of labour camp. However, in case of setting of any labour camp, contractor shall provide labour camps with all basic facilities for all the migrant workers employed by him till completion of construction/maintenance work is in progress in accordance with the **Building and Construction Workers (Regulation of Employment and Conditions of Service) Act, and Rules,1996.**

**Location and Space for Labour Camp**

- The Contractor agency will setup their camping locations at different places as would be identified.
- Each labour camp may house max. 25 laborers.
- These camps should be located away from the existing village or semi urban households to prevent likely social conflicts.
- Necessary permissions may be obtained from the respective revenue/municipal authorities.
- Temporary house structures should be provided by the contractor agencies to accommodate the labourers and their families, with provision of minimum infrastructure facilities, like water supply, sanitation and electricity etc.
- A minimum area of 6 sq. meters per person shall be provided.
- The rooms of labourer shall be well lighted and ventilated

The facilities to be provided for the labourers are discussed below:

I- **Drinking Water**: Towards the provision and storage of drinking water at the construction camp, the contractor shall ensure the following.

  - The contractor shall provide for a continuous and sufficient supply of potable water in the camps, in earthen pots or any other suitable containers.
  - If any water storage tank is provided, the bottom of the tank will be kept at least 1mt. above from the surrounding ground level.
  - The contractor shall identify suitable community water sources for drinking. Only in the event of nonavailability of other sources of potable water, the Contractor shall obtain water from an unprotected source only after the testing for its potability. Where water has to be drawn from an existing open well, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed in and be provided with dust proof trap door.
  - Every water supply or storage shall be at a distance of not less than 15m from any wastewater/sewage drain or other source of pollution. Water sources within 15m proximity of toilet, drain or any source of pollution will not be used as a source of drinking water in the Project.
  - A pump shall be fitted to covered well used as drinking water source, the trap door shall be kept locked and opened only for cleaning or inspection, which shall be done at least once a month

- Else a new well can be constructed and a pump will be fitted to the well for drinking water purpose of the labourers at the camp.

**II- Washing and Bathing Facilities**

In every site, adequate and suitable facilities for washing clothes and utensils shall be provided and maintained for the use of contract labor employed therein. Separate and adequate bathing shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic conditions.

**III- Toilets Facilities**

Each labour camp should be provided with community toilets with septic tank and soak pit arrangement. Sanitary arrangements, latrines (A latrine for every 15 labourers), urinals and adequate water shall be provided in every work place separately for male and female workers.

**IV- Supply of Free Fuel**

These labour forces may adopt unscrupulous methods of cutting trees and bushes for meeting their fuel wood requirement which would destroy the adjacent green cover and affect the local ecology. The Project authorities would ensure supply of free fuel to these labourers through the contract agencies so as to prevent such unscrupulous activities.

**V- Waste Disposal**

- Disposal of sanitary wastes and excreta shall be into septic tanks.
- Kitchen waste water shall be disposed into soak pits/kitchen sump located preferably at least 15 meters from any water body. Sump capacity should be at least 1.3 times the maximum volume of wastewater discharged per day. The bottom of the pit should be filled with coarse gravel and the sides shored up with board, etc. to prevent erosion and collapse of the pit. New soak pits shall be made ready as soon as the earlier one is filled.
- Solid wastes generated in the kitchen shall be reused if recyclable or disposed of in land fill sites.
- Provide segregated garbage bins in the camps and ensure that these are regularly emptied and disposed of in a hygienic manner
- The camping area should be periodically sprayed with Bleaching powder and other disinfectants

**VI- Medical and First Aid Facilities**

Medical facilities shall be provided to the laborer's at the construction camp. Visits of doctor shall be arranged for routine checkups would be conducted for women and children. A separate room for medical check-ups and keeping of first aid facilities should be built. The site medical room should display awareness posters on safety facilitation hygiene and HIV/AIDS awareness. The contract agency shall arrange supply of mosquito nets, supply of mosquito repellents to the laborer's and supply of preventative medicines to all labor force free of cost.

**VII-** Provision of Shelter during Rest, creches in case of 20 or more women workers and recreational facilities such as TV room, indoor and outdoor sports shall be provided by the Contractor.

Portable fire extinguishers and/or sand baskets shall be provided at easily accessible locations in the event of fire; Contractor shall educate the workers on usage of these equipment.

### VIII- Labour Camp De-Commissioning Provision

- Remove all temporary and permanent structures, including foundations, without causing damage to the surrounding environment.
- Level and grade the land to its natural contour, ensuring proper drainage.
- Restore the natural vegetation in the area using indigenous plant species to prevent erosion and support local biodiversity.
- Clear all solid and hazardous waste, ensuring segregation, recycling, and disposal in accordance with applicable waste management laws.
- Dismantle all structures, including workers' barracks, kitchens, storage units, and sewage/septic systems.
- Salvage reusable materials for recycling or repurposing where feasible.
- Dispose of non-recyclable materials in licensed waste disposal facilities to minimize environmental harm.
- Pump out and decommission septic tanks and sewage systems in compliance with local environmental guidelines.
- Conduct water quality testing of nearby water bodies (surface water and groundwater) post decommissioning.
- Labour camp decommissioning must comply with local laws and international standards, such as Environmental Protection Acts, Waste Management Rules, and Occupational Health and Safety Guidelines.

## Annexure A6: Guidelines/Procedure for Procedures for Borrow Area Operations and Management

For embankment construction or reinforcement, excavated earth material should be prioritized, subject to proper engineering analysis. However, if additional earth material is required for the bund or to construct access roads, it should be sourced from authorized government-approved sites. In cases where material must be obtained from borrow areas, these operations must be carefully managed due to their potential environmental impacts. This procedure aims to ensure that environmentally responsible practices are followed during the extraction of borrow materials, with appropriate mitigation measures in place. Furthermore, borrow areas should be properly rehabilitated after use to prevent environmental degradation and minimize any nuisance caused by the operations.

**Specific locations of borrow areas will be identified by contractor. Generally, government approved operational borrow areas in the nearby area should be selected for extracting the earth materials for construction.** However, if contractor opens new borrow area, then standard guidelines for operating the borrow areas should be followed. The selection and recommendations of borrow areas will be based on environmental as well as civil engineering considerations.

All precautions have to be taken to restrict unauthorized borrowing by the contractor. No borrow area shall be opened without permission of the CPIU and and consistent with the approved/adopted BIMP or community-based beel ecosystem and fishery management plan. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the engineer that there is no suitable area.

**Site Selections for Borrow Area**

| Identification of Borrow Area locations | Location/Sites to be avoided |
|---|---|
| - Identify barren land or riverside land for borrowing of earth.<br>- Prefer areas of highland with respect to surroundings;<br>- Avoid locating borrow area close to any road (maintain at least 30m distance from ROW and 10 m from toe of embankment, whichever is higher)<br>- Should not be located in eco-sensitive zone<br>- Should be at least 1.0 km away from inhabited areas<br>- Minimum distance of about 1.0 km from school, hospital and any archaeological sites<br>- Ensure that unsuitable soft rock is not prominent within the proposed depth of excavation which will render rehabilitation difficult | - Lands close to toe line of roads and hill slopes.<br>- Irrigated agricultural lands (in case of necessity for borrowing from such lands, the topsoil shall be preserved in stockpiles.)<br>- Grazing land<br>- Lands within 1km from settlements<br>- A distance of 1km should be maintained from environmentally sensitive areas such as Reserve Forests, Protected Forests, Sanctuary, wetlands<br>- Designated protected areas/forests<br>- Unstable hills side<br>- Seepage areas (Site of emergence of groundwater where the water table is present at the ground surface, including a springs)<br>- Ensure unsuitable soft rock is not prominent within the proposed depth of excavation which will render rehabilitation difficult<br>- streams and seepage areas, areas supporting rare plants/ animal species. It should be ensured that unsuitable soft rock is not prominent within the proposed depth of excavation which will render rehabilitation difficult. |

**Restrictions with Borrow Area Operation:**

- Contractor shall estimate the quantity of material to be collected from each borrow area based on allowable depth of excavation and top soil preservation.
- Contractor shall provide appropriate fencing all around the borrowed/excavated pit to prevent any mishap.
- The borrowing/excavation activity shall be restricted to a maximum depth of 2 m below general ground level at the site and restricted to 2 m above the groundwater table at the site.
- It shall be ensured that borrowing/ excavation activity shall not alter the natural drainage pattern of the area.
- Contractor shall maintain a 'Material Collection Register' (Sample Material Collection Register is provided in Annexure 18 ready reference) on daily material collection for each of the borrow areas, which shall be produced to Engineer's representative as and when requested.
- The Contractor shall maintain photographic record of each borrow area during pre, during and post excavation stage
- Regular periodic joint inspections shall be carried out during operation of the area by Contractor and Engineer's representatives

In general, the Contractor shall ensure compliance of the requirements listed below:

| **Attributes** | **Requirements** |
|---|---|
| Access road | Only approved access road shall be used |
| Top soil preservation | ○ The preservation of topsoil will be carried out in stockpile.<br>○ 15cm topsoil will be stripped off from the borrow pit and this will be stored in stockpiles in a designated area for height not exceeding 2m and side slopes not steeper than 1:2 (Vertical: Horizontal).<br>○ Preservation of Top Soil of 15cm depth and its reuse for plantation<br>○ EA shall ensure Validation of the work of re-use of top soil and check the re-use anytime if warranted. |
| Depth of excavation | ○ For cultivable (agriculture) land, total depth of excavation should be limited to 45 cm including top 15 cm for top soil preservation;<br>○ In other area, the borrowing/excavation activity shall be restricted to a maximum depth of 2 m below general ground level at the site and shall be restricted to 2 m above the groundwater table at the site.<br>○ If borrow area is located near habitation or villages, depth of borrow pits should not exceed 30 cm in depth to avoid accident |
| Damage to surrounding land | ○ Movement of workers and machinery should be regulated to avoid damage to surrounding land.<br>○ A minimum distance of 15 m from any public structure shall be kept from the periphery of any excavation area |
| Drainage control | ○ The borrowing/excavation activity shall not alter the natural drainage pattern of the area |

| Attributes | Requirements |
|---|---|
| | ○ The surface drainage in and around the area should be merged with surrounding drainage;<br>○ No water stagnation shall occur |
| Dust suppression | ○ Water should be sprayed on kutcha (earthen) haul road twice in a day or as may be required to avoid dust generation during transportation of material<br>○ Depending on moisture content, 0.5 to 1.5% water may be added to excavated soil before loading during dry weather to avoid fugitive dust emission |
| Covering material transport vehicle | ○ Material transport vehicle shall be provided with tarpaulin cover |
| Personal Protective Equipment | ○ Workers should be provided with helmet, gumboot and air mask and their use should be strictly enforced. |
| Redevelopment | ○ The area should be redeveloped agreed timeframe on completion of material collection as per agreed plan. |

**Statutory Clearance for Borrow Area**

For larger projects, which triggers project category A and B mentioned in EIA notification 2006 and its amendments needs to obtain environmental clearance from State Environmental Impact Assessment Authority (SEIAA) or District Environmental Impact Assessment Authority (DEIAA) of MoEFCC vide their notification no. S.O. 141(E) dated 15th January 2016. Where subprojects are very small-scale and doesn't trigger A and B category (under project 1(a) Mining of minerals) of EIA notification 2006 and it's amendments and may falls under exemption of certain cases requirement of Environmental Clearance mentioned in Appendix-IX. Exempt EC requirement for borrowing of earth/clay/sand/miner minerals for community works, like desilting of village pond or tanks, construction of village roads, ponds or bund undertaken in Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA) other government sponsored scheme and community efforts.

**For better clarity, contractor may consult local SPCB before any borrow operation and** Contractor must obtain necessary local environmental clearances/permits (if applicable). However, environmentally sound good-practice guidelines to be followed during collection of materials from borrow material and the areas are properly rehabilitated instead of creating environmental hazards and nuisance.

# Annexure A7: National and International Regulatory Standards and Threshold Limits

## 1- National Ambient Air Quality Standards- CPCB 2009

| Pollutants | Time-weighted average | Concentration in Ambient Air | | Methods of Measurement |
|---|---|---|---|---|
| | | Industrial, Residential, Rural and Other Areas | Ecologically Sensitive Areas (notified by Central Government) | |
| Particulate Matter (size less than 10 µm) or PM10 µg/m3 | Annual* | 60 | 60 | • Gravimetric<br>• Tapered Element Oscillating Microbalances (TOEM)<br>• Beta attenuation |
| | 24 hours** | 100 | 100 | |
| Particulate Matter (size less than 2.5µm) or PM2.5 µg/m3 | Annual* | 40 | 40 | • Gravimetric<br>• TOEM<br>• Beta attenuation |
| | 24 hours** | 60 | 60 | |
| Sulphur Dioxide (SO2) µg/m3 | Annual* | 50 | 20 | • Improved West and Gaeke<br>• Ultraviolet fluorescence |
| | 24 hours** | 80 | 80 | |
| Nitrogen Dioxide (NO2) µg/m3 | Annual* | 40 | 30 | • Modified Jacob and Hochheiser (Na-Arsenite)<br>• Chemilumiscence |
| | 24 hours** | 80 | 80 | |
| Carbon Monoxide (CO) (mg/m3) | 8 hours** | 2 | 2 | • Non-Dispersive Infra-Red (NDIR) spectroscopy |
| Ozone (O3) µg/m3 | 8 hours** | 100 | 100 | • UV photometriy<br>• Chemiluminescence<br>• Chemical Method |
| | 1 hour** | 180 | 180 | |
| Lead (Pb) µg/m3 | Annual* | 0.5 | 0.5 | • Atomic Absorption Spectrophotometry/ Inductively Coupled Plasma (AAS/ICP) method after sampling on EPM 2000 or equivalent filter paper<br>• Energy Dispersive X-ray Fluorescence (ED-XRF) using Teflon filter |
| | 24 hours** | 1 | 1 | |
| | 1 hour** | 4 | 4 | |
| Ammonia (NH3) µg/m3 | Annual* | 100 | 100 | • Chemiluminescence<br>• Indophenol Blue Method |
| | 24 hours** | 400 | 400 | |
| Benzene (C6H6) µg/m3 | Annual* | 5 | 5 | • Gas chromatography based continuous analyzer<br>• Adsorption and Desorption followed by Gas Chromatography (GC) analysis |

| Pollutants | Time-weighted average | Concentration in Ambient Air | | Methods of Measurement |
|---|---|---|---|---|
| | | Industrial, Residential, Rural and Other Areas | Ecologically Sensitive Areas (notified by Central Government) | |
| Benzo(a) Pyrene Particulate Phase only ng/m3 | Annual* | 1 | 1 | • Solvent Extraction followed by High performance liquid chromatography (HPLC)/ GC analysis |
| As ng/m3 | Annual* | 6 | 6 | • AAS/ICP method after sampling on EPM 2000 or equivalent filter paper |
| Ni ng/m3 | Annual* | 20 | 20 | • AAS/ICP method after sampling on EPM 2000 or equivalent filter paper |

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week, 24 hourly at uniform interval.; ng: nano gram ** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be compiled with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or monitoring and further investigation.

Source: MoEFCC Notification dated 16 November 2009

## 2- Noise Standards

### National Ambient Noise Quality Standards (as per Noise Pollution (Regulation and Control) Rules 2000)

| Category of Area/Zone | Limits in dB(A) Leq | |
|---|---|---|
| | Day Time | Night-time |
| Industrial area | 75 | 70 |
| Commercial area | 65 | 55 |
| Residential area | 55 | 45 |
| Silence Zone | 50 | 40 |

Note: (1) Day time shall mean from 6.00 a.m. to 10.00 p.m. (2) Nighttime shall mean from 10.00 p.m. to 6.00 a.m. (3) Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority (4) Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

Source: Gazette of India, vide S.O. 123(E), dated 14.2.2000 and subsequently amended by the Noise Pollution (Regulation and Control) (Amendment) Rules, 2000 vide S.O. 1046(E), dated 22.11.2000 and by the Noise Pollution (Regulation and Control) (Amendment) Rules, 2002 vide S.O. 1088(E), dated 11.10.2002, under the Environment (Protection) Act, 1986.

### National Occupational Noise

Occupational permissible exposure limit is permitted to 90 dB(A) for 8 hours/day and shall not be exposed to a noise level exceeding 115 dB(A) at any time. The permissible levels for noise exposure for work zone areas have been prescribed under the Model Rules of the Factories Act,1948:

| Peak sound pressure level in dB | Permitted number of impulses or impacts/day |
|---|---|
| 140 | 100 |
| 135 | 315 |
| 130 | 1000 |
| 125 | 3160 |
| 120 | 10000 |

Notes: No exposure in excess of 140 dB peak sound pressure level is permitted. For any peak sound pressure level falling in between any figure and the next higher or lower figure as indicated in column 1, the permitted number of impulses or impacts per day is to be determined by extrapolation on a proportionate basis.

Source: https://moef.gov.in/wp-content/uploads/2017/06/moef_gov_in_citizen_specinfo_noise_html.pdf

| Total time of exposure to sound pressure level (continuous or a number in dB(A) of short-term exposures) per day, in hours | Sound pressure level in dB(A) |
|---|---|
| 8 | 90 |
| 6 | 92 |
| 4 | 95 |
| 3 | 97 |
| 2 | 100 |
| 1.5 | 102 |
| 1 | 105 |
| 0.5 | 107 |
| 0.25 | 110 |

Notes: No exposure in excess of 115 dB(A) is to be permitted. For any period of exposure falling in between any figure and the next higher or lower figure as indicated in column 1, the permissible sound pressure level is to be determined by extrapolation on a proportionate basis.

Source: https://moef.gov.in/wp-content/uploads/2017/06/moef_gov_in_citizen_specinfo_noise_html.pdf

### National Ambient Noise Quality Standards for DG sets

| Category | Limits in dB(A) Leq |
|---|---|
| Diesel generator sets (up to 1000 KVA) manufactured on or after the 1 January 2005 at 1 meter from the enclosure surface | 75 |

**Source:** Noise Limit for Generator Sets run with Diesel were notified by Environment (Protection) second Amendment Rules vide GSR 371(E), dated 17 May 2002 at serial no.94 and its amendments vide GSR No 520(E) dated 1 July 2003; GSR 448(E), dated 12 July 2004; GSR 315(E) dated 16 May 2005; GSR 464(E)

dated 7 August 2006; GSR 566(E) dated 29 August 2007 and GSR 752(E) dated 24 October 2008; G.S.R. 215 (E), dated 15 March, 2011 under the Environment (Protection) Act, 1986

### 3- Emission Standards for Diesel Engines ≤ 800 kW for DG sets (2014)

| Power Category | Emission limits (g/kW-hr) | | | Smoke Limit (Light absorption coefficient, m-1) |
|---|---|---|---|---|
| | CO | NOx + HC | PM | |
| P ≤ 19 kW | ≤ 3.5 | ≤ 7.5 | ≤ 0.3 | 0.7 |
| More than 19 kW up to 75 kW | ≤ 3.5 | ≤ 4.7 | ≤ 0.3 | 0.7 |
| More than 75 kW up to 800 kW | ≤ 3.5 | ≤ 4.0 | ≤ 0.2 | 0.7 |

**Notes:**

1. The abbreviations used in the Table shall mean as under: NOx – Oxides of Nitrogen; HC – Hydrocarbon; CO – Carbon Monoxide; and PM – Particulate Matter.
2. Smoke shall not exceed above value throughout the operating load points of the test cycle.
3. The testing shall be done as per D2 – 5 mode cycle of ISO: 8178- Part 4.
4. The above-mentioned emission limits shall be applicable for Type Approval and Conformity of Production (COP) carried out by authorised agencies.
5. Every manufacturer, importer or, assembler (hereinafter referred to as manufacturer) of the diesel engine (hereinafter referred to as 'engine') for genset application manufactured or imported into India or, diesel genset (hereinafter referred to as 'product'), assembled or imported into India shall obtain Type Approval and comply with COP of their product(s) for the emission limits which shall be valid for the next COP year or, the date of implementation of the revised norms specified above, whichever earlier. Explanation - The term 'COP year' means the period from 1 April to 31 March.
6. Stack height (in metres), for genset shall be governed as % Pollution Control Board (CPCB) guidelines

**Source:** MoEFCC Notification dated 11th December 2013, g/kW-hr: gram per kilowatt hour

### 4- Drinking Water Standards – IS 10500:2012 and WHO Drinking water quality (4th Edition)

| S. No | Parameters | Drinking water specification IS 10500:2012 | | WHO Drinking water quality (4th Edition) |
|---|---|---|---|---|
| | | Requirement (Acceptable limit) | Permissible limit in the absence of alternate source | Guideline value |
| A | **Physico-chemical Parameters** | | | |
| 1. | pH (pH Scale) | 6.5 – 8.5 | No relaxation | - |
| 2. | Electrical Conductivity (µmho/cm) | - | - | - |
| 3. | TDS (mg/L) | 500 | 2000 | - |
| 4. | True Color (Hazen Scale) | 5 | 15 | - |
| 5. | Turbidity (NTU) | 1 | 5 | - |
| 6. | TSS (mg/L) | - | - | - |
| 7. | $BOD^5$ at 20 $^0C$ (mg/L) | - | - | - |
| 8. | COD (mg/L) | - | - | - |

| S. No | Parameters | Drinking water specification IS 10500:2012 | | WHO Drinking water quality (4th Edition) |
|---|---|---|---|---|
| | | Requirement (Acceptable limit) | Permissible limit in the absence of alternate source | Guideline value |
| 9. | Dissolved Oxygen (mg/L) | - | - | - |
| 10. | Total Hardness (mg/L) | 200 | 600 | - |
| 11. | Calcium Hardness (mg/L) | - | - | - |
| 12. | Magnesium Hardness (mg/L) | - | - | - |
| 13. | Calcium (mg/L) | - | - | |
| 14. | Magnesium (mg/L) | - | - | - |
| 15. | Total Alkalinity (mg/L) | 200 | 600 | - |
| 16. | Sodium (mg/L) | - | - | 50 |
| 17. | Sulphate (mg/L) | 200 | 400 | - |
| 18. | Sulphide (mg/L) | 0.05 | No relaxation | - |
| 19. | Sulphite (mg/L) | - | - | - |
| 20. | Orthophosphate (mg/L) | - | - | - |
| 21. | Total Phosphorus (mg/L) | - | - | - |
| 22. | Nitrate (mg/L) | 45 | No relaxation | 50 |
| 23. | Ammonical Nitrogen (mg/L) | 0.5 | No relaxation | - |
| 24. | Free Ammonia (mg/L) | - | - | - |
| 25. | Total Nitrogen (mg/L) | - | - | |
| 26. | Fluoride (mg/L) | 1.0 | 1.5 | 1.5 |
| 27. | Chloride (mg/L) | 250 | 1000 | - |
| **Bacteriological Parameters** | | | | |
| 28. | Total Coliform (MPN/100 ml) | Shall not be detectable in 100 mL | | |
| 29. | Faecal Coliform (MPN/100 ml) | Shall not be detectable in 100 mL | | |
| **Heavy Metals** | | | | |
| 30. | Iron (mg/L) | 0.3 | No relaxation | - |
| 31. | Zinc (mg/L) | 5 | 15 | |
| 32. | Copper (mg/L) | 0.05 | 1.5 | 2.0 |
| 33. | Arsenic (mg/L) | 0.01 | 0.05 | 0.01 |
| 34. | Lead (mg/L) | 0.01 | No relaxation | 0.01 |
| 35. | Nickel (mg/L) | 0.02 | No relaxation | - |
| 36. | Boron (mg/L) | 0.5 | 1.0 | 2.4 |
| 37. | Manganese (mg/L) | 0.1 | 0.3 | - |
| 38. | Mercury (mg/L) | 0.001 | No relaxation | 0.006 |
| 39. | Chromium (Hexavalent) (mg/L) | 0.05 | No relaxation | 0.05 |

## 5- Surface Water Quality Criteria for Designated Best Use (IS: 2296)

### I- CPCB Surface Water Quality Criteria for Designated best Use

| Sl. No. | Designated Best Use | Class of Water | Criteria |
|---|---|---|---|
| 1 | Drinking Water source (with conventional treatment) | A | • Total Coliform MPN/100 ml shall be 50 or less<br>• pH between 6.5 to 8.5<br>• Dissolved Oxygen 6 mg/l or more<br>• Biochemical Oxygen demand (BOD) 5 days 20°C 2 mg/l or less |
| 2 | Outdoor bathing (organized) | B | • Total Coliform MPN/100 ml shall be 500 or less<br>• pH between 6.5 to 8.5<br>• Dissolved Oxygen 5 mg/l or more<br>• Biochemical Oxygen demand (BOD) 5 days 20°C 3 mg/1 or less |
| 3 | Drinking Water source (without conventional treatment) | C | • Total Coliform MPN/100 ml shall be 5000 or less<br>• pH between 6 to 9<br>• Dissolved Oxygen 4 mg/l or more<br>• Biochemical Oxygen demand (BOD) 5 days 20°C 3 mg/1 or less |
| 4 | Propagation of Wildlife | D | • pH between 6.5 to 8.5 for fisheries<br>• Dissolved Oxygen 4 mg/l or more<br>• Free Ammonia (N) 1.2 mg/l or less |
| 5 | Irrigation, Industrial Cooling, Controlled Waste | E | • pH between 6.0 to 8.5<br>• Electrical Conductivity at 25°C µmhos/cm Max. 2250<br>• Sodium absorption rations Max. 26<br>• Boron, Max.2 mg/l |

**Source:** CPCB (1999). Bio mapping of rivers, Parivesh New Letter, 5 (iv), Central Pollution Control Board, Delhi, PP.20.

## II- IS 2296 Surface Water Quality Criteria for Designated best Use

| | Parameter and Unit | A | B | C | D | E |
|---|---|---|---|---|---|---|
| 1 | Taste | None | -- | -- | -- | -- |
| 2 | Odour | Unobj | -- | -- | -- | -- |
| 3 | Colour (True) (Hazen unit) | 10 | 300 | 300 | -- | -- |
| 4 | pH (max) (min : 6.5) | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 |
| 5 | Conductivity (25oC) uS/cm | -- | -- | -- | 1000 | 2250 |
| 6 | DO (mg/L) (minimum) | 6 | 5 | 4 | 4 | -- |
| 7 | BOD (3d, 27oC) (mg/L) | 2 | 3 | 3 | -- | -- |
| 8 | Total Coliforms (MPN/100 mL) | 50 | 500 | 5000 | -- | -- |
| 9 | TDS (mg/L) | 500 | -- | 1500 | -- | 2100 |
| 10 | Oil and Grease (mg/L) | -- | -- | 0.1 | 0.1 | -- |
| 11 | Mineral oil (mg/L) | 0.01 | -- | -- | -- | -- |
| 12 | Total Hardness (mg/L as CaCO3) | 300 | -- | -- | -- | -- |
| 13 | Chlorides (mg/L as Cl) | 250 | -- | 600 | -- | 600 |
| 14 | Sulfates (mg/L as SO4) | 400 | -- | 400 | -- | 1000 |
| 15 | Nitrates (mg/L as NO3) | 20 | -- | 50 | -- | -- |
| 16 | Free CO2 (mg/L ) | -- | -- | -- | 6 | -- |
| 17 | Free NH3 (mg/L as N) | -- | -- | -- | 1.2 | -- |
| 18 | Fluorides (mg/L as F) | 1.5 | 1.5 | 1.5 | -- | -- |
| 19 | Calcium (mg/L) | 80.10 | -- | -- | -- | -- |
| 20 | Magnesium (mg/L) | 24.28 | -- | -- | -- | -- |
| 21 | Copper (mg/L) | 1.5 | -- | 1.5 | -- | -- |
| 22 | Iron (mg/L) | 0.3 | -- | 50 | -- | -- |
| 23 | Manganese (mg/L) | 0.5 | -- | -- | -- | -- |
| 24 | Zinc (mg/L) | 15 | -- | 15 | -- | -- |
| 25 | Boron (mg/L as B) | -- | -- | -- | -- | 2 |
| 26 | Barium (mg/L) | 1 | -- | -- | -- | -- |
| 27 | Silver (mg/L) | 0.05 | -- | -- | -- | -- |
| 28 | Arsenic Total (mg/L) | 0.05 | 0.2 | 0.2 | -- | -- |
| 29 | Mercury (mg/L) | 0.001 | -- | -- | -- | -- |
| 30 | Lead (mg/L) | 0.1 | -- | 0.1 | -- | -- |
| 31 | Cadmium (mg/L) | 0.01 | -- | 0.01 | -- | -- |
| 32 | Chromium (VI) (mg/L) | 0.05 | 0.05 | 0.05 | -- | -- |
| 33 | Selenium (mg/L) | 0.01 | -- | 0.05 | -- | -- |
| 34 | Cyanide (mg/L as CN) | 0.05 | 0.05 | 0.05 | -- | -- |
| 35 | Phenols (mg/L) | 0.002 | 0.005 | 0.005 | -- | -- |
| 36 | Anionic detergents (mg/L as MBAS) | 0.2 | 1 | 1 | -- | -- |
| 37 | PAH (mg/L) | 0.2 | -- | -- | -- | -- |
| 38 | Pesticides (ug/L) | 0 | -- | -- | -- | -- |

Source IS 2296:1992

## 6- General Standards for Discharge of Environmental Pollutants: Effluents

| Sl. No. | Parameter | Inland surface water | Public sewers | Land for irrigation | Marine/coastal areas |
|---|---|---|---|---|---|
| 1 | Colour and odour | All efforts should be made to remove colour and unpleasant odour as far as practicable | | All efforts should be made to remove colour and unpleasant odour as far as practicable | All efforts should be made to remove colour and unpleasant odour as far as practicable |
| 2 | Suspended solids mg/l, max. | 100 | 600 | 200 | For process wastewater<br>For cooling water effluent 10 % abovetotal<br>suspended matter of influent. |
| 3 | Particle size of suspended solids | Shall pass 850 micron IS Sieve | - | - | Floatable solids, solids max. 3 mm<br>Settleable solids, max 856 microns |
| 4 | pH value | 5.5 to 9.0 | 5.5 to 9.0 | 5.5 to 9.0 | 5.5 to 9.0 |
| 5 | Temperature | shall not exceed 5°C above the receiving water temperature | - | - | shall not exceed 5°C above the receiving water temperature |
| 6 | Oil and grease, mg/l max, | 10 | 20 | 10 | 20 |
| 7 | Total residual chlorine, mg/l max | 1.0 | - | - | 1.0 |
| 8 | Ammoniacal nitrogen (N),mg/l, max. | 50 | 50 | - | 50 |
| 9 | Total kjeldahl nitrogen (N) ;mg/l, max. mg/l, max. | 100 | - | - | 100 |
| 10 | Free ammonia (NH3), mg/l, max. | 5.0 | - | - | 5.0 |
| 11 | Biochemical oxygen demand (3 days at 27°C), mg/l, max. | 30 | 350 | 100 | 100 |
| 12 | Chemical oxygen demand, mg/l, max. | 250 | - | - | 250 |
| 13 | Arsenic(As). | 0.2 | 0.2 | 0.2 | 0.2 |
| 14 | Mercury (Hg), mg/l, max. | 0.01 | 0.01 | - | 0.01 |
| 15 | Lead (Pb) mg/l, max. | 0.1 | 1.0 | - | 2.0 |
| 16 | Cadmium (Cd) mg/l, max | 2.0 | 1.0 | - | 2.0 |
| 17 | Hexavalent chromium (Cr + 6),mg/l, max. | 0.1 | 2.0 | - | 1.0 |

| Sl. No. | Parameter | Inland surface water | Public sewers | Land for irrigation | Marine/coastal areas |
|---|---|---|---|---|---|
| 18 | Total chromium (Cr) mg/l, max. | 2.0 | 2.0 | - | 2.0 |
| 19 | Copper (Cu) mg/l, max. | 3.0 | 3.0 | - | 3.0 |
| 20 | Zinc (Zn) mg/l, max. | 5.0 | 15 | - | 15 |
| 21 | Selenium (Se) | 0.05 | 0.05 | - | 0.05 |
| 22 | Nickel (Ni) mg/l, max. | 3.0 | 3.0 | - | 5.0 |
| 23 | Cyanide (CN) mg/l, max. | 0.2 | 2.0 | 0.2 | 0.2 |
| 24 | Fluoride (F) mg/l, max. | 2.0 | 15 | - | 15 |
| 25 | Dissolved phosphates (P),mg/l, max. | 5.0 | - | - | - |
| 26 | Sulphide (S) mg/l, max. | 2.0 | - | - | 5.0 |
| 27 | Phenolic compounds (C6H50H)mg/l, max. | 1.0 | 5.0 | - | 5.0 |
| 28 | Radioactive materials:<br>) Alpha emitters micro curie mg/l, max.<br>Beta emitters micro curie mg/l | 10-7<br>10-6 | 10-7<br>10-6 | 10-8<br>10-7 | 10-7<br>10-6 |
| 29 | Bio-assay test | 90% survival of fish after 96 hours in 100% effluent | 90% survival of fish after 96 hours in 100% effluent | 90% survival of fish after 96 hours in 100% effluent | 90% survival of fish after 96 hours in 100% effluent |
| 30 | Manganese | 2 mg/l | 2 mg/l | - | 2 mg/l |
| 31 | Iron (Fe) | 3mg/l | 3mg/l | - | 3mg/l |
| 32 | Vanadium (V) | 0.2mg/l | 0.2mg/l | - | 0.2mg/l |
| 33 | Nitrate Nitrogen | 10 mg/l | - | - | 20 mg/l |

**Notes:** These standards shall be applicable for industries, operations or processes other than those industries, operations or process for which standards have been specified in Schedule of the Environment Protection Rules, 1989

**Source:** GSR 801 (E), EPA, 1986, dated 31 December 1993

### 7- Soil Quality Standards for Screening of Contamination and Soil Fertility Rating

MoEFCC_guidelines_contaminatedsites.pdf (cpcb.nic.in),

https://agriculture.uk.gov.in/files/Soil_Testing_Method_by_Govt_of_India.pdf

## 8- International (WB/IFC- EHS Guideline) Environmental Quality Standards

### A- Recommended 2021 Air Quality Guidelines of WHO

| Pollutant | Averaging Time | 2021 AQG Level |
|---|---|---|
| $PM_{2.5}$ | Annual | 5 µg/m³ |
| | 24-hour | 15 µg/m³ |
| $PM_{10}$ | Annual | 15 µg/m³ |
| | 24-hour | 45 µg/m³ |
| $NO_2$ (Nitrogen dioxide) | Annual | 10 µg/m³ |
| | 24-hour | 25 µg/m³ |
| $O_3$ (Ozone) | 8-hour mean | 100 µg/m³ |
| $SO_2$ (Sulfur dioxide) | 24-hour | 40 µg/m³ |
| CO (Carbon monoxide) | 24-hour average | 4 mg/m³ |

**Source: https://iris.who.int/bitstream/handle/10665/345329/9789240034228-eng.pdf**

### B- Ambient Noise Level Guidelines

| **Receptor** | **One Hour LAeq (dBA)** | |
|---|---|---|
| | **Daytime 07:00 - 22:00** | **Nighttime 22:00 - 07:00** |
| Residential; institutional; educational | 55 | 45 |
| Industrial; commercial | 70 | 70 |

**Source:** Guidelines for Community Noise, World Health Organization (WHO), 1999.

### C- Noise Limits for Various Working Environments

| **Location/activity** | **Equivalent level LAeq,8h** | **Maximum Lamax, fast** |
|---|---|---|
| Heavy Industry (no demand for oral communication) | 85 dB(A) | 110 dB(A) |
| Light industry (decreasing demand for oral communication) | 50-65 dB(A) | 110 dB(A) |
| Open offices, control rooms, service counters or similar | 45-50 dB(A) | - |
| Individual offices (no disturbing noise) | 40-45 dB(A) | - |
| Classrooms, lecture halls | 35-40 dB(A) | - |
| Hospitals | 30-35 dB(A) | 40 dB(A) |

**Source:** Guidelines for Community Noise, World Health Organization (WHO), 1999

### D- Water Quality

Indicative Values for Treated Sanitary Sewage Discharges

| **Pollutants** | **Units** | **Guideline Value** |
|---|---|---|
| pH | pH | 6 – 9 |
| BOD mg/l 30 | mg/l | 30 |
| COD mg/l 125 | mg/l | 125 |
| Total nitrogen mg/l 10 | mg/l | 10 |

| Pollutants | Units | Guideline Value |
|---|---|---|
| Total phosphorus mg/l 2 | mg/l | 2 |
| Oil and grease | mg/l | 10 |
| Total suspended solids | mg/l | 50 |
| Total coliform bacteria | MPN/100 ml | 400 |

MPN = Most Probable Number

**Source:** https://www.ifc.org/wps/wcm/connect/3d9a54ae-c44c-488d-9851-afeb368cb9f9/1-3%2Bwastewater%2Band%2Bambient%2Bwater%2Bquality.pdf?MOD=AJPERES&CVID=ls4Xbfn

# Annexure A8: Tortoise and Avi-Fauna Management Plan

## I- Tortoise Management Plan

The SWIFT Project aims to achieve sustainable conservation and development of Assam's wetlands and fisheries while integrating ecological health and socio-economic benefits. Considering the presence of various tortoise species in Assam's rivers and beels, this Tortoise Management Plan provides a comprehensive framework to minimize project impacts and ensure tortoise conservation during SWIFT project activities.

### Key Components of the Tortoise Management Plan

### Baseline Assessment and Confirmation of Threatened Species in Beels

Before initiating any construction or intervention under the SWIFT Project, focused efforts are required to understand the ecological characteristics of the beels, which serve as the primary project sites. The identification of tortoise habitats will begin with community consultation and discussions with the District Forest Department and local wildlife experts. These initial interactions will gather valuable information about the potential presence of tortoises in the beels based on traditional knowledge, expert observations, and historical data. Based on the input from these consultations and the likelihood of species inhabiting the area, a detailed assessment will follow.

### A. Survey and Mapping

- Conduct baseline surveys to identify and map tortoise habitats within the beels.
- Systematically assess habitat conditions such as the presence of aquatic vegetation, nesting sites, basking areas, and connectivity to nearby river systems or floodplains.

### B. Species Identification and Confirmation:

- Collaborate with the District Forest Department to identify tortoise species and assess their conservation status.
- Use species checklists, field guides, and photographic documentation during field surveys.
- Determine conservation status using resources like the IUCN Red List and the Wildlife Protection Act (1972), with a focus on "Endangered" or "Critically Endangered" species.

Identification features of key Tortoise Species found in Assam are provided below as guidance for identification.

**Identification features of key Tortoise Species Found in Brahmaputra Basin**

| S.No | Species | Identification Features | Sample Photographs |
|---|---|---|---|
| 1 | ***Pangshura sylhetensis*** – *CR* | A freshwater tortoise with a relatively large and flattened shell. It has a light-colored, slightly raised carapace with darker markings. The species is known for its olive-brown or yellowish coloration, with darker, sometimes black, markings. |  |
| 2 | ***Geoclemys hamiltonii-EN*** | Known for its unique, rounded shell with prominent ridges. The carapace is typically dark brown or black with lighter markings. The plastron (underside of the shell) is pale, sometimes yellowish. It also has a long neck and a broad head, and is often found in slow-moving rivers and ponds. |  |
| 3 | ***Hardella thurjii*** *EN* | A small to medium-sized tortoise with a distinctive, low-domed shell. The carapace is generally brown with some darker markings, and it has a slightly flattened, oval-shaped body. The head is broad, with a short, thick neck. |  |
| 4 | ***Lissemys punctata-VU*** | This tortoise has a relatively flat, elongated shell, which is often brown or olive in color with a pattern of darker spots or markings. The plastron is pale yellow. The head is small with a prominent beak-like structure. |  |

**Identification features of key Tortoise Species Found in Brahmaputra Basin**

| S.No | Species | Identification Features | Sample Photographs |
|---|---|---|---|
| 5 | ***Nilssonia gangetica-VU*** | Characterized by its large, dark shell with a smooth and slightly domed appearance. The carapace is typically brown or dark green, and the plastron is yellowish. This species has a very long neck, and the head is large with a beak-like structure. |  |
| 6 | ***Nilssonia hurum-VU*** | Similar to Nilssonia gangetica, but with a more flattened, leathery shell. The carapace is dark, and the plastron is pale. It has a broad head with a thick neck, and its limbs are adapted for swimming in freshwater habitats. |  |
| 7 | ***Cuora amboinensis-*** *VU* | A freshwater tortoise with a distinctively smooth and shiny carapace. The shell is typically brown or black with some yellowish spots. It has a relatively small and rounded body with a flat head and long, slender legs. |  |

**C- Understanding its Biological life cycle**: it is important to understand the biological lifecycle patterns of the identified tortoise species, including their breeding, feeding, and migration or movement behaviors, and how these are influenced by or depend on the beels within their habitat. The study should comprehensively analyze the role of the beels in supporting these lifecycle processes, while also exploring the broader social, cultural, ecological, and biodiversity significance of the tortoise in the area. This holistic approach will not only emphasize the importance of the tortoise within the beel ecosystem but also highlight its role in the wider environmental and community context, ensuring a balanced conservation strategy.

| Timeline and Responsibility | | | | |
|---|---|---|---|---|
| Start: Prior to construction | End: Before Construction | Frequency: once | Responsibility: CPIU/PIU in consultation with District Forest Department | Supervision: PMU |

*2.* **Action Plan for Tortoise Conservation in Case of Confirmed Presence of Threatened Species in Subproject Beel**

If surveys confirm the presence of threatened tortoise species within the project beels, immediate and comprehensive actions will be taken to ensure their protection which includes

**A. Stakeholder and Expert Consultation:**

- Engage the District Forest Department, local wildlife experts, and environmental safeguards specialists to guide conservation strategies.
- Consult with local communities to incorporate traditional knowledge of tortoise behaviors and habitats into action plans.

**B. Immediate Habitat Protection:**

- **Establish No-Disturbance Zones:**
  - Demarcate areas critical to tortoise survival, such as nesting sites, feeding zones, and movement corridors, as “no-disturbance zones.”
  - Clearly mark and restrict access to these zones, allowing only authorized personnel for monitoring.
- **Adjust Project Design and Activities:**
  - Halt activities like desilting, bund restoration, or inlet/outlet management near critical habitats.
  - Modify project designs to avoid encroachment on tortoise habitats while maintaining project objectives.

**C. Species Relocation (If required):**

- Assess alternative habitats for relocation in consultation with the District Forest Department and wildlife experts.
- Implement relocation under strict protocols to minimize stress and ensure survival.
- Prepare suitable sites in advance and monitor relocated populations for acclimatization and survival.

| Timeline and Responsibility | | | | |
|---|---|---|---|---|
| Start: Prior to construction | End: Before Construction and during construction if species recorded during construction | Frequency: once | Responsibility: CPIU/PIU in consultation with District Forest Department | Supervision: PMU |

*3.* **Integration of protection measures into EMP and Implementation**

- Update EMPs to include tortoise protection measures as a priority such as
    - Install physical barriers (e.g., fencing, buffers) around critical tortoise habitats to prevent accidental encroachment or construction activities that could harm tortoises or their nesting sites.
    - Implement proper waste disposal protocols, and pollution prevention techniques to protect tortoise habitats from contamination.
    - Regularly monitor tortoise activity within and around the construction zones using field observations
    - Conduct training sessions for all workers and staff on how to identify tortoise species, their habitats, and the importance of minimizing disturbance to them
    - Identify and monitor tortoise nesting sites and ensure construction activities avoid disturbing these areas during the breeding season
    - if necessary, install wildlife corridors or tunnels to allow tortoises to safely move between fragmented habitats or across construction zone
    - Immediately report any incidents of tortoise harm, habitat disturbance, or non-compliance with conservation measures to the Project Implementation Unit (PIU)
- Ensure contractors and staff comply with guidelines to avoid habitat disturbances and adhere to environmental safeguards.
- Regularly report progress and conservation actions to the relevant authorities for transparency and compliance.

| **Timeline and Responsibility** | | | | |
|---|---|---|---|---|
| Start:<br>Prior to construction | End:<br>Before Construction and during construction if species recorded during construction | Frequency:<br>During | Responsibility:<br>For EMP update-CPIU/PIU in consultation with District Forest Department<br>Implementation of Env. Safeguards-by contractor | Supervision:<br>PMU |

**4. Long-Term Conservation Measures**

- Restore degraded habitats within the beels and enhance wetland conservation measures to support tortoise populations.
- Establish monitoring programs to track tortoise habitat use, and population trends over time using tools and field surveys.
- Foster community involvement in habitat monitoring and protection to strengthen conservation efforts.

| **Timeline and Responsibility** | | | | |
|---|---|---|---|---|
| Start:<br>Prior to construction | End:<br>Contunious efforts | Frequency:<br><br>Periodic | Responsibility:<br>CPIU/PIU in during construction<br>BDC during O&M phase | Supervision:<br><br>DoF/ARIAS Society |

## 5. Capacity Building and Knowledge Sharing

Building the capacity of project staff, contractors, and local stakeholders is crucial for effective conservation. Therefore, training programs for contractors, PIU staff will be carried out on habitat identification, tortoise handling protocols, and ecological importance by PMU through subject area experts.

## II- Avi-Fauna (Birds) Management Plan

While most beels under the SWIFT project are located outside ecologically critical areas such as Protected Areas (PAs), Key Biodiversity Areas (KBAs), or Important Bird Areas (IBAs) but these wetland ecosystems may still valuable habitats for local and migratory bird species, especially during key ecological periods like the wintering season (November-February) and breeding/nesting season (March-July). To prevent unintended impacts during beel restoration (e.g., excavation, de-silting, bund strengthening), precautionary measures will be implemented by the Contractor, under the close supervision of the CPIU with oversight by the PIU and PMU.

Following action plan is proposed to prevent and minimise impact on Avi-fauna:

### 1. Pre-Construction Avifaunal Assessment

- PIU will conduct a Rapid Avifauna Assessment before starting site works at each beel
- The assessment will:
  - Identify nesting, roosting, feeding, and resting zones (if any).
  - Record the presence of any species listed as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) under IUCN or Schedule I under the Wildlife (Protection) Act, 1972.
  - Map sensitive habitats and incorporate them into the contractor's layout and work schedule.

### 2. Seasonal Activity Scheduling

If any CR/EN/VU or Schedule I species is identified at or near the site:

- No major earthwork, de-silting, or mechanized activity will be conducted near nesting/roosting zones during:
- Winter Migratory Season and Breeding/Nesting Period (To be confirmed by State Wildlife Department)
- Maintenance and light manual work may continue under supervision, at a safe distance from sensitive areas.

### 3. Contractor Responsibilities- Site-Specific Precautionary Measures

- Include avifauna protection measures in the Contractor's Environmental Management Plan (CEMP) and Work Method Statements
- Establish and enforce a minimum 50-meter "no-disturbance" buffer around identified nesting or roosting zones.
- Prohibit or strictly limit to use of
  - Heavy machinery near bird activity zones. Honking, blasting, or loud construction noise.

    - Night-time work near bird habitats- no work after dusk in such areas.
- Provide camouflage screens or natural barriers around nesting zones if construction is nearby but unavoidable.
- Stop work immediately in areas where active nests or nesting colonies are encountered, and inform the PIU for further guidance.
- Organize awareness programs for contractor and construction staff, covering: Conservation importance of protected and migratory birds and Legal obligations under the Wildlife (Protection) Act, 1972, including penalties and imprisonment for violations.
- Artificial light (if any)should be directed towards subproject facilities and not towards the natural habitats.
- All the equipment likely to generate high noise shall be appropriately enclosed or inbuilt noise enclosures be provided so as to meet the ambient noise standards as notified under the Noise Pollution (Regulation and Control) Rules, 2000, as amended in 2010 under the Environment Protection Act (EPA), 1986
- Proper guideline should be issued so that noisy equipment's are not operated during the night time.
- Undertake maintenance of the equipment as simple maintenance can reduce noise levels. All stationary noise generating equipment's such power generators etc. should be used away from the biodiversity sensitive area.
- Movement of vehicles should be restricted to office hours only.
- The DG set should also be provided with proper exhaust muffler with insertion loss of minimum 25 dB(A).
- Restriction on pressure horns.
- Poaching is strictly prohibited.
- Provide site induction training for all workers, supported by:
    - Leaflets/posters in local languages.
    - Display of key Do's and Don'ts at site offices and work zones.
    - Group sensitization sessions for all workers and sub-contractors.

**4. Responsibility of PIU and PMU**

- CPIU Environmental Focal Person will:
    - Ensure that avifauna protection is addressed in the contractor's plans and site preparation activities.
    - Conduct monthly site checks during sensitive ecological seasons.
- PMU will:
    - Review contractor compliance.
    - Provide guidance if protected or rare species are discovered
    - Liaise with local forest/wildlife departments if required.

**5. Documentation and Reporting**

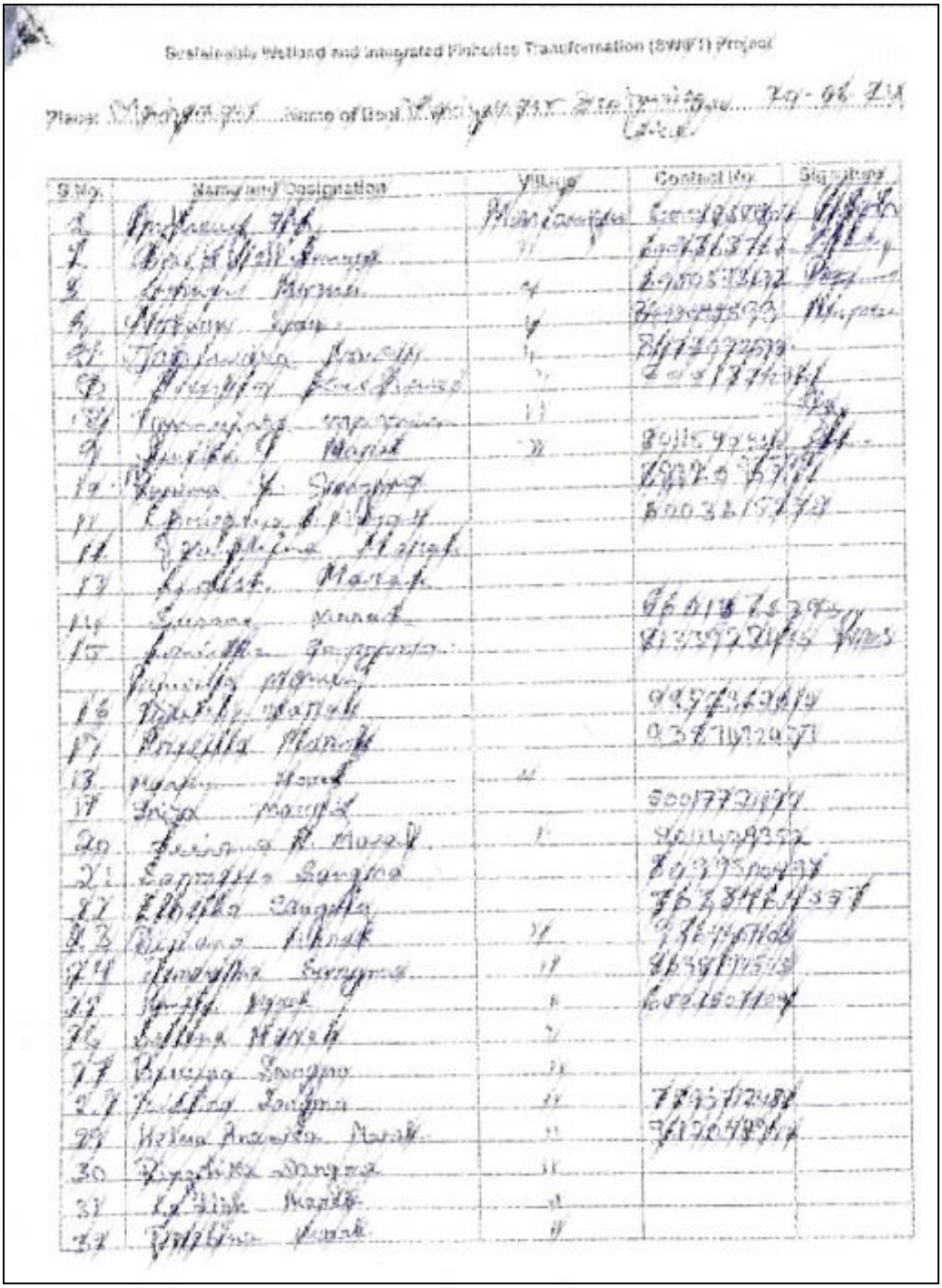
- CPIU/PIU to maintain records and submit a Monthly Avifauna Observation Report (including photo documentation) during winter and breeding seasons.
- Any bird-related incidents (e.g., nest destruction, sightings of rare species, injury/mortality) to be reported to PMU within 24 hours for further action and reporting to State Wildlife Department.

**6. Implementation Arrangement and Duties for Tortoise and Avi-Fuana Management Plan**

following table outlines the roles and responsibilities of various stakeholders involved in the Tortoise and Avi-fauna Management Plan, ensuring coordinated efforts towards conservation and successful project implementation.

| Agency | Duties |
|---|---|
| **Contractor** | - Responsible for executing project activities while adhering to conservation guidelines and EMP protocols |
| **Project Implementation Unit (PIU) including CPIU** | - Baseline Survey<br>- Monitor contractors' compliance with tortoise and Avi-fauna management measures.<br>- Ensure timely coordination with the District Forest Department and other stakeholders. |
| **Project Management Unit (PMU)** | - Oversee overall implementation of the Tortoise and Avi Fauna Management Plan.<br>- Provide technical and logistical support to PIU and contractors. |
| **District Forest Department** | - Provide expertise in species identification, habitat assessment, and relocation efforts.<br>- Guide conservation strategies and ensure alignment with wildlife regulations |
| **Environmental Safeguards Experts of CPIU and PIU** | - Support PIU and PMU in integrating conservation measures into project activities.<br>- Provide training and guidance to contractor<br>- Conduct regular site visits to monitor compliance and provide technical advice. |

**Annexure A9: List of participants and sample photos of safeguard consultation**
(Attendance sheets are intentionally blurred to hide personal details)



Sustainable Wetland and Integrated Pinnacles Transformation (SWIFT) Project

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Sustainable Wetland and Integrated Planning Transformation (SWIFT) Project

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| 42 | Salman Sangma | " | | |
| 43 | Suparna Sangma | " | | |
| 44 | Rina Ema | " | 7002328[illegible] | |
| 45 | Rajiv Mapuch | " | | |
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| 54 | Kusparick Sangma | Mendangpia | | |
| 55 | Arjuna Marak | " | | |
| 56 | Bablu Thg Sangma | | | |
| 57 | Rina Chanda | | | |
| 58 | Pinkila Sangma | | | |
| 59 | Dilchisa Sangma | | | |
| 60 | Rajulan Mapuk | | | |
| 61 | Pary Marak | | | |
| 62 | Supriya Momin | | 7002328[illegible] | |
| 63 | Mukul Momin | | | |

Sustainable Wetland and Silkworm Habitats Transformation (SWHT) Project

Place: Kokrajhar Name of Beel: Rongrong Jalkar Date: 20-03-2024

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Sustainable Wellbeing and Integrated Fisheries Transformation (SWIFT) Project

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Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

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Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

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| 1 | Sahidul Mondal | Belford | [illegible] | [illegible] |
| 2 | Kashinath Hazra | Belford | [illegible] | [illegible] |
| 3 | Pijush Mondal | Belford Bazar | [illegible] | [illegible] |
| 4 | Ramprasad Mandal | Belford | [illegible] | [illegible] |
| 5 | Tushar Mandal | Belford Bazar | [illegible] | [illegible] |
| 6 | Sumanta Patra | Belford | [illegible] | [illegible] |
| 7 | Nabakishor Sahoo | Belford | [illegible] | [illegible] |
| 8 | Jadabendra Hazra | Belford | [illegible] | [illegible] |
| 9 | Bijoy Das | Belford | [illegible] | [illegible] |
| 10 | Rajani Hazra | Bapuna Pally | [illegible] | [illegible] |
| 11 | Nagendra Das | Shibganj | [illegible] | [illegible] |
| 12 | Subhas Das | Sarenagar | [illegible] | [illegible] |
| 13 | Ajoy Mandal | Belford | [illegible] | [illegible] |
| 14 | Soumitra Das | Belford | [illegible] | [illegible] |
| 15 | Dantendra Bhakta | Belford | [illegible] | [illegible] |
| 16 | Sudipta Mandal | Belford | [illegible] | [illegible] |
| 17 | Hashina Bachhar | Belford | [illegible] | [illegible] |

Sustainable, Resilient and Integrated Pioneers Transformation (SRIPT) Project

Place: ... Name of Group: ... Date: 7.7.2023

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Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

Place: Barisal ..... Name of Bank: Lohagara Bank ..... Date: 23-08-24

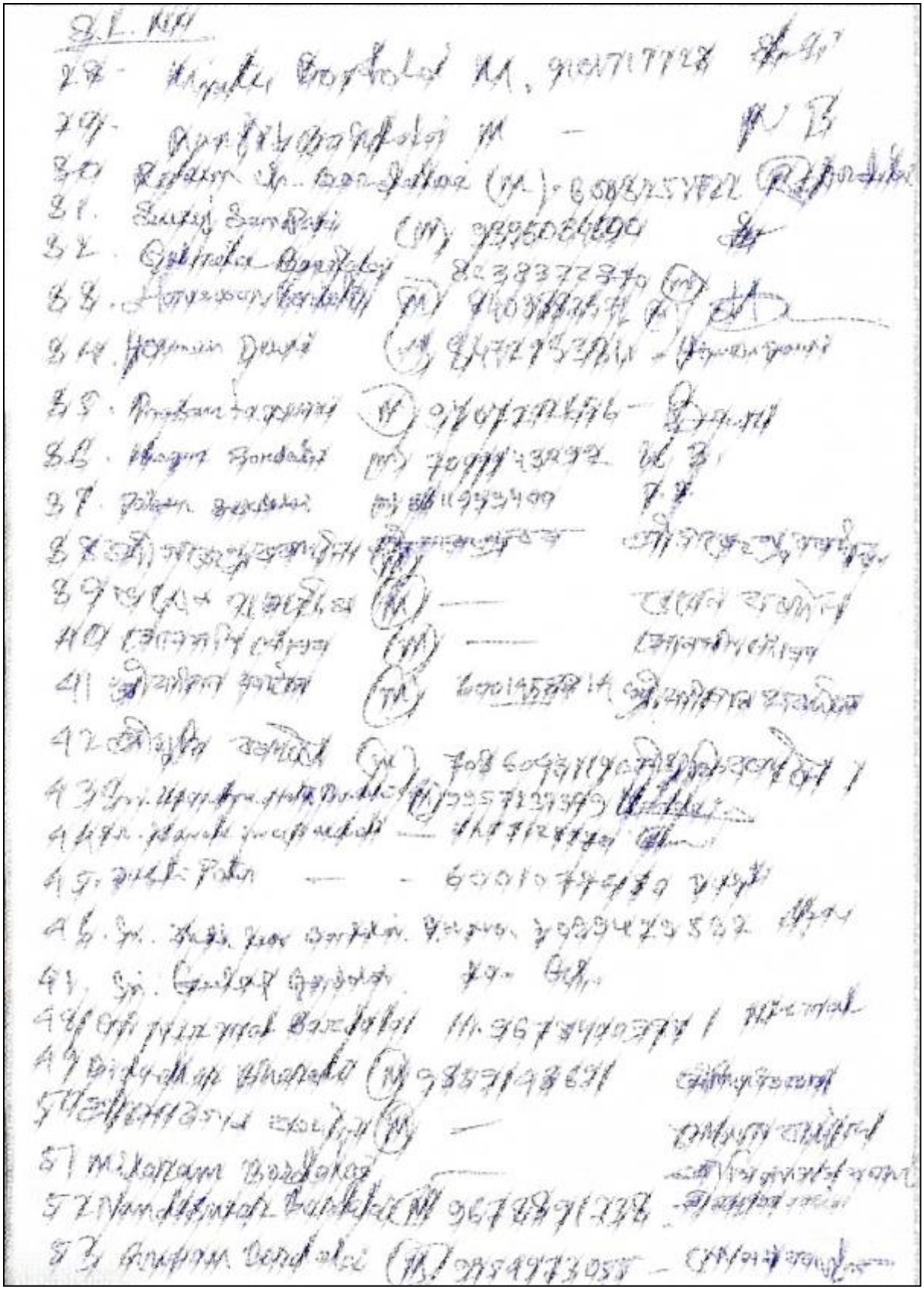
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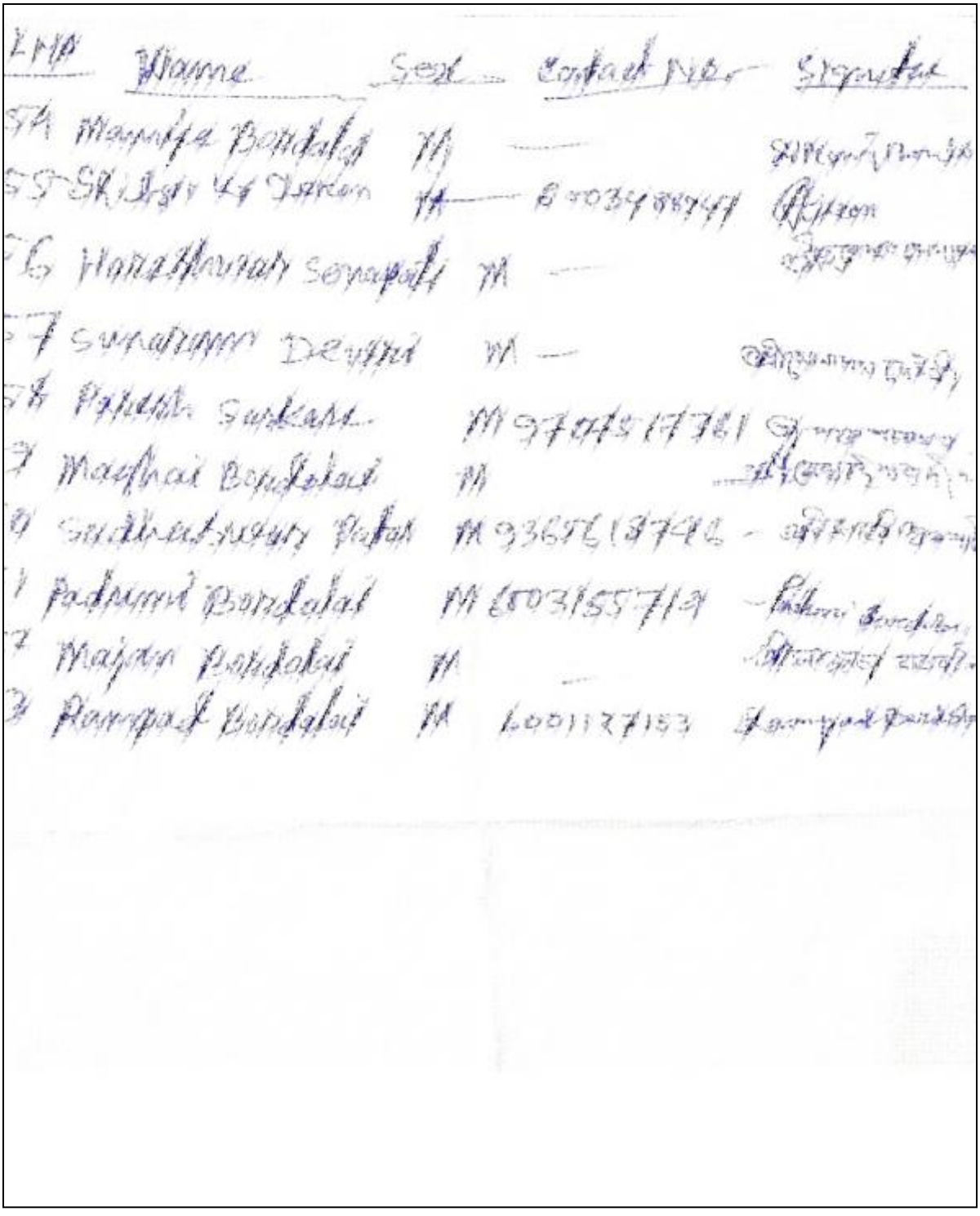
Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

Participant List

Place: Jiwagaon Date: 06/08/2024

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| EMP | Name | Sex | Contact No | Signature |
|---|---|---|---|---|
| 54 | Mayukha Bandopadhyay | M | — | |
| 55 | SK Iqbal Ali Akbar | M | 8100349887491 | |
| 56 | Hanabhavan Senapati | M | — | |
| 57 | Sunandan Dey | M | — | |
| 58 | Palash Sarkar | M | 9707517781 | |
| 7 | Mayhai Bandopadhyay | M | | |
| 9 | Siddhartasagar Patar | M | 9365613746 | |
| 1 | Padmini Bandopadhyay | M | 8031557139 | |
| 2 | Majan Bandopadhyay | M | — | |
| 3 | Ramapada Bandopadhyay | M | 6001127153 | |

Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

Participant List

Place Sarayan Village Date 7/08/2024

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Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

Participant List

Place: Sangam Date: 07/02/2024

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Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

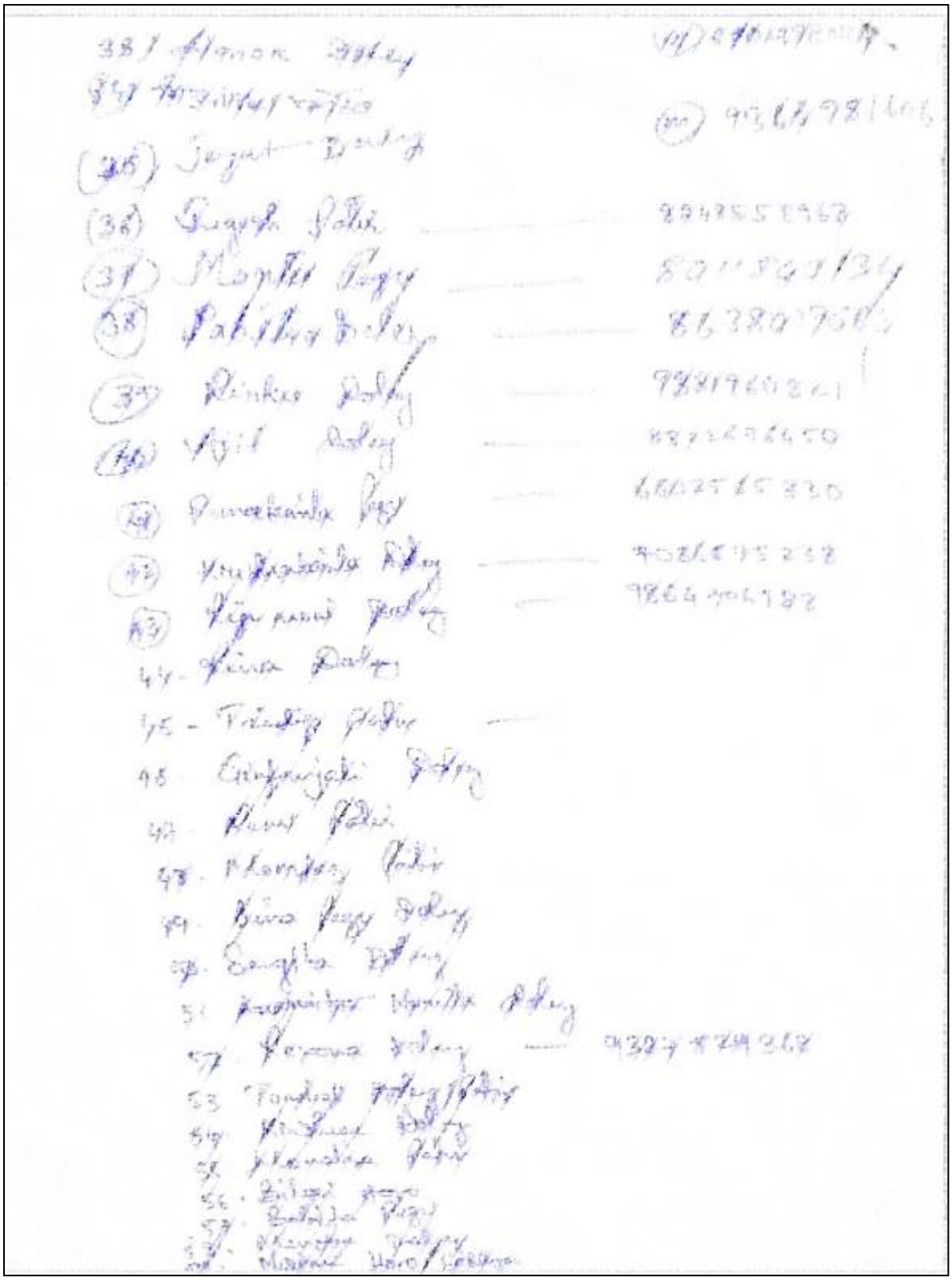
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Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

Place: Kolboshi Name of Beel: Mordesh Beel Date: 15/07/2024

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Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

Name of Group: Kunjhaun Name of Boat: Kunjdubra boat Date: 9/10/2024

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Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

Village: Chakaitapara Name of Boat: Chakaitapara Boat Date: 10/09/2024

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Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

Place: Gojirakar ..... Name of Beel: Lalpukri Beel ..... Date: 21.07.2024

Meeting

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| 1 | Dipak Kathoppy, DFDO | Gojirakar | 8638737[illegible] | [illegible] |
| 2 | [illegible] | | [illegible] | [illegible] |
| 3 | Rajkha Kalwar Sukla JE | | FE360[illegible] | [illegible] |
| 4 | Subgirdhara Das FD | | 9577554662 | [illegible] |
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Sustainable Well and and Integrated Fisheries Transformation (SWIFT) Project

Place: Makoma Barrage Name of Event: Makoma Awareness Date: 27-08-2024

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Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project

Place: Rex Gate ..... Name of Book: Dokpwanu Bank ..... Date: 2-03-2024

Drainage District

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**Pictures from Site Visit**

| **Consultations during Pre-Fact Finding Mission** | |
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| Consultation in Mariyampur village, Mariyampur Eco-Tourism Lake, Goalpara district | Consultation in Khasi Sagunbari, Sagunbari beel, Goalpara district |
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| Consultation in Singimari village, Rokapada Singimari beel, Goalpara district. | |
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| Consultation in Baniyapara, Dakra beel, Dhubri district | Consultation in Hakama Town, Hakama beel, Dhubri district |
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| Consultation in Udmari Chola village, Udamari Chola beel, Dhubri district | Consultation in Bheltari village, Purni beel, Dhubri district |

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| Consultation in Amrikhawa village, Cilli beel, Barpeta district | Consultation and site visit in Dahucli village, Rowmari beel, Nalbari district |
| **Consultations during Safeguard Mission for Priority Beels** | |
|  |  |
| Consultation in Jurgaon village, Bechamari beel, Morigaon district | |
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| Consultation with people in Sawguri village, Sawguri beel, Jorhat district | Consultation in Kalbari village, Moridesoi beel, Jorhat district |
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| Consultation with people in Kunjaduba village, Kokrajhar district | Meeting with BDO in Kunjaduba, Kokrajhar district |

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Consulation with people in Chalantara village, Bongaigaon district</td><td>Religious performance for beel health in Chalantara beel</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Consultation in Gujrola, Gujrola beel, Kareemganj district.</td><td>Could not visit Taiyakuri beel in Sribhumi district due to submergence of road.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Consultation in Mahara Barasapori village in Lakhimpur district</td><td>Consultation in Ger Geri village, Dalpung beel, Demaji district</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">Consultation in 3 No. Borhonnllong village, Lonkadeep beel, Tinsukiya district</td></tr>
</table>

## Annexure A10: Guidelines for Construction and Demolition Waste Management (as per Construction and Demolition Waste Management Rules, 2016)

(i) Every waste generator shall segregate construction and demolition waste and deposit at collection centre or handover it to the authorized processing facilities;

(ii) Waste generator shall ensure that there is no littering or deposition of waste so as to prevent obstruction to the traffic or the public or drains;

(iii) Large generators (who generate more than 20 tons or more in one day or 300 tons per project in a month) shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition or remodelling work;

(iv) Large generators shall have Environmental Management Plan to address the likely environmental issues from construction, demolition, storage, transportation process and disposal/reuse of C & D Waste;

(v) Large generators shall segregate the waste into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar;

(vi) Large generators shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities;

(vii) Segregate and store the waste generated in three separate streams namely bio-degradable, non-biodegradable and domestic hazardous wastes in suitable bins and handover segregated wastes to authorized waste pickers or waste collectors as per the direction or notification by the local authorities from time to time;

(viii) Wrap securely the used sanitary waste like diapers, sanitary pads etc., in the pouches provided by the manufacturers or brand owners of these products or in a suitable wrapping material as instructed by the local authorities and shall place the same in the bin meant for dry waste or non- bio-degradable waste;

(ix) Store separately construction and demolition waste, as and when generated, in his own premises and shall dispose of as per the Construction and Demolition Waste Management Rules, 2016;

(x) Store horticulture waste and garden waste generated from his premises separately at site and dispose of as per the directions of the local body from time to time;

(xi) No waste generator shall throw, burn or burry the solid waste generated by him, on streets, open public spaces outside his premises or in the drain or water bodies;

(xii) All waste generators shall pay such user fee for solid waste management, as specified in the by-laws of the local bodies; and

(xiii) No person shall organize an event or gathering of more than one hundred persons at any unlicensed place without informing the local body, at least three working days in advance and such person or the organizer of such events hall ensure segregation of waste at source and handing over of segregated waste to waste collector or agency as specified by the local body.

## Annexure A11: Standard Operating Procedures (SOPs) and Guidelines for Construction Sites for COVID-19 Outbreak

A SOP is issued amidst the current phase of the pandemic for 'local transmission and limited community transmission. This SOP is applicable to the current phase of COVID-19 pandemic in India (local transmission and limited community transmission). For construction sector, National Real Estate Development Council (NAREDCO), under the guidance of Ministry of Health and Family Welfare (MoHFW), Ministry of Housing and Urban Affairs (MoHUA) and Govt. of India, has defined the SOPs and guidelines to ensure safety of construction site workers.

**Guidelines Applicable for all**




- All Protocol including Emergency Response will be laid out. Identity Cards will be issued to everyone entering the site area. Periodic tailgate sessions will be arranged to review site protocols in view of highly dynamic scenarios ensuring social distancing norms.
- Mandatory Thermal Scanning of everyone entering and exiting a construction site will be done for fever with thermal scanners.
- Provision for hand wash and sanitizer (touch free recommended) will be made at all entry and exit points and common areas (including at distant locations like higher floors). Everyone will be required to wash and sanitize his/her hands before entering the site. Same procedure to be followed after exiting the premise.
- Everyone entering the site area should mandatorily wear a face mask.
- Hand gloves should be used by the workers who are handling material coming from outside
- There will be a strict ban on Gutka, Tambaku, Paan etc. on site and spitting shall be strictly prohibited.
- Food should be consumed at designated areas only ensuring social distancing.
- Post lunch waste should be disposed of by individuals in designated bins and the area should remain clean.
- Entire construction sites including site office, labour camp, canteens, pathways, toilets, entry/exit gates will be disinfected on a daily basis.
- Housekeeping team should be provided with necessary equipment.
- There will be a total ban on non-essential visitors at sites.
- Hospitals/clinics in the nearby area, which are authorized to treat COVID-19 patients, should be identified and list should be available at Site all the time.
- A doctor will be present periodically (at least once a week) at site on allotted time for any medical assistance.
- Appropriate signage at construction site spelling out safety practices in the language which is understood by all.
- For any confusion, clarification and update, everyone should approach designated authority or rely on an authentic source.

**Guidelines for workers**

- On day 0, before resuming the work on sites post lockdown period, mandatory medical check-up will be arranged for all workers.
- The workers coming from outside should observe home-quarantine for at least 14 days as per the guidelines issued by MoHFW.
- Only medically fit workers will be deployed at site and medical assistance will be arranged for unfit workers.
- A unique photo identity card with serial number will be issued to all the workers and their family members staying at site.
- All the essential items will be made available to them at site only. If necessary, they can go out wearing face masks, after informing the supervisor.
- No outside worker will be allowed to stay at site without following proper procedure and instructions.
- Start time on site will be staggered to avoid congestion at the entry gates.
- As in most cases, workers reside at the Sites, hence no travel arrangements are required for them.
- The workers staying outside (which are always nearby) should reach the site either by walking or by their individual mode of transport (bicycle, two-wheeler etc.).
- During attendance, training and other sessions, social distancing guidelines will be followed along with provision of no-touch attendance.
- All workers may be advised to take care of their own health and look out for respiratory symptoms/fever and, if feeling unwell, should leave the workplace immediately after informing their reporting officers.
- They should observe home-quarantine as per the guidelines issued by MoHFW and should immediately inform the nearest health centre.
- Workers should not shake hands when greeting others and while working on the site.
- Mandatorily wear face masks while working on site. While not wearing masks, cover your mouth and nose with tissues if you cough/sneeze or do so in the crook of your arm at your elbow.
- Avoid large gatherings or meetings. Maintain at least 1 metre (3 feet) distance from persons, especially with those having flu-like symptoms, during interaction.
- Not more than 2/4 persons (depending on size) should be allowed to travel in lifts or hoists.
- Use of the staircase for climbing should be encouraged.
- Workers should clean hands frequently by washing them with soap and water for at least 40 seconds.
- Workers should not share their belongings like food, water bottles, utensils, mobile phones etc. with others.
- The utensils should be washed properly post use at designated places.
- Post work, workers should change their clothes before leaving the site and clothing should not be shook out.
- Avoid touching your eyes, nose, or mouth with unwashed hands.

## Annexure A12: Technical Note on Environment Monitoring, Inventory of flora and fauna, FTK and Beel Health Card

### I- Beel Water Quality Monitoring:

Assam's beels, vital inland water resources, play a multifaceted role. They are key players in the region's water cycle, nurture rich biodiversity, regulate floods, and sustain local communities through essential livelihood resources. However, human activities increasingly threaten their water quality. Clean beel water is paramount for their ecological and economic value. Beels provide water for human use, harbor diverse fish and aquatic life for food, and support overall health through a balanced ecosystem (ILEC 2003). This balance relies on physical, chemical, and biological factors in the water and their regular monitoring is crucial. It identifies changes that could harm the entire beel environment, detects pollution or runoff variations early, and allows timely intervention to prevent further damage. Monitoring is also essential for fish health, as their growth and survival depend heavily on water quality.

Recognizing the importance of healthy water for beel ecosystems, this project proposes analysing key physico-chemical and biological parameters. This comprehensive analysis will provide a clear picture of beel water quality and its suitability for various uses. Essentially, water quality analysis will function as a valuable "report card" for conservation efforts. Tracking changes in key parameters will demonstrate project effectiveness, highlight areas for improvement, and ultimately ensure the long-term health of these vital water bodies.

**Guidelines to be adopted for Water Quality Monitoring:**

- Sample collection, sampling records and data validation is proposed to be done as mentioned in “Guidelines for Water Quality Monitoring published by Central Pollution Control Board (CPCB), Ministry of Environment and Forests, GOI. cpcb.nic.in/wqm/Guidelines_Water_Quality_Monitoring_2017.pdf
- Collection, preservation, transportation and Analysis of samples would be done as per standard methods prescribed by American Public Health Association on Water and Waste Water Examination (latest)/ or Bureau of Indian Standards (IS) methods
- A laboratory recognized by MoEFCC under EPA 1986 or by NABL would be hired to conduct water quality monitoring work
- Results to be compared with CPCB Designated Best Uses Class and other relevant standards/Guidelines for water quality required for sustainable fisheries
- For Soil and sediment analysis relevant IS method/ American Society for Testing and Materials (ASRTM) method/ Manual of Soil Testing, Ministry of Agriculture, Govt. of India should be used.

**Sampling Plan:**

Parameters, sample types, frequency and number of samples proposed to be collected from each beel is summarized in Table 1.

| Table 1: Sampling Plan and Scope of Water Quality and Soil/ Sediment Assessment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***S. No*** | ***Parameters*** | ***No. of Samples per beel*** | ***Frequency of Sampling*** | | | ***Total number of samples to be collected from each beel during entire Project tenure*** | ***Total number of Samples in 102 beels*** | ***Rate per Sample (Rs.)*** | ***Total Amount (Rs.)*** |
| | | | Pre Implementation (Baseline) | During Implementation | Post Implementation | | | | |
| ***1*** | **Water Quality Assessment**<br>**General Physico-chemical Parameters**<br>1. Temperature<br>2. pH<br>3. Electrical conductivity (EC)<br>4. Dissolved Oxygen (DO) (Surface and Bottom Sample of Water)<br>5. Secchi depth Transparency<br>6. Total dissolved solid (TDS)<br>7. Total Alkalinity<br>8. $CO_2$<br>9. Total Hardness<br>10. Ammoniacal nitrogen (NH4-N)<br>11. Nitrate (NO3)<br>12. Inorg. Phosphate<br>13. Total Nitrogen<br>**Demand parameter**<br>14. Bio-chemical Oxygen Demand (BOD)<br>15. Chemical Oxygen Demand (COD)<br>**Major ions:** | *At least 1 sample in shallow and 1 in deeper zone* | Once | Once | Once | 3 | 306 | 8000 | 24,48,000 |

| Table 1: Sampling Plan and Scope of Water Quality and Soil/ Sediment Assessment | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***S. No*** | ***Parameters*** | ***No. of Samples per beel*** | ***Frequency of Sampling*** | | | ***Total number of samples to be collected from each beel during entire Project tenure*** | ***Total number of Samples in 102 beels*** | ***Rate per Sample (Rs.)*** | ***Total Amount (Rs.)*** |
| | | | Pre Implementation (Baseline) | During Implementation | Post Implementation | | | | |
| | 16. Calcium (Ca++)<br>17. Magnesium (Mg++)<br>**Microbiological**<br>Total Coliform and fecal coliforms<br>**Metals**<br>As, Pb, Fe (mg/l) | | | | | | | | |
| ***2*** | **Sediment quality Assessment:**<br>• Total Organic Carbon<br>• Total phosphorous (mg/kg)<br>• Total Nitrogen (mg/kg)<br>• Potassium (mg/kg)<br>• As, Pb, Fe (mg/kg) | *At least 1sample in shallow and 1 in deeper zone* | Once | Once | Once | 3 | 306 | 4000 | 12,24,000 |
| | Total Amount (Rs.) | | | | | | | | 36,72,000/- |

## II- Air and Noise Quality Monitoring in Beel Surroundings

Ambient air quality and noise quality monitoring will be conducted in the surrounding area of the beel to assess the impacts of construction activities. The monitoring will measure air pollutants such as particulate matter (PM10, PM2.5), nitrogen dioxide (NO2), sulfur dioxide (SO2), and carbon monoxide (CO), as well as noise levels in decibels (dB). Standard methods prescribed by the Central Pollution Control Board (CPCB) will be used to ensure accuracy, reliability, and compliance with national environmental standards. This activity is essential for evaluating the environmental impact of construction, ensuring regulatory compliance, and implementing effective mitigation measures to minimize pollution.

**Sampling Plan:**

Parameters, sample types, frequency and number of samples proposed to be collected from each beel is summarized in Table 2.

| **Table 2: Sampling Plan and Scope of Air and Noise Monitoring** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***S. No*** | ***Parameters*** | ***No. of Samples*** | ***Frequency of Sampling*** | | | ***Total number of samples to be collected from each beel during entire Project tenure*** | ***Total number of Samples in 102 beels*** | ***Rate per Sample (Rs.)*** | ***Total Amount (Rs.)*** |
| | | | Pre Implementation (Baseline) | During Implementation | Post Implementation | | | | |
| ***1*** | Air Quality-$PM_{10}$, $PM_{2.5}$, $SO_2$, $NO_2$, CO (24-hr Sampling) | One location near beel | Once | Once | Once | 3 | 306 | 10,000 | 30,60,000 |
| ***2*** | Noise levels-Ambient and occupational exposure. Equivalent noise levels on dB (A) scale for day and night | One location near beel | Once | Once | Once | 3 | 306 | 2,000 | 6,12,000 |
| | Total Amount (Rs.) | | | | | | | | 36,72,000/- |

### III- Biodiversity and Wildlife Survey to confirm IUCN threatened species if any

Beels are complex ecosystems with intricate relationships between plants, animals, and the physical environment. Studying beel flora and fauna helps us understand these relationships and how they function together. By studying the different species present and their interactions, we can also identify potential threats to the ecosystem. Once conservation efforts are implemented, biodiversity assessment allows us to monitor their effectiveness. Thus, biodiversity data provides crucial feedback on the success of the project and helps guide adjustments if needed.

Particularly for SWIFT project, this study is even more important because healthy and diverse fish populations rely on a strong food web supported by aquatic biodiversity. Plankton provides food for small fish, which then sustain larger fish populations for fisheries. Even a diverse ecosystem with multiple fish and native species is more resilient to environmental changes. In addition to this, diverse aquatic plants create hiding places and breeding grounds for fish, promoting healthy populations for fishing.

Many bird species (avifauna) also rely on beels for food. Aquatic insects, fish, and plants provide sustenance for these birds, making biodiversity essential for their populations. Beels with diverse vegetation offer nesting and breeding grounds for various bird species. This habitat complexity is supported by aquatic biodiversity. Similar to fish, specific bird species might be sensitive to changes in the beel ecosystem. Monitoring bird populations can provide insights into the overall health of the beel. Therefore, proposed biodiversity study will establish a baseline of the current ecological state of the project sites and this data will useful for measuring the success of the SWIFT project and tracking changes in fish populations and other aquatic flora and fauna over time. Certain aquatic species are also sensitive to changes in water quality or habitat health. By monitoring the presence or abundance of these bioindicators overall health of the beel ecosystem can be assessed.

**Sampling Plan:**

Biological Parameters, frequency and number of samples proposed to be collected from each beel is summarized in Table 2

| *Table 2:* **Biological Parameters, frequency and number of samples proposed to be collected from each beel** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***S. No*** | ***Parameters*** | ***No. of Samples/ Assessment per beel*** | ***Frequency of Sampling*** | | | ***Total number of samples to be collected from each beel during entire Project tenure*** | ***Total number of Samples in 102 beels*** | ***Rate per Sample (Rs.)*** | ***Total Amount (Rs.)*** |
| | | | Pre Implementation (Baseline) | During Implementation | Post Implementation | | | | |
| ***1.*** | ***Biodiversity/Ecological Survey:***<br>• Phytoplankton's (diversity and density)<br>• Zooplankton's (diversity and density)<br>• Fish species based on catch survey/secondary information<br>• Identification of Submerged, Emergent, and Floating Macrophytic diversity<br>• Avi fauna study (based on site visit and secondary data | *At least 1 sample in shallow and 1 in deeper zone* | *Once* | *Once* | - | *2* | *204* | *10000* | *20,40,000* |
| ***2.*** | ***Wildlife Survey to confirm IUCN threatened species if any*** | *To be carried out by PMU through State Forest Department .once prior to construction* | | | | | *102 beels* | *LS* | *45,80,000* |
| | Total Amount (Rs.) | | | | | | | | *66,20,000/-* |

## IV- Guidelines for Water Quality Parameters required for sustainable fisheries

CIFRI (Central Inland Fisheries Research Institute) doesn't provide a single set of standards for ideal fishing water quality. This is because various fish species have varying tolerances for different water quality parameters. However, CIFRI does offer guidelines for some key water quality parameters[110] that influence fish health and growth. Following are the desired limits of key water quality parameters based on CIFRI documents and other available publications:

1- Temperature

Every fish species has an optimal temperature for its growth and maturation. Indian major carps and many other fishes in our country growth well in temperature ranging between 20-30°C.

2- Transparency

For fishery development, optimum transparency of a water body should be ranged between 20 and 50 cm (Nath et al., 1994). Very high transparency (more than 0.5 m) indicates poor productivity, while very low transparency due to suspended clay, silt or plankton bloom is also not desirable in aquatic ecosystem.

3- Dissolved Oxygen

Dissolved oxygen (DO) is absolutely essential for growth and survival of fish and fish food organisms. Dissolved oxygen content in a water body ranging between 5 and 10 mgl' during morning may be optimum for fish health. Low level of D.O may be lethal to many species if sustained for a long period.

4- Water reaction (pH)

Slightly alkaline water reaction (pH 7.4-8.2) is optimum for fish production (Nath et at.,1994).

- pH 4.0 and below: Direct fish mortality (Nath, 1986)
- pH 4-5: Sub lethal effect on fish
- pH 5-6: Poor productivity and reduced fish growth
- pH 7.4- 8.2: Optimum for fish growth
- pH 9-10: Sub lethal effect on fish

5- Alkalinity

Total alkalinity ranging between 80 and 150 mg/l is optimum for fish culture (Nath et al., 1994).

6- Carbon dioxide

In open water systems such as rivers, lakes and reservoirs free CO2 ranged between trace and 10 mg/l. $CO_2$ content is maximum in the morning and minimum or absent during noon or afternoon due to its utilization in photosynthesis by phytoplankton and macrophytes present in the water body. However, high $CO_2$ content in water (20 mg/l and above) indicates aquatic pollution. In fish ponds 5-10 mg/l of free $CO_2$ is conducive for carp culture (Nath et al., 1994). $CO_2$ content ranging between 12-50 mg/l may have sub-lethal effect which may include respiratory stress

7- Ammonia:

[110] Bulletin No.115.pdf (cifri.res.in) page 59

Ammonia content ranging between 0.02 and 0.05 mg/l is safe for tropical fishes and prawn. Sub lethal effect is noted depending on the species in the range of 0.05-0.4 mg/l But ammonia content ranging between 0.4-2.5 mg/l may be lethal to many fishes and prawns.

8- Total hardness

The recommended ideal value of hardness for fish culture is at least 20 ppm (Swann, 1997) and a range of 30-180 mg/l (Santhosh and Singh, 2007). 20-200 mg/l- very conduce for fish growth (Nath 1994)

9- Nutrients

Inorganic nitrogen content ranging between 1.0 to 2.6 mg/l might be considered optimum for high fish production (Nath et al 1994). Similarly, phosphate content ranging between 0.2 and 0.6 mg/l is considered optimal for fish production in ponds.

10- Plankton

Those aquatic pelagic organisms, which are carried about by the movement of the water rather than their own ability to swim are called planktons. The plant components are called as phytoplankton and animal components as zooplanktons and they serve as fish food. Fertilization may not be the only reason for eutrophication or excessive growth of planktons in pond water surface. The growth of certain species of blue green algae forms dense scums in surface waters, cause shallow thermal stratification, less availability of soluble phosphate in the top layer and prevents the penetration of light for photosynthesis to depths below 1m so leading to anoxic conditions in the deep areas (lack of oxygen and high concentration of free carbon dioxide) resulting in fish kills. Organisms. Bhatnagar and Singh (2010) suggested the optimum plankton population (approximately 3000-4500 Nos/litre) in pond fish culture. However, stress developed for fishes when plankton population found <3000 and >7000 Nos./litre.

## V- Water Quality Field Testing Kits (WQFTK)

Water Quality Field Testing Kits (WQFTK) is an assembly of simple portable equipment's/ accessories to measure various chemical constituents form the water sample in the field. The Field-Testing Kits generally give a qualitative estimate with the help of standard chemical reagents. The kits available in the market are of various types and capabilities for measuring different chemical constituents. Accordingly, the chemical reagents and accessories are provided in the kit and specific training is also provided by the supplier for using the FTK.

These Field-testing kits (FTKs) for water quality monitoring of beels offer significant advantages for both fisheries and the department responsible for managing them. The basic purpose of water quality monitoring is to sensitize the fisherman and ground level staff of DoF, about the water quality concerns in their areas and to address the specific water quality issues. Acquisition of data, periodically, at the beel level will provide basic information about water quality issues, if any, for self-interpretation and decision making.

**Key Parameters to be Covered:**

- Temperature
- pH
- Total Dissolved Solids
- Secchi Disc Transparency
- Total Hardness
- Alkalinity
- $CO_2$
- Dissolved Oxygen
- Ammonia
- Nitrate
- Chloride
- Bacteriological
- Other parameters added by DoF

**Data collection and Application of FTK:**

The Water Quality Field Testing Kits is to be used by the office of DFDO and District Implementation Partners for measurement of parameters to ascertain beel water quality as and when required. DoF should ensure that the participatory approach is being adopted for water quality monitoring by FTKs, which would involve following steps:

- Identification of two-three people (based on how capable someone is of doing WQ testing) at Village level for assistance in WQ testing through Field Test Kit.
- Conduct an intensive training of selected people for undertaking water samples analysis as per the manual available in FTKs.

- Initially, DoF staff shall collect 2-3 samples and get it analyzed through trained staff of DFDO/ local person, under their supervision, so as to develop confidence with the procedure, and then allow for further usage.
- A separate register is to be maintained by the person responsible, for recording all the parameters measured through the FTK.
- The DFDOs using FTK are advised to collect all required information about the kit; like physical status, the number of parameters and how many tests can be performed, custodian of the kits etc.
- The water quality data of project beels should be maintained by the office of DFDO on quarterly basis. The data shall be shared with PMU within 5 days of its sample collection and analysis. Any absurd values and anomalies shall be rectified/removed at the DFDO level. Thoroughly verified data must be shared with PMU for further compilation and authentication.

**Advantage of WQFTK For SWIFT Project**

- **Rapid Assessment:** FTKs allow for quick and easy on-site water quality testing. Fishery workers or even local communities can gather data on key parameters like dissolved oxygen, pH, and ammonia levels. This rapid assessment helps identify potential problems that could harm fish populations.
- **Strategic Interventions and Improved Decision-Making:** With real-time data from FTKs, fishery department can take targeted actions to address water quality issues. This could involve aeration to increase oxygen levels, reducing pollution sources, or adjusting stocking practices. Data collected by FTKs also empowers fishery managers to make informed decisions about fish stocking, habitat management, and overall fishery health.
- **Cost-Effective and Wider Coverage:** FTKs are a significantly cheaper alternative to sending water samples to laboratories for analysis. This allows for more frequent monitoring of beels, leading to a better understanding of water quality trends. Due to their ease of use and portability, FTKs can be used to monitor water quality in remote areas that might be difficult or expensive to reach with traditional methods. This provides a more comprehensive picture of beel health across a wider geographical area.
- **Community Engagement:** FTKs can be used to empower local communities to participate in water quality monitoring of beels. This fosters a sense of ownership and encourages involvement in conservation efforts.
- **Data Collection for Long-Term Management:** Regular use of FTKs builds a valuable data set over time. This allows the department to track changes in water quality and identify long-term trends and develop management plan.

**Financial Implication: Total 300 FTK will be purchased @Rs.13000 per kit.**

## VI- Development of Beel Health Card

Health of a wetland means the “Condition” or “Status” of the wetland. It refers to the state of a combination of physical, chemical, and biological characteristics of a wetland. It indicates how well the living (biotic, i.e. flora, fauna etc.) and non-living (abiotic, i.e. water, sediments etc.)

components of a wetland ecosystem are performing. Therefore, A healthy wetland ecosystem is one in which living and non-living components and their interrelationships are intact enough to make the wetland capable of withstanding disturbances and stressors.

The guidelines for implementing the Wetland (Conservation and Management) Rules, 2017 in India recommend the use of wetland health cards to provide a consistent and standardized approach to assessing the health of wetlands across India. This allows for comparisons to be made between different wetlands and helps track changes in their health over time.

To Comply rules and recommendation of MoEFCC, GoI, beel (Wetland) Health Card would be developed for individual beels, just after the collection of 1st baseline water quality monitoring. This health card will be further enriched by incorporating other relevant information gathered during the preparation of the Detailed Project Report (DPR). The following outlines the recommended approach and methodology for developing these health cards:

**Approach and method to be adopted for Preparation of Health Report Card**

Health Report Card for a wetland/Beel must be developed as per the standard protocol/frame-work[111] developed by the MoEFCC for preparing Health Report Cards for 100 wetlands of the country. Prepared from qualitative information and quantitative data gathered from integrated wetland assessment (based on wetland landscape level assessment, rapid surveys and monitoring). Standard Frame-work of Health Report Card developed by MoEFCC, GoI is presented in Table 1 while Assessing method revolves around the standard proforma of Health Card is presented in Table 2 for ready reference.

[111] S_4.2_Module_2_Brief_Document.pdf (indianwetlands.in)

| Standard Frame-work of Health Report Card developed by MoEFCC, GoI | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Features** | **Indicator** | **Desired Value** | **Actual Value** | **A** | **B** | **C** | **D** | **E** | **Score** |
| Area | % wetland converted to non-wetland use since 2000 | 0% | | 0% | 1-5% | 6-10% | 11-20% | More than 20% | |
| Hydrology and Catchments | Ratio of number of natural inlets choked and diverted to total number of natural inlets | <0.2 | | 0-0.2 | 0.3-0.4 | 0.4-0.6 | 0.7-0.8 | More than 0.8 | |
| | Ratio of number of natural outlets choked and diverted to total number of natural outlets | <0.2 | | 0-0.2 | 0.3-0.4 | 0.4-0.6 | 0.7-0.8 | More than 0.8 | |
| | Biological Oxygen Demand | Between 3-6 mg/l | | 80-100% sample meet the criteria | 60-80% sample meet the criteria | 40-60% sample meet the criteria | 20-40% sample meet the criteria | Less than 20% sample meet the criteria | |
| Biodiversity | % wetland area covered by invasive macrophytes | <10% | | <10% | 11-20% | 21-30% | 31-40% | More than 40% | |
| | Annual waterbird counts as a proportion of average count of last 5 years | 0.7 | | More than 0.7 | 0.6-0.7 | 0.5-0.6 | 0.4-0.5 | less than 0.5 | |
| Governance | Clearly demarcated wetlands map | Wetlands map prepared and approved by CWLW | | Wetlands map prepared and approved by State | Wetland map prepared and under consideration of State Wetlands Authority | Wetlands map prepared but not placed in State Wetlands Authority | Wetlands map under preparation | Wetlands map not prepared | |
| | Wetlands management plan | Management plan prepared and approved by CWLW | | Management plan prepared and approved | Management plan prepared and submitted to SWA | Management plan prepared, not submitted to SWA | Management plan under preparation | No manage-ment plan | |
| | Wetlands Notification | Wetlands notified under WPA | | Final notification under extant regulation | Draft notification | Regulation under process | Regulation planned, process initiated | No regulation | |

**Table 2: Assessing method revolves around the standard proforma of Health Card**

| Particulars | Frequency | Assigned weight | Value<br>Frequency*Assigned Weight |
|---|---|---|---|
| Number of indicators in Rank A | | 1 | |
| Number of indicators in Rank B | | 0.8 | |
| Number of indicators in Rank C | | 0.6 | |
| Number of indicators in Rank D | | 0.4 | |
| Number of indicators in Rank E | | 0.2 | |
| | Total Frequency | | Total Value |

**Ecosystem Health Score = Total Value/Total Frequency**

**Gradings/Ranking to decide Beel Health**

By comparison of the observed present data with threshold values, Beel health could be determined by using following grading

- A: 80-100%
  All water quality and biological health indicators meet desired levels
  quality of water in these locations tends to be excellent, very good for fish and shellfish habitats
- B: 60-80%
  Most water quality and biological health indicators meet desired levels
  quality of water in these locations tends to be very good very good for fish and shellfish habitats
- C: 40-60%
  Mix of good and poor level of water quality and biological health indicators quality of water in these locations tends to be fair habitat for fish and shellfish habitats
- D: 20-40%
  Some or few water quality and biological health tends to be poor often leading to poor habitat conditions for fish and shellfish
- F: 0-20%
  Very few or no water quality and biological health indicators meet desired levels quality of water tends to be very poor.

## Annexure A13: Construction Site Checklist for EMP implementation and Compliance Monitoring (to be used by contractor in field)

Subproject/Beel Name:

Contractor Name:

Filled by:

| S.No | Action/Activities | Status (Yes/No) | Additional Measures required as per EMP | Frequency | Remarks |
|---|---|---|---|---|---|
| 1. | EHS supervisor appointed by contractor and available on site since joining | | | Prior to start of construction and monthly thereafter | |
| 2. | EHS supervisor/contractor staff/labours attended training/workshop related to EMP and safeguard compliances | | | Prior to start of construction and after joining of any new staff or labour force | |
| 3. | Whether all consents/NOCs as applicable are taken prior to work execution including tree cutting permission, CTO/CTE? | | | Prior to start of construction and monthly thereafter | |
| 4. | Whether shifting or dismantling of utilities viz. electric lines, poles, telephone lines, water pipes etc. are done properly and alternative provided? | | | Once prior to start of construction | |
| 5. | Whether uncultivated areas/waste land used for storage and/or handling of construction materials, and construction camp? | | | Once prior to setting of material storage site and construction camp | |
| 6. | Verify that site for composting is marked and ready for composting process prior de-weeding operation | | | Once prior to start of de-weeding | |
| 7. | Whether borrow pits (if any) are located at upstream side? | | | Once prior to start of borrowing | |
| 8. | Is there any impact on water availability for during construction? | | | Monthly | |
| 9. | Site management plan (Labour, safety, material, schedule, equipment etc.,) prepared | | | Prior to start of construction and monthly thereafter | |
| 10. | Is material sourcing being done from authorized sources? | | | Monthly | |
| 11. | Is material transfer route to the site identified and able to vehicle carry load? | | | Monthly | |

| S.No | Action/Activities | Status (Yes/No) | Additional Measures required as per EMP | Frequency | Remarks |
|---|---|---|---|---|---|
| 12. | Whether any additional tree cutdown to provide access road or working area? | | | Monthly | |
| 13. | Whether mitigation measures suggested to minimize the impacts on topography and drainage patterns are taken properly? | | | Monthly | |
| 14. | Schedule de-weeding and desilting activities during the dry season to minimize water disturbance | | | Prior to start of operation | |
| 15. | Confirm that desilting is planned to avoid sensitive areas such as spawning grounds, nesting sites, | | | Prior to start of operation | |
| 16. | Ensure sediment barriers (e.g., silt curtains) are used around the desilting areas to prevent suspended solids from spreading. | | | Daily during operation | |
| 17. | Confirm that excavated earth material is prioritized for bund strengthening, following suitable engineering analysis | | | Daily during operation | |
| 18. | Air/Dust under control plan is in place | | | Daily | |
| 19. | PUC of construction vehicle checked | | | Monthly | |
| 20. | Excavated soil properly placed within minimum space | | | Daily | |
| 21. | Check that desilted material is stored in designated areas before reuse. | | | Daily during desilting operation | |
| 22. | Confirm that desilted material is used primarily for bund strengthening and is transported in lined or covered vehicles to avoid spillage | | | Daily during operation | |
| 23. | Verify that harvested weeds are collected and Store at designated place only | | | Daily during operation | |
| 24. | Check that all composting activities health and safety standards to avoid contamination and environmental impact | | | Daily during operation | |
| 25. | Construction area is confined; no traffic/pedestrian entry observed | | | Daily | |

| S.No | Action/Activities | Status (Yes/No) | Additional Measures required as per EMP | Frequency | Remarks |
|---|---|---|---|---|---|
| 26. | Surplus soil/debris/waste is disposed without delay as per provisions mentioned in EMP | | | Daily | |
| 27. | Tarpaulins used to cover sand and other loose material when transported by vehicles after unloading, wheels and undercarriage of vehicles cleaned prior to leaving the site | | | Daily | |
| 28. | Noise control measures taken at site | | | Daily | |
| 29. | Drainage and storm water management measures are in place | | | Daily | |
| 30. | Hazardous waste viz. lubricant/Oil management is being done by EMP measures | | | Daily | |
| 31. | whether landslides/erosion prone area, stability of bank checked? | | | Daily | |
| 32. | Any discharge of wastewater from construction site/labour camp? | | | Monthly | |
| 33. | Are there any oil spillages/leakages? | | | Daily | |
| 34. | No pipes disturbed/removed during excavation | | | Daily | |
| 35. | No chance finds encountered during excavation | | | Daily | |
| 36. | Work is planned in consultation with village administration | | | Prior to start of construction and monthly thereafter | |
| 37. | Trenches are not kept open unduly | | | Daily | |
| 38. | No public/unauthorized entry observed in work site | | | Daily | |
| 39. | Safety measures (barricades, security) in place at work sites | | | Daily | |
| 40. | Workers using appropriate PPE (boots, masks, gloves, helmets, ear muffs etc) | | | Daily | |
| 41. | Workers conducting or near heavy noise work is provided with ear muffs | | | Daily | |
| 42. | Is contractor staff following standard and safe construction practices? | | | Daily | |

| S.No | Action/Activities | Status (Yes/No) | Additional Measures required as per EMP | Frequency | Remarks |
|---|---|---|---|---|---|
| 43. | First aid facilities are available on site | | | Daily | |
| 44. | Drinking water provided at the site | | | Daily | |
| 45. | Toilet facility provided at the site Separate toilet facility is provided for women workers | | | Weekly | |
| 46. | Worker's camp (if any) is maintained cleanly adequate toilet and bath facilities provided | | | Weekly | |
| 47. | Contractor employed local workers as far as possible | | | Prior to start of construction and monthly thereafter | |
| 48. | Whether any incident of poaching/hunting/forest fire/mass fishing? | | | Monthly | |
| 49. | Keep the photographic /video records of each of the project activities | | | Daily | |

Checked By:

## Annexure A14: Environmental Monitoring Report Format (to be used by PIU/PMU)

- Brief discussion on the basis for monitoring
- Indicate type and location of environmental parameters to be monitored
- Indicate the method of monitoring and equipment to be used
- Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements

*As a minimum the results should be presented as per the tables below.*

### I- Air Quality Results

| Site No. | Date of Testing | Site Location | Parameters (Government Standards) | | | | |
|---|---|---|---|---|---|---|---|
| | | | PM10 µg/m3 | PM2.5 µg/m3 | SO2 µg/m3 | NO2 µg/m3 | CO (mg/m3) |
| Site Name and Coordinates | | | | | | | |
| Site Name and Coordinates | | | | | | | |

### II- Water Quality Results for Surface (Beel) and Drinking Water

| Site No. | Date of Sampling | Site Location | Parameters | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Key Parameters as per IS 10500:2012 for Drinking water | | | Key Parameters as IS 2296 for Surface water | | |
| Site Name and Coordinates | | | | | | | | |
| Site Name and Coordinates | | | | | | | | |

### III- Noise Quality Results

| Site No. | Date of Testing | Site Location | LAeq (dBA) (Government Standard) | |
|---|---|---|---|---|
| | | | Day Time | Night Time |
| Site Name and Coordinates | | | | |
| Site Name and Coordinates | | | | |

## IV- Soil/Sediment/Compost Quality Results

| Site No. | Date of Testing | Site Location | Soil Quality Parameters | | | | |
|---|---|---|---|---|---|---|---|
| | | | Macro and Micro Nutrients and Heavy Metals | | | | |
| Site Name and Coordinates | | | | | | | |
| Site Name and Coordinates | | | | | | | |

*Note: add more tables to show results of other monitoring activities.

**Summary of Environmental Monitoring Activities (for the Reporting Period)**

| Impacts (List from IEE) | Mitigation Measures (List from IEE) | Parameters Monitored (As a minimum those identified in the IEE should be monitored) | Method of Monitoring | Location of Monitoring | Date of Monitoring Conducted | Name of Person Who Conducted the Monitoring |
|---|---|---|---|---|---|---|
| **Design Phase** | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **Pre-Construction Phase** | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **Construction Phase** | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

a Attach Laboratory Results and Sampling Map/Locations

## Annexure A15: Template for Quarterly Environmental Progress and Monitoring Report (to be used by CPIU/PIU)

| Key Question | Yes/No/Not Applicable | Remarks |
|---|---|---|
| **A- Contract and Pre-Construction** | | |
| 1. Are there any work contract that has been awarded in this Quarter? | | |
| 2. whether bid EMP(s) cleared by ADB? | | |
| 3. Is IEE/EMP of each subproject prepared? | | |
| **B- Project Execution- Safeguard Compliance and EMP implementation:** | | |
| 1. Whether regulatory permits/NOC/consent (if any) obtained before construction? (Provide subproject wise list) | | |
| 2. Whether Construction Site Checklist for EMP implementation and Monitoring is being filled and submitted by contractor? | | |
| 3. **Implementation of Environmental Management Plan**. Provide discussions on the implementation of mitigation measures to reduce impacts of project activities, and attach sample photographs of these measures and discuss them briefly | | |
| **C- Project Execution: Grievances** | | |
| 1. Does the Project have a functioning GRM? | | |
| 2. Is there any complain received and resolved? if yes provide numbers | | |
| **Grievance Redress Mechanism Information:** Indicate the any grievance/s received at the period of the QPR and status of ongoing grievance. | | |
| **D- Project Execution: Project Safeguards Non-Compliance** | | |
| 1. Does the Project have any outstanding non-compliances on environmental safeguards? | | |
| 2. If yes, is there a time-bound Corrective Action Plan agreed between ADB and PMU? | | |
| 3. Is the implementation of corrective actions on track? | | |
| **E- Project Execution: Monitoring** | | |
| 1. Are the environmental monitoring reports submitted as per agreed schedule, commencing from project effectiveness? | | |
| 2. If no, for how long has it been overdue? | | |

## Annexure A16: Environmental Monitoring Report (EMR) Outline

The PMU is required to prepare semiannual monitoring reports that describe progress on implementation of the project EMP and compliance issues and corrective actions (if needed). A sample outline which can be adapted as necessary is provided below.

**I. Introduction**

A. Overall Project Description and Components

B. Location of the Subproject (*use maps and pictures*)

C. Environmental Category (*discuss categorization based on ADB SPS and national law*)

D. Project Implementation Progress (*summary of activities and construction progress and main civil works during reporting period*)

**II. Institutional Arrangement for Environmental Safeguards**

A. Institutional Arrangement (description of the project institutional arrangement as a whole; use figure/framework)

B. Environmental Safeguard Staff/Personnel

**III. Statutory Environmental Requirements**

A. Government Policy Compliance (discuss status of clearance/s, permit/s, etc. and compliance of the project; include all permits and clearances as appendices)

B. Compliance Issues (indicate any noncompliance on national/state and reason of noncompliance)

**IV. Loan Covenants**

**V. Construction Progress**

**VI. Implementation of Environmental Management Plan**

A. Summary of Inspection Activities

B. Compliance with Construction Environmental Management Plans (CEMPs).

C. CEMP implementation issues

**VII. Summary of Environmental Monitoring**

A. Environmental Monitoring Plan (emission and ambient)

1. Summary of Monitoring
2. Results
3. Assessment

B. Other Monitoring Program (if relevant)

1. Summary of Monitoring
2. Results

3. Assessment

**VIII. Information Disclosure and Consultations (only applicable if any consultations are performed during reporting period)**

**IX. Grievance Redress Mechanism (GRM)**

A. GRM Framework, members and access

B. Grievances Received (*if any*)

C. Status of Current Grievances (*if any*)

**X. Conclusion**

A. Overall Progress of Implementation of Environmental Management Measures

B. Unanticipated Environmental Risks and Impacts

C. Corrective Action Plan (footnote 1)

**XI. Annexes (as appropriate)**

- Copies of ambient and/or emission monitoring results
- Clearances and permits
- Photographs
- Other

## Annexure A17: Sample Material Collection Register (to be used by contractor to maintain the record for construction material)

1- Subproject Name:

2- Location of Borrow/Quarry:

3- Geographical Coordinates:

4- Estimated Quantity Required for Subproject (MT):

5- Whether Quarry/borrow area Approved by Government:

| Date | Material Lifted from Borrow/Quarry site (MT) | Material consumed in construction (MT) | Material available at construction site (MT) | Remarks | Signature of construction manager/ site in-charge |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

## Annexure A18. Sample Grievance Registration Form

The ----------Project welcomes complaints, suggestions, queries and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback. Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

| | | | | | |
|---|---|---|---|---|---|
| **Date** | | **Place of registration** | | | |
| **Contact Information/Personal Details** | | | | | |
| **Name** | | **Gender** | | **Age** | |
| **Home Address** | | | | | |
| **Place** | | | | | |
| **Phone Number** | | | | | |
| **E-mail** | | | | | |
| **Complaint/Suggestion/Comment/Question**<br>Please provide the details (who, what, where and how) of your grievance below | | | | | |
| **How do you want us to reach you for feedback or update on your comment/grievance?** | | | | | |

**FOR OFFICIAL USE ONLY**

| | |
|---|---|
| Registered by: (Name of Official registering grievance) | |
| Mode of communication:<br>Note/Letter Email<br>Verbal/Telephonic | |
| Reviewed by: (Names/Positions of Official(s) reviewing grievance) | |
| Action Taken: | |
| Whether Action Taken Disclosed: | **Yes** |
| Means of Disclosure: | |

# Annexure A19: Water Quality of Rivers of Assam (March 2023-March-2024)

| Name Of Monitoring Location | Temp (°C) | | DO (mg/L) | | pH | | Conductivity (µS/cm) | | BOD (mg/L) | | Nitrate (mg/L) | | Fecal Coliform (MPN/100ml) | | Total Coliform (MPN/100ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mn | Mx | Mn | Max | Mn | Mx | Min | Max | Min | Mx | Min | Mx | Min | Max | Min | Max |
| River Brahmaputra At Dibrugarh | 19 | 25 | 5 | 8.7 | 6.8 | 7.6 | 102 | 152 | 2 | 2.7 | 0.7 | 1.2 | 360 | 1100 | 730 | 2100 |
| River Brahmaputra At Pandu | 18 | 30 | 6.1 | 9.2 | 6.7 | 7.6 | 126 | 174 | 2 | 2.7 | 0.6 | 1.5 | 730 | 1100 | 1500 | 2100 |
| River Jhanji At N.H. Crossing Jorhat | 17 | 32 | 5.5 | 8.1 | 6.6 | 7.8 | 106 | 130 | 2.1 | 2.5 | 0.6 | 1.1 | 300 | 620 | 730 | 2100 |
| River Dhansiri At Golaghat | 20 | 32 | 5 | 10.5 | 7 | 7.9 | 136 | 172 | 2 | 2.4 | 0.7 | 1.3 | 620 | 940 | 1100 | 2000 |
| River Subansiri At Gerukamukh (Before Confluence With River Brahmaputra) | 19 | 23 | 6.2 | 10.5 | 6.8 | 7.5 | 112 | 144 | 2 | 2.5 | 0.4 | 1.1 | 360 | 940 | 1100 | 2100 |
| River Brahmaputra At Nimatighat | 16 | 30 | 6.3 | 8.4 | 7 | 7.9 | 124 | 186 | 2 | 2.5 | 0.6 | 1 | 300 | 730 | 600 | 2000 |
| River Disang At Gudamghat | 17 | 29 | 5.7 | 7.1 | 6.9 | 7.9 | 98 | 126 | 1.8 | 2.5 | 0.6 | 1.2 | 360 | 910 | 730 | 2300 |
| River Brahmaputra At Jogighopa Near Bridge | 20 | 36 | 5.4 | 7.2 | 7 | 7.8 | 146 | 170 | 2 | 2.7 | 0.7 | 2 | 600 | 1100 | 1200 | 2100 |
| River Burhidihing At Margherita | 20 | 23 | 5.2 | 8.9 | 7 | 7.9 | 106 | 148 | 2 | 2.5 | 0.6 | 1.1 | 360 | 730 | 910 | 1600 |
| River B. River At Panchagram | 19 | 23 | 6 | 6.3 | 6.8 | 7.4 | 102 | 134 | 2 | 2.7 | 0.6 | 0.9 | 620 | 1100 | 1400 | 2000 |
| River Brahmputra River At Dhenukhapahar | 18 | 26 | 7 | 7.7 | 6.8 | 7.4 | 120 | 146 | 2 | 2.5 | 0.7 | 1.5 | 360 | 1100 | 910 | 2000 |
| River Bhogdoi At Jorhat | 18 | 33 | 5.2 | 8.5 | 6.6 | 7.7 | 132 | 258 | 1.9 | 2.5 | 0.6 | 1.2 | 360 | 910 | 910 | 2000 |
| River Bharalu At Guwahati | 19 | 36 | 0.5 | 1 | 6.9 | 7.6 | 520 | 610 | 30.6 | 34 | 1.6 | 3.8 | 2300 | 2900 | 4200 | 5300 |
| River Digboi At Lakhipathe, Reserve Forest, Digboi | 21 | 24 | 2.4 | 5.9 | 6.8 | 7.8 | 140 | 268 | 3 | 3.4 | 0.6 | 2 | 300 | 940 | 720 | 2000 |
| River Mora Bharali At Tezpur | 19 | 30 | 3.8 | 5.4 | 6.9 | 7.4 | 132 | 242 | 3 | 3.4 | 0.8 | 1.8 | 360 | 940 | 1100 | 2000 |
| River Disang At Dillighat, Dibrugarh | 20 | 23 | 5.3 | 8.8 | 7 | 7.5 | 120 | 172 | 1.8 | 2.6 | 0.4 | 1.2 | 360 | 1100 | 910 | 2100 |
| River Kolong At Marigaon | 19 | 33 | 5 | 7.5 | 6.9 | 7.8 | 140 | 198 | 2 | 2.5 | 0.7 | 1.2 | 600 | 930 | 1000 | 2000 |
| River Manas At Nh-31 Crossing, Barpeta District | 18 | 32 | 5.1 | 5.5 | 6.9 | 7.7 | 132 | 168 | 1.9 | 2.7 | 0.6 | 1.5 | 600 | 730 | 1100 | 1500 |

| Name Of Monitoring Location | Temp (°C) | | DO (mg/L) | | pH | | Conductivity (µS/cm) | | BOD (mg/L) | | Nitrate (mg/L) | | Fecal Coliform (MPN/100ml) | | Total Coliform (MPN/100ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mn | Mx | Mn | Max | Mn | Mx | Min | Max | Min | Mx | Min | Mx | Min | Max | Min | Max |
| River Kharsang B/C With Buridihing Near Kharsang | 20 | 24 | 5.1 | 9 | 6.9 | 7.6 | 128 | 166 | 1.8 | 2.6 | 0.4 | 1 | 300 | 730 | 720 | 1600 |
| River Burhidihing Near Duliajan At D/S, Tinsukia | 20 | 24 | 5.1 | 9 | 6.7 | 7.7 | 122 | 178 | 2 | 2.7 | 0.6 | 1.1 | 620 | 1100 | 1400 | 2100 |
| River Jia Bharali At Biswanath Charali, Sonitpur | 14 | 25 | 6.6 | 7 | 7 | 7.5 | 126 | 142 | 2 | 2.5 | 0.7 | 1.5 | 300 | 730 | 910 | 2000 |
| River Brahmaputra At Chandrapur, Guwahati | 18 | 29 | 6.9 | 10 | 6.8 | 8 | 128 | 178 | 2 | 2.6 | 0.6 | 1.5 | 610 | 2800 | 1500 | 3600 |
| River Pagldia Near Nalbari Town, Dist. Nalbari | 17 | 33 | 5.8 | 9.9 | 7 | 8 | 142 | 230 | 2 | 2.6 | 0.6 | 0.9 | 610 | 1500 | 1100 | 2100 |
| River Brahmaputra At Dhubri | 18 | 34 | 5.2 | 6 | 6.8 | 7.4 | 130 | 160 | 2 | 2.5 | 0.7 | 1.2 | 620 | 1100 | 1500 | 2100 |
| River Brahmputra At Sualkuchi, Dist. Kamrup | 18 | 30 | 5 | 9.9 | 7.1 | 7.9 | 110 | 132 | 2 | 2.8 | 0.6 | 1 | 720 | 1500 | 1400 | 2100 |
| River Kathakal U/S At Matijuri, Dist. Hailakandi | 22 | 24 | 5.4 | 6.3 | 6.8 | 7.2 | 104 | 134 | 2 | 2.5 | 0.7 | 1.1 | 720 | 1500 | 1400 | 2100 |
| River Brahmputra Near Water Intake Point At Kacharighat, Panbazar, Guwahati | 19 | 32 | 5.4 | 9.9 | 7.2 | 7.8 | 132 | 214 | 2.1 | 2.5 | 0.6 | 1.5 | 360 | 1100 | 910 | 2700 |
| River Kundli At Kundli/ Sapakhowa, Sadia | 20 | 25 | 5 | 9.7 | 6.9 | 7.7 | 126 | 172 | 2 | 2.6 | 0.6 | 1.2 | 620 | 910 | 1400 | 1900 |
| River Burhidihing At Duliajan (Intake Point Of Oil India Ltd.) | 20 | 23 | 5 | 8.6 | 6.9 | 7.7 | 124 | 176 | 2 | 2.5 | 0.6 | 1 | 620 | 1100 | 1200 | 2800 |
| River Dikhow At Dikhow Bridge Sivasagar | 18 | 31 | 6 | 8 | 6.8 | 7.6 | 120 | 148 | 1.8 | 2.4 | 0.8 | 1.1 | 360 | 910 | 730 | 2100 |
| River Kohora At N.H. Crossing, Kohora (Brahmaputra) | 21 | 32 | 5.1 | 9.6 | 6.8 | 7.5 | 106 | 176 | 2 | 2.5 | 0.7 | 1.9 | 360 | 1100 | 1100 | 2100 |
| River Boginadi Near Bridge Nh-52, Lakhimpur | 19 | 32 | 5.5 | 6.3 | 7 | 7.9 | 116 | 138 | 2 | 2.4 | 0.5 | 1.7 | 620 | 930 | 1300 | 2000 |

| Name Of Monitoring Location | Temp (°C) | | DO (mg/L) | | pH | | Conductivity (µS/cm) | | BOD (mg/L) | | Nitrate (mg/L) | | Fecal Coliform (MPN/100ml) | | Total Coliform (MPN/100ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mn | Mx | Mn | Max | Mn | Mx | Min | Max | Min | Mx | Min | Mx | Min | Max | Min | Max |
| River Ranga Nadi D/S Of Hydel Project | 19 | 28 | 5.4 | 6.4 | 6.9 | 8 | 132 | 168 | 2 | 2.6 | 0.6 | 1.2 | 300 | 730 | 730 | 1500 |
| River Panchnoi At Nh-52 Crossing, Orang | 16 | 28 | 5.3 | 6.2 | 6.8 | 7.8 | 102 | 150 | 2.2 | 2.7 | 0.7 | 1.5 | 620 | 940 | 1300 | 2100 |
| River Kapili At Dharmtul Bridge, Nh-31, Morigaon | 19 | 30 | 5.2 | 9.2 | 6.8 | 7.6 | 120 | 166 | 2 | 2.5 | 0.7 | 1 | 360 | 930 | 910 | 1600 |
| River Kolong At U/S Of Anandaram Dekial Phukan Bridge, Nagaon | 18 | 29 | 5 | 7.4 | 6.8 | 7.5 | 116 | 176 | 2 | 2.5 | 0.8 | 1.2 | 720 | 1100 | 1500 | 2100 |
| River Beki At Nh-37 Crossing At Barpeta Road | 15 | 30 | 5.3 | 5.6 | 6.8 | 7.6 | 136 | 166 | 2 | 2.5 | 0.7 | 1.7 | 360 | 1100 | 1100 | 2000 |
| River Sankosh Dhubri | 18 | 33 | 5.2 | 5.4 | 6.8 | 7.6 | 128 | 152 | 2 | 2.5 | 0.6 | 1.2 | 360 | 1100 | 910 | 2000 |
| River B. At D/S Of Silchar | 20 | 24 | 5.1 | 5.6 | 7 | 7.3 | 90 | 116 | 2 | 2.6 | 0.6 | 1.2 | 300 | 1100 | 730 | 2800 |
| River Sonai At Sonai | 21 | 25 | 5.2 | 5.6 | 7.2 | 7.4 | 88 | 120 | 2.1 | 2.5 | 0.7 | 1 | 600 | 1100 | 1100 | 2000 |
| River Kushiara At Sribhumi | 19 | 24 | 5.4 | 6.8 | 7 | 7.3 | 84 | 108 | 2 | 2.5 | 0.6 | 1 | 360 | 730 | 910 | 1600 |
| River Dikrong Near Bridge At Nh-52, Bandardewa | 18 | 28 | 5.5 | 6.3 | 7 | 7.9 | 120 | 166 | 1.8 | 2.6 | 0.5 | 2 | 360 | 730 | 910 | 1600 |
| River Baroi Near Bridge At Nh-52, Biswanath District | 18 | 26 | 5.3 | 7 | 6.8 | 7.9 | 102 | 140 | 1.9 | 2.5 | 0.4 | 4 | 610 | 1100 | 1200 | 2000 |
| River Gabharu Near Bridge At Nh-52, Near Tumiuki, Sonitpur | 16 | 28 | 5 | 6.3 | 6.8 | 7.8 | 106 | 136 | 2.1 | 2.6 | 0.7 | 1.1 | 600 | 730 | 1100 | 1500 |
| River Dhansiri Near Bridge At Nh-15, Dhansiri Bhalukmari Jungle, Udalguri | 18 | 30 | 5.8 | 6.4 | 6.9 | 7.5 | 112 | 146 | 1.9 | 2.4 | 0.7 | 1.6 | 300 | 730 | 730 | 1500 |
| River Bega Mg Road, Mangaldoi | 18 | 32 | 5 | 6.2 | 7 | 7.6 | 90 | 130 | 3 | 3.3 | 0.7 | 1.5 | 910 | 1100 | 1600 | 2800 |
| River Nuwa Noi Near Bridge Over Boinaoja Para, Mangaldoi | 19 | 34 | 5.3 | 6.3 | 6.8 | 7.5 | 106 | 132 | 2 | 2.6 | 0.7 | 1.3 | 600 | 730 | 1100 | 1400 |
| River Kakodonga At Nh-37 Crossing | 18 | 34 | 4.8 | 6.5 | 6.5 | 7.9 | 102 | 138 | 2.1 | 2.4 | 0.6 | 1.2 | 300 | 730 | 730 | 1500 |

| Name Of Monitoring Location | Temp (°C) | | DO (mg/L) | | pH | | Conductivity (µS/cm) | | BOD (mg/L) | | Nitrate (mg/L) | | Fecal Coliform (MPN/100ml) | | Total Coliform (MPN/100ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mn | Mx | Mn | Max | Mn | Mx | Min | Max | Min | Mx | Min | Mx | Min | Max | Min | Max |
| River Bhogdoi (Pujadubi Ghat) Intake Point Of Urban Water Supply, Jorhat | 18 | 33 | 6 | 8.5 | 6.6 | 7.8 | 128 | 228 | 1.6 | 2.8 | 0.6 | 1 | 300 | 730 | 700 | 1100 |
| River Towkak At Sonari | 18 | 30 | 5.9 | 7.9 | 6.9 | 7.9 | 96 | 128 | 1.4 | 2.6 | 0.6 | 1 | 360 | 730 | 730 | 2100 |
| River Suffry At Maibella | 18 | 34 | 5.5 | 7.9 | 6.5 | 7.1 | 128 | 202 | 1.8 | 2.3 | 0.6 | 1.3 | 300 | 360 | 720 | 910 |
| River Dikhow At Nagini Mora (Inter-State Boundaries, Assam-Nagaland) | 18 | 30 | 5.7 | 8.5 | 6.7 | 7.5 | 120 | 162 | 1.7 | 2.6 | 0.6 | 1.2 | 360 | 910 | 1100 | 2100 |
| River Dorika Near Msw Dumping Site, Sivasagar | 18 | 33 | 4.2 | 6 | 6.6 | 7.9 | 102 | 208 | 1.9 | 2.8 | 0.6 | 1.3 | 730 | 1100 | 1500 | 2800 |
| River Dikhow At Dikhowmukh Confluence With Brahamputra | 17 | 32 | 5.8 | 8 | 6.7 | 7.8 | 132 | 209 | 1.8 | 2.4 | 0.8 | 1.1 | 300 | 730 | 730 | 2800 |
| River Sessa Near Sessa Tiniali, Nh Bridge, Dibrugarh | 19 | 26 | 5 | 8.9 | 7 | 7.6 | 110 | 182 | 2 | 2.6 | 0.8 | 1.7 | 300 | 730 | 910 | 1900 |
| River Brahamputra At Bogibeel Bridge, Bogibeel, Dibrugarh | 20 | 28 | 5 | 8.7 | 7 | 7.4 | 120 | 146 | 2 | 2.5 | 0.6 | 1 | 300 | 1100 | 730 | 2100 |
| River Tingrai Near Tinsukia Msw Dumping Site, Itakhola | 20 | 26 | 5.3 | 10.2 | 6.8 | 7.8 | 114 | 184 | 2 | 2.8 | 0.6 | 2 | 620 | 1100 | 1300 | 2000 |
| River Gai Nadi At Somarajan, Dhemaji | 19 | 23 | 5.2 | 8.8 | 6.9 | 7.8 | 124 | 174 | 2 | 2.7 | 0.6 | 1 | 360 | 730 | 910 | 1400 |
| River Jiadhal Kumotiya River Near Jiadhal Bridge, Dhemaji | 18 | 23 | 5 | 8.3 | 6.8 | 7.5 | 120 | 174 | 2.1 | 2.5 | 0.6 | 1.1 | 360 | 730 | 1100 | 1500 |
| River Kaliani Near Kanaighat Bridge, Kanaighat | 21 | 31 | 5.8 | 9.6 | 7 | 7.7 | 120 | 148 | 2 | 2.4 | 0.5 | 1.2 | 360 | 1100 | 910 | 2000 |
| River Dhansiri At Jahaighat | 21 | 32 | 5.6 | 10.1 | 6.8 | 7.4 | 122 | 154 | 2 | 2.5 | 0.6 | 1.4 | 620 | 1400 | 1300 | 2100 |
| River Kuji (Near New Bogagigaon) Near Water Intake Point For Nf Railway | 20 | 36 | 5.2 | 5.5 | 6.8 | 7.5 | 140 | 166 | 2 | 2.6 | 0.6 | 1.3 | 360 | 1100 | 1100 | 2100 |

| Name Of Monitoring Location | Temp (°C) | | DO (mg/L) | | pH | | Conductivity (µS/cm) | | BOD (mg/L) | | Nitrate (mg/L) | | Fecal Coliform (MPN/100ml) | | Total Coliform (MPN/100ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mn | Mx | Mn | Max | Mn | Mx | Min | Max | Min | Mx | Min | Mx | Min | Max | Min | Max |
| River Manas (Santoshpur) Near Lengtisinga | 19 | 34 | 5.2 | 8 | 6.8 | 7.5 | 106 | 156 | 1.9 | 2.7 | 0.6 | 1.1 | 600 | 910 | 1100 | 2100 |
| River Killing In Morigaon District | 17 | 32 | 5.1 | 8.9 | 6.9 | 7.8 | 84 | 106 | 1.8 | 2.5 | 0.6 | 1.2 | 300 | 1100 | 910 | 2100 |
| River Madhura At Madhuraghat, Cachar | 18 | 28 | 5 | 5.5 | 6.8 | 7.2 | 98 | 172 | 2 | 2.7 | 0.6 | 1.2 | 360 | 940 | 1100 | 2000 |
| River Digaru At Nh Crossing | 18 | 28 | 4.2 | 8 | 7 | 7.6 | 98 | 132 | 2 | 2.4 | 0.6 | 1.1 | 600 | 1100 | 1200 | 2000 |
| River Kulsi At Chaygaon Near Nh37 Crossing | 18 | 32 | 5 | 10.4 | 7 | 7.8 | 96 | 170 | 2.1 | 2.7 | 0.6 | 0.9 | 620 | 1100 | 1100 | 2100 |
| River Puthimari Near Puthimari Chowk At Nh Crossing | 18 | 34 | 6.4 | 9 | 7.2 | 8 | 122 | 176 | 2.1 | 2.7 | 0.6 | 1.3 | 620 | 1100 | 1400 | 2300 |
| River Brahmaputra At Biswanath Ghat | 16 | 33 | 7.1 | 7.6 | 6.8 | 7.9 | 92 | 168 | 1.8 | 2.7 | 0.7 | 1.1 | 360 | 1100 | 730 | 2100 |
| River Disang At Nh Crossing | 17 | 31 | 5.5 | 7.2 | 6.7 | 7.7 | 96 | 176 | 1.6 | 2.6 | 0.7 | 1.1 | 300 | 1100 | 730 | 2000 |
| River Tocklai Near Bridge At Jorhat | 18 | 34 | 5 | 6.7 | 6.6 | 7.8 | 138 | 272 | 2.3 | 2.9 | 0.7 | 1.4 | 360 | 1100 | 1400 | 2800 |
| River Tunia At D/S Brpl | 20 | 35 | 5.1 | 6.7 | 6.8 | 7.8 | 138 | 188 | 1.9 | 2.8 | 0.7 | 1.5 | 720 | 940 | 1200 | 1900 |
| River Larsing Near Locl Depo At Moinarbond | 17 | 31 | 5.1 | 5.4 | 7 | 7.3 | 92 | 158 | 2 | 2.3 | 0.7 | 1.2 | 300 | 730 | 940 | 1500 |
| River Dhateshwari D/S Of Hailakandi | 20 | 24 | 4.6 | 5.8 | 6.6 | 7.2 | 122 | 166 | 2 | 2.8 | 0.7 | 1.3 | 360 | 730 | 910 | 1600 |
| River Demow At Demow Town | 19 | 33 | 5.2 | 7.9 | 6.8 | 7.7 | 108 | 162 | 1.7 | 2.8 | 0.8 | 1.1 | 360 | 910 | 910 | 2300 |
| River Borsila At Borsila, Deopani, Namti | 18 | 31 | 5 | 8.5 | 6.6 | 7.4 | 83 | 126 | 1.8 | 2.6 | 0.6 | 1.1 | 360 | 910 | 730 | 2100 |
| River Barnadi Near Bridge, Nh-52, Dumunichowki Kamrup | 18 | 37 | 5.9 | 9.8 | 7 | 7.8 | 90 | 144 | 2 | 2.4 | 0.5 | 0.9 | 360 | 910 | 910 | 2000 |
| River Baralia (Near Chatpuja Ghat) Rangia, Kamrup | 18 | 36 | 6.9 | 9 | 7.1 | 7.9 | 128 | 176 | 2 | 2.7 | 0.6 | 0.9 | 620 | 1100 | 1100 | 2100 |
| River Buralia (Near Bridge Along Nh-31) Nalbari | 18 | 33 | 5.1 | 8.5 | 7 | 8 | 116 | 172 | 2.1 | 2.6 | 0.5 | 1 | 600 | 910 | 1200 | 2000 |
| River Tihu (Near Bridge Along Nh-31) Tihu, Nalbari | 17 | 32 | 5 | 9.6 | 6.8 | 8 | 105 | 136 | 2 | 2.5 | 0.6 | 0.9 | 620 | 930 | 1400 | 2000 |

| Name Of Monitoring Location | Temp (°C) | | DO (mg/L) | | pH | | Conductivity (µS/cm) | | BOD (mg/L) | | Nitrate (mg/L) | | Fecal Coliform (MPN/100ml) | | Total Coliform (MPN/100ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mn | Mx | Mn | Max | Mn | Mx | Min | Max | Min | Mx | Min | Mx | Min | Max | Min | Max |
| River Singra (Near Bridge Along Nh-37) Boko, Kamrup | 18 | 31 | 5.5 | 10.4 | 6.9 | 7.6 | 102 | 138 | 2 | 2.5 | 0.6 | 1 | 360 | 910 | 910 | 2100 |
| River Aie Near Rakhaldubi Dist., Bongaigaon | 19 | 34 | 5.1 | 6.7 | 6.8 | 7.4 | 116 | 166 | 2 | 2.4 | 0.6 | 0.9 | 300 | 940 | 910 | 1600 |
| River, Tunia U/S Brpl, Dhaligaon, Dist. Chirang | 19 | 35 | 4.6 | 5.4 | 6.9 | 7.6 | 122 | 162 | 2 | 2.6 | 0.6 | 1.8 | 360 | 720 | 1100 | 1600 |
| River Jamuna At Doboka Near Bridge, Dist. Hojai | 19 | 31 | 5 | 8.2 | 6.9 | 7.6 | 126 | 156 | 2.1 | 2.5 | 0.6 | 1.6 | 360 | 1100 | 910 | 2100 |
| River Bondanjan, Sluice Gate, Birkuchi Narengi Tiniali, Kharghuli, No. 2 | 19 | 30 | 5 | 6.3 | 6.9 | 7.6 | 116 | 168 | 2 | 2.6 | 0.6 | 1.4 | 360 | 2100 | 1100 | 3600 |
| River Basistha Chariali, Nutan Bazaar, Guwahati | 19 | 33 | 4.5 | 7.9 | 6.9 | 7.8 | 120 | 168 | 2 | 2.6 | 0.4 | 1.1 | 1500 | 2100 | 2700 | 3600 |
| River Pamohi Gachuk, Pamohi Road, Guwahati | 19 | 34 | 3.8 | 7 | 7 | 7.5 | 162 | 254 | 2 | 2.6 | 0.6 | 1.4 | 1400 | 2000 | 2400 | 3400 |
| River Gadadhar At Golkganj Bridge | 16 | 32 | 4.8 | 6.1 | 6.8 | 7.4 | 120 | 234 | 2 | 2.5 | 0.6 | 1.2 | 360 | 1500 | 1100 | 2700 |
| River Namdang near bridge at hati patty geleky | 18 | 31 | 5 | 7.7 | 6.5 | 7 | 120 | 208 | 1.7 | 2.5 | 0.6 | 1.4 | 300 | 730 | 700 | 1500 |
| River Namdang At Kalugaon | 18 | 30 | 5.1 | 7.8 | 6.5 | 7 | 110 | 196 | 2 | 2.6 | 0.7 | 1.3 | 300 | 720 | 730 | 1400 |
| River Kapili At Kheroni Ghat Near Bridge, West Karbi Anglong, Kheroni | 19 | 29 | 5.3 | 8 | 6.8 | 7.6 | 118 | 176 | 2 | 2.5 | 0.6 | 1 | 360 | 930 | 910 | 2000 |
| River Daloo At Daloo, Cachar | 20 | 28 | 5.1 | 6.3 | 7.2 | 7.5 | 128 | 140 | 2.1 | 2.7 | 0.6 | 1 | 360 | 930 | 730 | 2000 |
| River Ego (Simen) Near Simenchapori Bridge,Dhemaji | 20 | 24 | 5 | 8.6 | 6.9 | 8 | 140 | 198 | 2 | 2.6 | 0.6 | 1 | 300 | 730 | 620 | 1500 |
| River Disang at Nangalmara Ghat | 17 | 29 | 5.5 | 7.5 | 7 | 7.7 | 120 | 192 | 1.8 | 2.5 | 0.7 | 1.2 | 360 | 910 | 730 | 2800 |
| River Dikhow at Simaluguri | 19 | 29 | 6.5 | 7.9 | 7 | 7.8 | 120 | 156 | 1.6 | 2.7 | 0.6 | 1.1 | 360 | 1100 | 1100 | 2800 |
| River TIHU At D/S Of Industrial Area Near Helochapara Shiva Temple | 18 | 32 | 5.1 | 9.9 | 7 | 7.8 | 116 | 198 | 2 | 2.6 | 0.7 | 1 | 360 | 1500 | 910 | 3500 |

| Name Of Monitoring Location | Temp (°C) | | DO (mg/L) | | pH | | Conductivity (µS/cm) | | BOD (mg/L) | | Nitrate (mg/L) | | Fecal Coliform (MPN/100ml) | | Total Coliform (MPN/100ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mn | Mx | Mn | Max | Mn | Mx | Min | Max | Min | Mx | Min | Mx | Min | Max | Min | Max |
| River Kulsi At Kukurmara | 17 | 33 | 5.3 | 10.4 | 6.8 | 7.6 | 90 | 120 | 2 | 2.5 | 0.6 | 0.9 | 360 | 940 | 1400 | 2000 |
| River Tunia At New Bongaigaon Railway Station | 21 | 35 | 5 | 5.8 | 7 | 7.4 | 128 | 156 | 2 | 2.6 | 0.6 | 1.2 | 300 | 1500 | 1100 | 2800 |
| River Brahmaputra At Matia (Bahati Ghat) | 19 | 36 | 5.4 | 6.4 | 7 | 7.3 | 120 | 136 | 2 | 2.3 | 0.7 | 0.9 | 360 | 1100 | 910 | 2700 |
| River Mornoi At Mornoi Ghat | 19 | 35 | 5.2 | 5.6 | 7 | 7.4 | 90 | 122 | 2 | 2.6 | 0.6 | 1.2 | 300 | 1100 | 610 | 2000 |
| River Brahmaputra Newr Dhola Sadia Bridge | 20 | 26 | 5.5 | 9.4 | 6.9 | 7.8 | 98 | 132 | 2 | 2.5 | 0.6 | 0.8 | 730 | 1500 | 1500 | 2800 |
| River Doomdooma At D/S Of Doomdooma Town at Hansara | 20 | 25 | 5.1 | 9.4 | 6.8 | 8.1 | 122 | 136 | 2 | 2.5 | 0.6 | 0.9 | 300 | 1500 | 720 | 3500 |
| River Bega At D/S Of Mangaldoi Town | 18 | 32 | 4.8 | 5.8 | 7 | 7.5 | 92 | 132 | 2.4 | 3.4 | 0.6 | 1 | 620 | 1900 | 1500 | 3500 |
| River Ghogra Near Iti, Srikona Main Block | 16 | 24 | 5.5 | 6.3 | 7 | 7.2 | 103 | 134 | 2 | 2.5 | 0.6 | 0.9 | 360 | 2000 | 910 | 3500 |
| River Tunia at NH near BGR | 20 | 35 | 4.3 | 5.6 | 7 | 7.7 | 126 | 150 | 2.1 | 2.7 | 0.7 | 1 | 620 | 1500 | 1300 | 3500 |

**Source: NWCP, 2023-24, Assam Pollution Control Board**

# Annexure A20: Beel Monitoring Report

Summary of Findings

The water quality assessment of 15 beels located across five zones in Assam was conducted for ADB-funded SWIFT project. M/s Advanced Environmental Testing and Research Lab (AETRL), carried out field investigations and analysis between August and September 2024. Of the 25 parameters tested, pH, Dissolved Oxygen (DO), and conductivity were measured on-site, while the remaining parameters were analyzed in the laboratory. The pH of these wetlands ranged from 6.3 to 7.8, with an average of 6.9, indicating slightly acidic conditions, which reflect the some of the wetlands' richness in organic matter. Secchi depth measurements, indicating water clarity, ranged from 0 to 1.5 meters, with an average of 0.7 meters. According to the norms, hyper-eutrophic lakes generally exhibit maximum transparency values of ≤ 1.5 meters and minimum transparency of ≤ 0.7 meters. The present data indicate that the studied beels are highly productive ecosystems with a shallow euphotic zone due to the growth of water hyacinth, which can disrupt the overall limnology and fish species diversity in the beel. Surface water DO levels ranged from 6.2 to 7.8 mg/L, with all values exceeding the Class C water standard of 5.0 mg/L, signifying adequate oxygenation. However, Biochemical Oxygen Demand (BOD) levels (2.5-3.9 mg/l), averaging 3.2 mg/L, slightly exceeded the inland surface water threshold of 3 mg/L, suggesting organic pollution. The analysis also showed Chemical Oxygen Demand (COD) concentrations between 6.5 mg/L and 10.2 mg/L, and nitrogen levels were recorded as relatively high, indicating productive ecosystems. Total nitrogen varied from 2.1 mg/L to 5.2 mg/L, while nitrate concentrations ranged from 0.5 to 3.2 mg/L. Inorganic phosphate levels were noted to be slightly elevated, ranging from 0.02 to 0.65 mg/L, with the U.S. EPA threshold for eutrophic conditions set at 0.035 mg/L. Coliform bacteria were present but within safe limits, with total coliforms recorded between 2290-2900 MPN/100 ml and faecal coliforms in the range of 1060-1610 MPN/100 ml, all below the Class C limit.

Sediment analysis revealed Total Organic Carbon (TOC) content between 0.8% and 1.3%, reflecting varying levels of organic matter. Phosphorus concentrations in the sediment ranged from 30.6 Kg/Ha to 56.1 Kg/Ha, suggesting differing nutrient inputs, likely influenced by agricultural runoff. Nitrogen levels varied from 483 Kg/Ha to 604.8 Kg/Ha, affecting primary productivity and the risk of eutrophication. Heavy metal concentrations, including arsenic, lead, manganese, and zinc, were generally within safe limits but showed variability across the wetlands. This comprehensive assessment provides crucial insights into the water and sediment quality of Assam's beels.

Biodiversity Survey was also conducted to assess the flora and fauna found in and around selected beels, utilizing a combination of primary site surveys and analysis of secondary information from various research articles and reports. The findings indicate that no threatened species were recorded within the examined village beels during the survey period, suggesting that the current biodiversity status in these areas does not include any species classified as threatened. Additionally, none of the studied beels were located within Protected Areas (PAs) or Key Biodiversity Areas (KBAs).

1.0 Background:




Assam's beels, vital inland water resources, play a multifaceted role. They are key players in the region's water cycle, nurture rich biodiversity, regulate floods, and sustain local communities through essential livelihood resources. However, human activities increasingly threaten their water quality. Clean beel water is paramount for their ecological and economic value. Beels provide water for human use, harbour diverse fish and aquatic life for food, and support overall health through a balanced ecosystem. This balance relies on physical, chemical, and biological factors in the water and their regular monitoring is crucial. It identifies changes that could harm the entire beel environment, detects pollution or runoff variations early, and allows timely intervention to prevent further damage. Monitoring is also essential for fish health, as their growth and survival depend heavily on water quality.

Table 1 : Scope of Work of Present Assignment

| *S. No* | *Parameters* | *No. of Samples per beels* | *Total number Samples to be collected* |
|---|---|---|---|
| *1* | Water Quality Assessment<br>General Physico-chemical Parameters<br>1. Temperature<br>2. pH<br>3. Electrical conductivity (EC)<br>4. Dissolved Oxygen (DO) (Surface and Bottom Sample of Water)<br>5. Secchi depth Transparency<br>6. Total dissolved solid (TDS)<br>7. Total Alkalinity<br>8. $CO_2$<br>9. Total Hardness<br>10. Ammoniacal nitrogen (NH4-N)<br>11. Nitrate (NO3)<br>12. Inorg. Phosphate<br>13. Total Nitrogen<br>Demand parameter<br>14. Bio-chemical Oxygen Demand (BOD)<br>15. Chemical Oxygen Demand (COD)<br>Major ions:<br>16. Calcium (Ca++)<br>17. Magnesium (Mg++)<br>Microbiological<br>Total Coliform and fecal coliforms<br>Metals<br>As, Pb, Fe Mn, Cu, Zn (mg/l) | *At least 1 sample in shallow and 1 in deeper zone* | 30 Samples<br><br><br>3 Beels per Zone Total (Max. 15 beels) (To be identified |

| *S. No* | *Parameters* | *No. of Samples per beels* | *Total number Samples to be collected* |
|---|---|---|---|
| *2* | Sediment quality Assessment:<br>• Total Organic Carbon<br>• Total phosphorous (mg/kg)<br>• Total Nitrogen (mg/kg)<br>• Potassium (mg/kg)<br>• As, Pb, Fe Mn, Cu, Zn (mg/kg) | *At least 1sample* | 15 Samples<br><br>3 Beels per Zone Total (Max. 15 beels) (To be identified) |
| *3* | *Biodiversity/Ecological Survey:*<br>• Phytoplankton's (diversity and density)<br>• Zooplankton's (diversity and density)<br>• Benthic fau | *At least 1 sample* | 3 Beels per Zone Total (Max. 15 beels) (To be identified |
| *4* | Terrestrial Wildlife/ Aquatic Biodiversity Assessment and Mammals/ Avi fauna based on site visit and secondary source information to be carried out with the help of wildlife expert<br>• Fish species based on catch survey/secondary information<br>• Identification of Submerged, Emergent, and Floating Macrophytic diversity | *15 sites* | 3 Beels per Zone Total (Max. 15 beels) (To be identified |

In view of the above, Water Quality Assessment for 15 identified Beels located in 5 zones of Assam are carried out under the ADB funded project. ADB consultant has appointed M/s Advanced Environmental Testing and Research Lab (AETRL), New Delhi for carrying out this work under SWIFT project. This report is an overview of the findings of the field investigations and analysis carried out during August -September 2024. Under the assignment, not only water samples were collected for aquatic biodiversity Assessment. Information on mammals and birdlife (avifauna) have been compiled from secondary sources, supplemented by discussions with local officials and indigenous communities.

2.0 Scope of Work:

The scope includes collection, preservation, transportation, and analysis of water samples collected from 15 wetlands located various clusters of Assam State. Baseline water quality data will be used to identify the extent of degradation in water quality and pollution load in these wetlands. This data would also be used to identify interventions to restore the wetlands through conservation methods. The scope of work for the present assignment is depicted in Table 1 while Details of Sampling Site, GPS Coordinates are presented in Table 2.

3.0 Methodology Adopted:

As per the defined ToR and scope of works, AETRL Pvt. Ltd. has collected 30 water samples from 15 wetlands. Samples were collected, preserved, transported and analysed as per standard procedure laid down in Water and Wastewater Analysis published by American Public Health Association (APHA 2012). Out of the total 25 parameters, some water quality parameters viz. pH, DO, and Conductivity was analysed at the site to avoid any variation. For other parameters, the samples collected were brought to the laboratory for analysis. The methodologies were adopted from APHA/IS methods and their numbers are also incorporated in the result tables mentioned in Annexure 1. Brief descriptions of key methods are summarized in the preceding paragraphs.

The physical parameters like temperature and pH were measured in the field with calibrated digital thermometer and hand-held pH meter. pH was further confirmed in the laboratory and no difference was observed as samples were preserved appropriately.

Electrical Conductivity was assessed through calibrated conductivity meter taking 0.01M KCl solution. While total dissolved solid (TDS) and suspended solids (SS) was measured gravimetrically by drying at 180 °C and 105 °C, respectively.

The ammonical nitrogen (NH3-N) was determined through titrimetric method after distillation. The nitrate was measured through Ultraviolet spectrophotometric screening method, taking potassium nitrate as standard and taking absorbance at 220 nm and 275 nm. Hardness was measured by EDTA titrimetric method. For analysis of calcium, calcium hardness was determined first and then calcium was determined through calculation method.

As far as alkalinity is concern, it was determined through titration method taking sodium carbonate as standard. The carbonate and bicarbonates were measured through calculation method. Total phosphorus was measured through the stannous chloride method taking anhydrous KH2PO4 as standard and taking absorbance at 690 nm. Pollution indicating parameters such as BOD was determined through 5-days BOD test as prescribed in Standard Methods while COD was analyzed through open-reflux method. Sulphate was assessed through turbidimetric method using barium sulphate turbidity to form a calibration curve and determining sulphate through spectrophotometer at 420 nm. Chloride was assessed through Argentometric method using sodium chloride as standard. Sodium and potassium were determined through flame emission photometric method. All the other metals were determined through flame atomic absorption spectrophotometry (AAS-Perkin Elmer 700) while coliforms bacteria were measured by MPN method. In addition to water samples, sediment samples were analysed by adopting Lab SOP prepared based on ASTM/IS methods

For biological parameters, sampling and identification of the phytoplankton and zooplankton was carried out with the help of standard books (Welch 1948, Edmondson,1959; Pennak, 1958; Fitter and Manuel, 1986, and others). Macrofaunal diversity was identified under the Metzer light microscope and highly magnified hand lens with the help of standard keys and manuals, Needham and Needham (1962), Mike et al. (2005), Pennak (1989), Subba Rao, (1989) and Chandra (1991).

Table 2: Details of Sampling Site, GPS Coordinates and Date of sampling

| S.No. | Beel | District | Sample Code | Wetland Coordinates |
|---|---|---|---|---|
| 1. | Mahara Anchilik beel | Lakhimpur | S1 | 94.218548 27.168044 |
| 2. | | | S2 | |
| 3. | Tekidubi | | S3 | 94.231383 27.157987 |
| 4. | | | S4 | |
| 5. | Dalpung Beel | Dhemaji | S5 | 94.591938 27.408491 |
| 6. | | | S6 | |
| 7. | 3 No Borhullung Lonkadeep Beel | Tinsukia | S7 | 95.792891 27.558384 |
| 8. | | | S8 | |
| 9. | Moridesoi Beel | Jorhat | S9 | 94.075971 26.802893 |
| 10. | | | S10 | |
| 11. | Sawaguri | | S11 | 94.01336 |

| S.No. | Beel | District | Sample Code | Wetland Coordinates |
|---|---|---|---|---|
| 12. | | | S12 | 26.755606 |
| 13. | Bhagampur | Nagaon | S13 | 92.832905 |
| 14. | | | S14 | 26.432918 |
| 15. | Sapekhality | | S15 | 92.65910 |
| 16. | | | S16 | 26.29507 |
| 17. | Bechamari Beel | Morigaon | S17 | 92.272647 |
| 18. | | | S18 | 26.170827 |
| 19. | Morikolong | | S19 | 92.400785 |
| 20. | | | S20 | 26.249291 |
| 21. | Purani Beel | Dhubri | S21 | 90.158246 |
| 22. | | | S22 | 26.312896 |
| 23. | Udmari Chora | | S23 | 90.241719 |
| 24. | | | S24 | 26.282528 |
| 25. | Chalantapara Beel | Bongaigaon | S25 | 90.593879 |
| 26. | | | S26 | 26.264415 |
| 27. | Tiayakuri Beel | Sribhumi | S27 | 92.448926 |
| 28. | | | S28 | 24.75722 |
| 29. | Gojarala Beel | | S29 | 92.471825 |
| 30. | | | S30 | 24.759895 |

4.0 Results and Discussion:

As per assigned ToR, a total of 25 parameters were analysed in 30 water samples collected from 15 Wetlands located in various districts of Assam, India. Apart from this, 15 samples of sediments were also collected and analysed for nutrients and heavy metals. Complete results of the water quality and biodiversity assessment of these wetlands are summarized in Annexure 1 to Annexure 5 and depicted in Fig.1-Fig.4. Flora and fauna assessed during the study is also summarized in Annexure 6 of this report.

Out of the total 25 parameters, some of the key pollution indicating and important limnological parameters were chosen for discussion and interpretation which are summarized below in subsequent sections of the report.

4.1 Assessment of Physico-chemical Water Quality of Wetlands:

The water pH of these wetlands varied between 6.3 and 7.8, with an average value of 6.9. In the majority of wetlands, pH values were recorded as slightly acidic, indicating that these wetlands are rich in organic matter. The decomposition of plant material produces organic acids, which may contribute to the lower pH. However, in most of the wetlands, the pH values were found to be well within the tolerance limits of inland surface water quality standards (Class C).

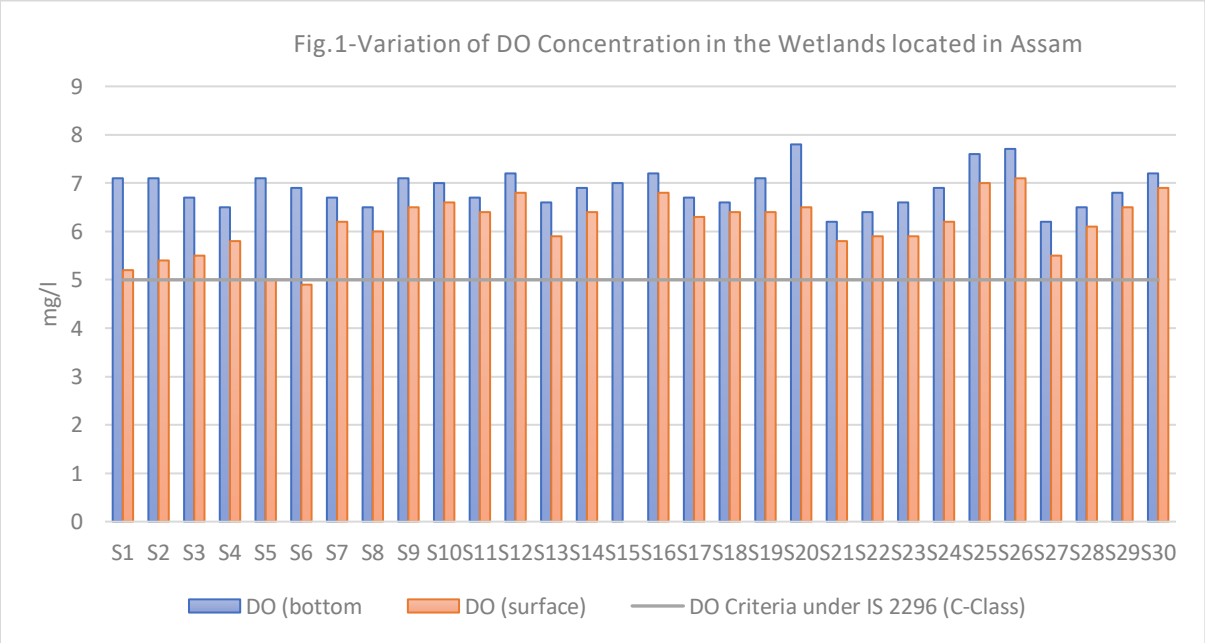
Secchi disc transparency depth is the simplest, most extensive and appropriate parameter for determination of ecosystem health. In studied wetlands, secchi depths were recorded in between Nil-1.5 m with average value of 0.7 meter. The Organization for Economic Cooperation and Development (OECD, 1982) has developed the boundary values of transparency for several types of lakes. As per the norms, the hyper-eutrophic lakes generally show the maximum transparency

values ≤ 1.5 m and minimum transparency ≤ 0.7 m. Thus, present data indicate Assam wetlands are more productive ecosystem having low euphotic zones due to growth of water hyacinth that can hamper entire beel limnology and fish species.

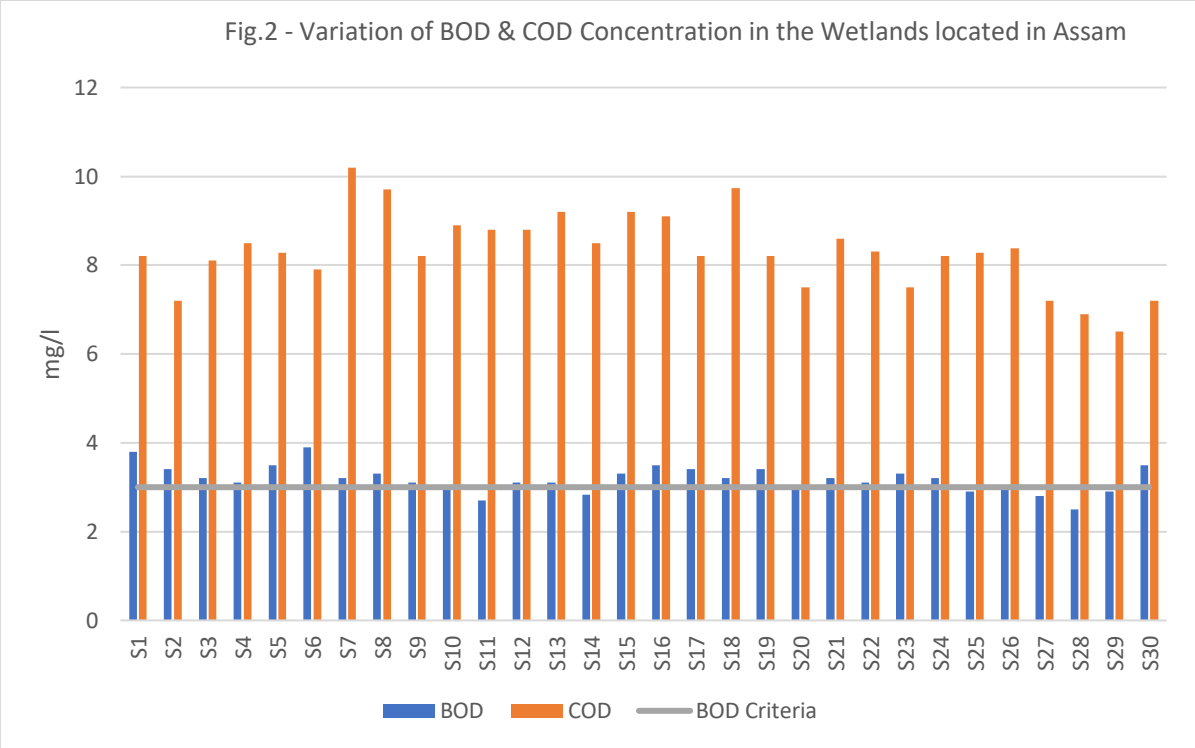
The hardness of a water body is mainly governed by the content of calcium and magnesium salts largely combined with bicarbonate, carbonate, sulphate's, chlorides and other anions. In studied wetlands, total hardness of water was recorded in the range 20 to -220mg/l with an average concentration of 79.8 mg/l.

Total dissolved solids in a water body indicate the magnitude of anthropogenic disturbances in the catchment and suspended and dissolved solids in wetland water. In wetlands located in various districts of Assam, TDS was recorded in between 52 to 270 mg/l with an average value of 119.5. TDS values were found well within the tolerance limit of 1500 mg/L (Class C-IS 2296).

Dissolved oxygen in water is essential for the respiratory metabolism of most aquatic organisms. Decreased levels of oxygen are considered a reliable parameter for assessing the process of eutrophication. The dissolved oxygen (DO) concentration in collected surface water samples ranged from 6.2 to 7.8 mg/L, with an average concentration of 6.9 mg/L. In the bottom samples, DO levels varied from 4.9 to 7.1 mg/L, also with an average value of 6.1 mg/L. Despite the slightly lower concentration of DO in the bottom samples, all recorded values were well above the desired criteria of 5.0 mg/L for Class C water (Fig.1).

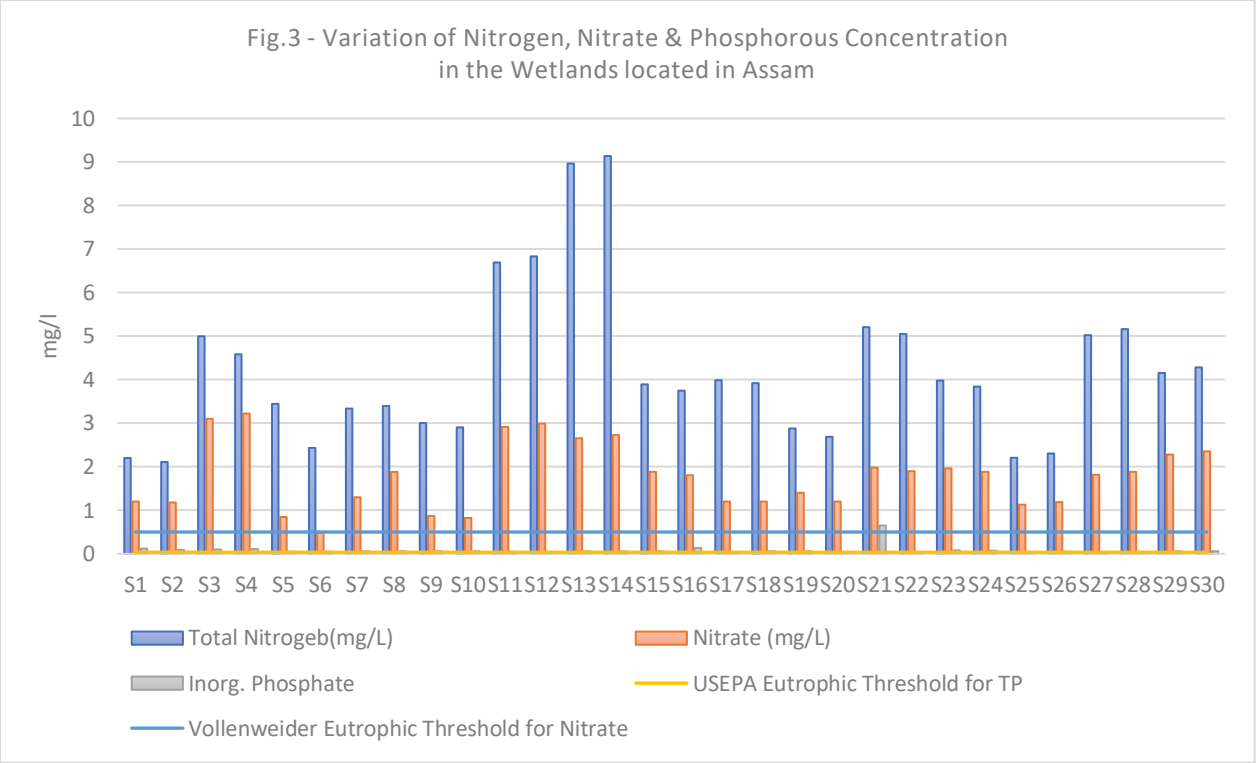



Biochemical oxygen demand (BOD) is a pollution-indicating parameter. Input of a large amount of sewage effluents, human excreta, etc are known to cause an increase in BOD levels. In studied wetlands, BOD concentration ranged from 2.5 mg/L to 3.9 mg/L with an average value of 3.2 mg/l. In the present case, the average value of BOD was recorded as slightly higher than the threshold limit of BOD for inland surface water (3 mg/L). In the present study, BOD values indicate the organic pollution in these wetlands. However, COD concentration ranged low and was found between 6.5 mg/L to 10.2 mg/L. with average value of 8.3 mg/l. COD was strongly correlated with BOD concentration. Variation of BOD and COD Concentration in wetlands located in the Bareilly district is shown in Fig.2.

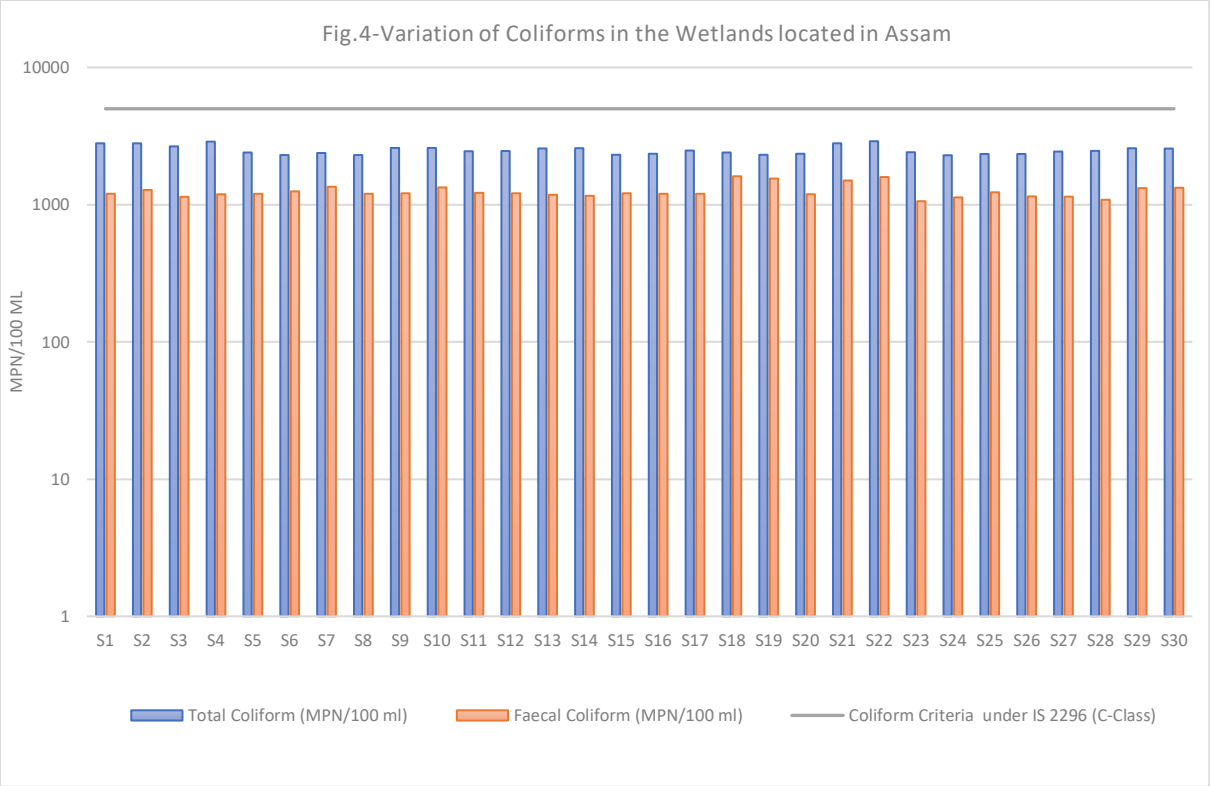



Nitrogen is one of the most important causative agents of eutrophication. In aquatic ecosystems, inorganic nitrogen exists in the forms of ammonia, nitrate and nitrite, of these; nitrate-nitrogen is the commonest form. In collected samples, the concentration of nitrate nitrogen was found slightly high. A high concentration of NO3-N had also been taken as an index of eutrophication. Vollenweider (1968) classified the trophic status of the lakes based on total amount of inorganic nitrogen and lakes having 500-1500 µg/l of inorganic nitrogen are considered as eu-polytrophic lakes. The concentration of Total Nitrogen and nitrate at most of the locations was recorded high to this criterion and varied between 2.2 mg/l to 5.2 mg/l and 0.5-3.2 mg/l respectively that indicating productive ecosystems.

Another key nutrient, Inorg. phosphate concentration was found slightly high in these wetlands (0.02-0.65 mg/). U.S. EPA (2000) chose the limit for TP for defining eutrophic is 0.035 mg/l. In the present study, at most of the location, even alone Inorg. Phosphate concentration was observed higher than the prescribed limit for eutrophication. Variation of nutrients parameters Nitrogen, Nitrate and Phosphate concentration in wetlands located in Assam is shown in Fig.3.




Total coliform counts were recorded between 2290-2900 MPN/100ml while faecal coliforms were also detected in the range of 1060-1610 MPN/100ml. At most of the locations, total Coliforms counts were recorded well below the Class C limits of Coliforms (5000MPN/100 ml). Variation in coliforms counts is depicted in Fig. 4




In present study, metals concentrations in all the samples collected from both the wetlands were found below the permissible limits of drinking water standards (BIS 10500). Iron was recorded in between 0.02-0.16 mg/l while Zinc was recorded 0.53 -1.85 mg/l. other Metals such as lead, manganese, arsenic and cupper were recorded BDL.

4.2 Assessment of Sediment Samples:

This report presents the results of the sediment analysis conducted on samples collected from 15 beels. The analysis was performed to determine the levels of Total Organic Carbon (TOC), Total Phosphorus, Total Nitrogen, Potassium, and selected heavy metals (As, Pb, Fe, Mn, Cu, and Zn) in the sediments. These parameters provide insights into the sediment quality and potential ecological impacts on the beel ecosystems. Fifteen sediment samples were collected from 15 different beels. Each sample was taken from the top 10 cm of the sediment layer using a sediment core sampler.

The TOC content in the sediment samples ranged from 0.8% to 1.3%, with an average of 0.9%. This range indicates varying levels of organic matter across the beels, reflecting differences in organic inputs and decomposition rates. Phosphorus concentrations ranged between 30.6 Kg/Ha to 56.1 Kg/Ha, with an average of 45.2 Kg/Ha. This wide range suggests variability in nutrient loading, possibly due to differences in agricultural runoff or natural inputs. Total nitrogen levels varied from 483 Kg/Ha to 604.8 Kg/Ha with an average of 536.3 Kg/Ha. These values indicate differing levels of nitrogen availability, which can impact primary productivity and potential eutrophication. Potassium content ranged from 114 Kg/Ha to 218 Kg/Ha averaging 164.5 Kg/Ha . This variation highlights differences in sediment mineral composition, which could affect the growth of aquatic vegetation.

The concentrations of heavy metals such as As, Pb, Mn and Zn are generally within safe limits for sediments but show variability, suggesting possibly due to agricultural runoff or natural mineralization processes.

4.3 Assessment of Aquatic Biodiversity of Wetlands:

The community composition of plankton communities, benthos, and aquatic macrophytes was assessed at all 15 beels. A total of 53 species of phytoplankton were recorded in which 27 species belonged to Chlorophyceae, 12 species belong to Bacillariophyceae, and 12 belonged to Cyanophyceae. The Euglenaphyceae was represented by 2 species. ( Refer Annexure 3)

A total of 22 species of Zooplankton species were also recorded from these wetlands ( Refer Annexure 4). Out of which Protozoa and Rotifera was dominated species followed by Ciliophora, Copepoda and Ostracoda.

A total of 19 families of macro-zoobanthos were recorded under 3 phyla and the community composition was dominated by Phylum Arthropoda composed of 14 families, followed by Annalida (3 families) and Mollusca with 2 families. (Refer Annexure 5)

Annexure -1 Water Quality of Assam Wetlands Covered under the Assignment (Part-1)

| S. No | Parameter | Method | Lakhimpur District | | | | Dhemaji District | | Tinsukia | | Jorhat District | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mahara Anchalik Beel | | TIkiDubi | | Dalpung Beel | | Visit to 3 No BorhullungLonkadeep beel | | Moridisai | |
| | | | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 |
| 1 | Water Temperature (°C) | IS:3025 Part-9 | 24.5 | 24.2 | 24.8 | 24.6 | 23.6 | 23.4 | 24.1 | 24.1 | 25.1 | 24.9 |
| 2 | PH | IS:3025 Part-11 | 7.59 | 7.52 | 7.8 | 7.73 | 6.94 | 7.0 | 6.67 | 6.7 | 6.94 | 6.98 |
| 3 | Electrical Conductivity (µmho/cm) | IS:3025 Part-11 | 304 | 309 | 344 | 348 | 80.8 | 84.2 | 134.6 | 136.2 | 273 | 270 |
| 4 | SD (m) | - | 0.2 | 1.1 | 0.6 | 0.6 | 0.2 | 0.2 | 0.3 | 0.3 | 1 | 1 |
| 5 | TDS (mg/L) | IS:3025 Part-16 | 182 | 185.4 | 210 | 209 | 55.6 | 57.2 | 87.6 | 90.2 | 177.4 | 174 |
| 6 | DO (mg/L) Surface | IS:3025 Part-38 | 7.1 | 7.1 | 6.7 | 6.5 | 7.1 | 6.9 | 6.7 | 6.5 | 7.1 | 7 |
| | DO (mg/L) Bottom | | 5.2 | 5.4 | 5.5 | 5.8 | 5 | 4.9 | 6.2 | 6.0 | 6.5 | 6.6 |
| 7 | $BOD^5$ at 20 $^0C$ (mg/L) | 5210 B | 3.8 | 3.4 | 3.2 | 3.1 | 3.5 | 3.9 | 3.2 | 3.3 | 3.1 | 3 |
| 8 | COD (mg/L) | 5220 B | 8.2 | 7.2 | 8.1 | 8.5 | 8.3 | 7.9 | 10.2 | 9.7 | 8.2 | 8.9 |
| 9 | Total Hardness (mg/L) | 2340 C | 122 | 128 | 180 | 188 | 32 | 34 | 52 | 58 | 124 | 122 |
| 10 | Calcium (mg/L) | 3500-Ca B | 32 | 36 | 44 | 47.2 | 6.4 | 9.6 | 14.4 | 16 | 34.4 | 34 |
| 11 | Magnesium (mg/L) | | 11.886 | 9.23 | 19.81 | 23.206 | 3.88 | 2.43 | 3.88 | 4.37 | 9.23 | 8.99 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | Total Alkalinity (mg/L) | 2320 B | 112 | 118 | 180 | 164 | 20 | 22 | 36 | 34 | 114 | 110 |
| 13 | Nitrate (mg/L) | 4500 N03 B | 1.2 | 1.18 | 3.1 | 3.2217 | 0.8453 | 0.482 | 1.2987 | 1.88 | 0.8711 | 0.823 |
| 14 | Ammonical Nitrogen (mg/L) | 4500 C | 0.8 | 0.78 | 1.36 | 0.87 | 2.23 | 1.69 | 1.68 | 1.15 | 1.81 | 1.77 |
| 15 | Total Nitrogen (mg/L) | | 2.2 | 2.11 | 5.0 | 4.6 | 3.4 | 2.4 | 3.3 | 3.4 | 3.0 | 2.9 |
| 16 | Inorg, phosphate (mg/L) | 4500-P D | 0.12 | 0.09 | 0.1 | 0.11 | 0.05 | 0.05 | 0.06 | 0.06 | 0.0599 | 0.0591 |
| 17 | Total Coliform (MPN/100 ml) | 9221 B | 2800 | 2800 | 2660 | 2880 | 2400 | 2300 | 2380 | 2300 | 2590 | 2590 |
| 18 | Faecal Coliform (MPN/100 ml) | 9221 C | 1200 | 1280 | 1140 | 1190 | 1200 | 1250 | 1350 | 1200 | 1210 | 1336 |
| 19 | Iron (mg/L) | 3030 and 3111 | 0.066 | 0.016 | 0.035 | 0.047 | 0.024 | 0.022 | 0.055 | 0.054 | 0.088 | 0.086 |
| 20 | Zinc (mg/L) | 3030 and 3111 | 0.55 | 0.97 | 0.82 | 0.9 | 0.65 | 0.68 | 0.76 | 0.79 | 0.74 | 0.73 |
| 21 | Lead (mg/L) | 3030 and 3111 | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) |
| 22 | Manganese (mg/L) | 3030 and 3111 | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) |
| 23 | Arsenic as As (mg/L) | 3030 and 3111 | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) |
| 24 | Copper as Cu (mg/L) | 3030 and 3111 | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) |

Annexure -1 Water Quality of Assam Wetlands Covered under the Assignment (Part-2)

| S. No | Parameter | Method | Jorhat District | | Nagaon | | | | Morigaon | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sawaguri | | Bhagampur | | Sapekhality | | Bechamari Beel | | Morikalang | |
| | | | S11 | S12 | S13 | S14 | S15 | S16 | S17 | S18 | S19 | S20 |
| 1 | Water Temperature (°C) | IS:3025 Part-9 | 24.9 | 24.8 | 24.2 | 24 | 24.1 | 24.1 | 23.8 | 23.7 | 23.8 | 23.8 |
| 2 | PH | IS:3025 Part-11 | 7.5 | 7.4 | 6.86 | 6.95 | 7.21 | 7.18 | 6.28 | 6.45 | 6.78 | 6.82 |
| 3 | Electrical Conductivity (µmho/cm) | IS:3025 Part-11 | 342 | 325 | 246 | 249 | 146.3 | 150 | 80 | 86 | 119 | 121 |
| 4 | SD (m) | - | 0.9 | 1.2 | 0.3 | 0.30 | 0.6 | 0.9 | 0.6 | 0.7 | 1.4 | 1.5 |
| 5 | TDS (mg/L) | IS:3025 Part-16 | 266 | 270 | 160 | 162 | 95.1 | 100 | 52.3 | 58.4 | 77.8 | 82.2 |
| 6 | DO (mg/L) Surface | IS:3025 Part-38 | 6.7 | 7.2 | 6.6 | 6.90 | 7.0 | 7.2 | 6.7 | 6.6 | 7.1 | 7.8 |
| | DO (mg/L) Bottom | | 6.4 | 6.8 | 5.9 | 6.40 | | 6.8 | 6.3 | 6.4 | 6.4 | 6.5 |
| 7 | $BOD^5$ at 20 $^0C$ (mg/L) | 5210 B | 2.7 | 3.1 | 3.1 | 2.84 | 3.3 | 3.5 | 3.4 | 3.2 | 3.4 | 3 |
| 8 | COD (mg/L) | 5220 B | 8.8 | 8.8 | 9.2 | 8.5 | 9.2 | 9.1 | 8.2 | 9.7 | 8.2 | 7.5 |
| 9 | Total Hardness (mg/L) | 2340 C | 216 | 220 | 92 | 93 | 64 | 70 | 28 | 30 | 56 | 54 |
| 10 | Calcium (mg/L) | 3500-Ca B | 40 | 61.6 | 20 | 24 | 16 | 16.8 | 3.2 | 7.2 | 16 | 14.8 |
| 11 | Magnesium (mg/L) | | 28.18 | 15.12 | 10.2 | 8.01 | 5.83 | 6.8 | 4.86 | 2.91 | 3.88 | 4.13 |
| 12 | Total Alkalinity (mg/L) | 2320 B | 212 | 210 | 72 | 70 | 48 | 46 | 8 | 14 | 28 | 26 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | Nitrate (mg/L) | 4500 N03 B | 2.8 | 2,8 | 2.654 | 2.727 | 1.8849 | 1.806 | 1.2 | 1.2 | 1.4 | 1.2 |
| 14 | Ammonical Nitrogen (mg/L) | 4500 C | 1.8 | 1.7 | 1.1 | 1.32 | 1.59 | 1.54 | 2.36 | 2.3 | 1.17 | 1.2 |
| 15 | Total Nitrogen (mg/L) | - | 4.9 | 5.2 | 4.2 | 4.5 | 3.9 | 3.7 | 4.0 | 3.9 | 2.9 | 2.7 |
| 16 | Inorg, phosphate (mg/L) | 4500-P D | 0.0456 | 0.0461 | 0.0574 | 0.0581 | 0.06 | 0.135 | 0.04 | 0.06 | 0.06 | 0.04 |
| 17 | Total Coliform (MPN/100 ml) | 9221 B | 2450 | 2460 | 2570 | 2580 | 2310 | 2350 | 2480 | 2400 | 2310 | 2350 |
| 18 | Faecal Coliform (MPN/100 ml) | 9221 C | 1220 | 1210 | 1180 | 1160 | 1210 | 1200 | 1200 | 1610 | 1550 | 1190 |
| 19 | Iron (mg/L) | 3030 and 3111 | 0.044 | 0.0445 | 0.05 | 0.048 | 0.038 | 0.0374 | 0.048 | 0.047 | 0.025 | 0.0253 |
| 20 | Zinc (mg/L) | 3030 and 3111 | 0.67 | 0.67 | 0.66 | 0.67 | 0.7 | 0.68 | 0.53 | 0.57 | 0.98 | 0.99 |
| 21 | Lead (mg/L) | 3030 and 3111 | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) |
| 22 | Manganese (mg/L) | 3030 and 3111 | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) |
| 23 | Arsenic as As (mg/L) | 3030 and 3111 | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) |
| 24 | Copper as Cu (mg/L) | 3030 and 3111 | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) |

Annexure -1 Water Quality of Assam Wetlands Covered under the Assignment (Part-3)

| S. No | Parameter | Method | Dhubri | | | | Bongaigaon | | Sribhumi District | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Purani Beel | | Udmari Chora | | Chalantaparaharipuri Beel | | Tiayakuri Beel | | Gojarala Beel | |
| | | | S21 | S22 | S23 | S24 | S25 | S26 | S27 | S28 | S29 | S30 |
| 1 | Water Temperature (°C) | IS:3025 Part-9 | 24.1 | 24 | 24.2 | 24.2 | 23.9 | 24.1 | 24.5 | 24.3 | 24.5 | 24.4 |
| 2 | pH | IS:3025 Part-11 | 6.27 | 6.35 | 7.22 | 7.14 | 6.9 | 7.00 | 6.91 | 7.01 | 6.51 | 6.6 |
| 3 | Electrical Conductivity (µmho/cm) | IS:3025 Part-11 | 88 | 82 | 165 | 170 | 161 | 164 | 91.2 | 96 | 114 | 108 |
| 4 | SD (m) | - | 0 | 0 | 0.8 | 1 | 1.3 | 1.500 | 1.2 | 1.4 | 0.2 | 1.1 |
| 5 | TDS (mg/L) | IS:3025 Part-16 | 55 | 52 | 107.4 | 115 | 105 | 106 | 68 | 65 | 82 | 78 |
| 6 | DO (mg/L) Surface | IS:3025 Part-38 | 6.2 | 6.4 | 6.6 | 6.9 | 7.6 | 7.7 | 6.2 | 6.5 | 6.8 | 7.2 |
| | DO (mg/L) Bottom | | 5.8 | 5.9 | 5.9 | 6.2 | 7 | 7.1 | 5.5 | 6.1 | 6.5 | 6.9 |
| 7 | $BOD^5$ at 20 $^0C$ (mg/L) | 5210 B | 3.2 | 3.1 | 3.3 | 3.2 | 2.9 | 2.94 | 2.8 | 2.5 | 2.9 | 3.5 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | COD (mg/L) | 5220 B | 8.6 | 8.3 | 7.5 | 8.2 | 8.3 | 8.4 | 7.2 | 6.9 | 6.5 | 7.2 |
| 9 | Total Hardness (mg/L) | 2340 C | 34 | 32 | 52 | 55 | 48 | 48.68 | 20 | 30 | 58 | 54 |
| 10 | Calcium (mg/L) | 3500-Ca B | 8.8 | 8 | 14.4 | 15.2 | 6.4 | 6.49 | 3.2 | 8 | 16.8 | 17.2 |
| 11 | Magnesium (mg/L) | | 2.916 | 2.916 | 3.88 | 4.13 | 7.77 | 7.88 | 2.91 | 2.43 | 3.9 | 2.7 |
| 12 | Total Alkalinity (mg/L) | 2320 B | 8 | 10 | 40 | 42 | 36 | 36.51 | 20 | 20.28 | 52 | 48 |
| 13 | Nitrate (mg/L) | 4500 N03 B | 1.9782 | 1.898 | 1.9628 | 1.883 | 1.1289 | 1.19 | 1.8141 | 1.88 | 2.2793 | 2.35 |
| 14 | Ammonical Nitrogen (mg/L) | 4500 C | 2.67 | 2.61 | 1.59 | 1.546 | 0.84 | 0.87 | 2.67 | 2.73 | 1.43 | 1.47 |
| 15 | Total Nitrogen (mg/L) | - | 5.2 | 5.0 | 4.0 | 3.8 | 2.2 | 2.3 | 5.0 | 5.2 | 4.2 | 4.3 |
| 16 | Inorg, phosphate (mg/L) | 4500-P D | 0.65 | 0.0184 | 0.08 | 0.072 | 0.045 | 0.049 | 0.044 | 0.045 | 0.0588 | 0.060 |
| 17 | Total Coliform (MPN/100 ml) | 9221 B | 2800 | 2900 | 2410 | 2290 | 2340 | 2340 | 2440 | 2466 | 2578 | 2564. |
| 18 | Faecal Coliform | 9221 C | 1500 | 1590 | 1060 | 1130 | 1230 | 1148 | 1144 | 1086 | 1320 | 1328. |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (MPN/100 ml) | | | | | | | | | | | |
| 19 | Iron (mg/L) | 3030 and 3111 | 0.018 | 0.0182 | 0.04 | 0.046 | 0.033 | 0.033 | 0.038 | 0.039 | 0.148 | 0.155 |
| 20 | Zinc (mg/L) | 3030 and 3111 | 0.72 | 0.73 | 0.65 | 0.67 | 0.91 | 0.923 | 0.72 | 0.730 | 1.84 | 1.852 |
| 21 | Lead (mg/L) | 3030 and 3111 | BDL (0.002) | BDL(0.002) | BDL (0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL(0.002) | BDL (0.002) | BDL(0.002) | BDL(0.002) |
| 22 | Manganese (mg/L) | 3030 and 3111 | BDL (0.001) | BDL(0.001) | BDL (0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL (0.001) | BDL(0.001) | BDL(0.001) |
| 23 | Arsenic as As (mg/L) | 3030 and 3111 | BDL (0.0001) | BDL(0.0001) | BDL (0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL(0.0001) | BDL (0.0001) | BDL(0.0001) | BDL(0.0001) |
| 24 | Copper as Cu (mg/L) | 3030 and 3111 | BDL (0.001) | BDL(0.001) | BDL (0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL(0.001) | BDL (0.001) | BDL(0.001) | BDL(0.001) |

Annexure-2 Characteristics of Sediment Collected from Wetlands Covered under this Assignment (Part-1)

| S.No | Parameter | Unit | Lakhimpur | | Dhemaji | Tinsukia | Jorhat | | Nagaon | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mahara Anchalik Beel | TIkiDubi | Dalpung Beel | 3 No Borhullung Lonkadeep beel | Moridisai | Sawaguri | Bhagampur | Sapekhality |
| | | | SD1 | SD2 | SD3 | SD4 | SD5 | SD6 | SD7 | SD8 |
| 1 | Total Organic Carbon | % | 1.3 | 0.98 | 1.1 | 1.2 | 0.81 | 0.79 | 0.92 | 0.96 |
| 2 | Total phosphorous | kg/ha | 55.3 | 52.01 | 53.32 | 31.61 | 30.62 | 48.06 | 31.49 | 32.47 |
| 3 | Total Nitrogen | kg/ha | 520.8 | 533.4 | 529.2 | 493.5 | 504 | 512.4 | 562.8 | 546 |
| 4 | Potassium | kg/ha | 210 | 218 | 202 | 162 | 180 | 188 | 186 | 162 |
| 5 | Arsenic as As | ppm | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 6 | Lead as Pb | ppm | 0.048 | 0.051 | 0.046 | 0.062 | 0.04 | 0.044 | 0.043 | 0.041 |
| 7 | Iron as Fe | ppm | 8.2 | 8.6 | 7.9 | 5.776 | 4.896 | 7.776 | 7.856 | 7.568 |
| 8 | Zinc as Zn | ppm | 3.89 | 3.25 | 3.5 | 3.35 | 2.2 | 2.06 | 2.9 | 2.47 |
| 9 | Copper as Cu | ppm | 0.1674 | 0.153 | 0.558 | 0.126 | 0.396 | 0.153 | 0.144 | 0.126 |
| 10 | Manganese as mn | ppm | 4.77 | 4.44 | 3.36 | 3.48 | 5.4 | 5.52 | 5.04 | 4.8 |

Annexure-2 Characteristics of Sediment Collected from Wetlands Covered under this Assignment (Part-2)

| S.No | Parameter | Unit | Morigaon | | Dhubri | | Bongaigaon | Sribhumi | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Bechamari Beel | Morakalang | Purani Beel | Udmari Chora | Chalantaparaharipuri Beel | Tiayakuri Beel | Gojarala Beel |
| | | | SD9 | SD10 | SD11 | SD12 | SD13 | SD14 | SD15 |
| | | | | | | | | | |
| 1 | Total Organic Carbon | % | 0.79 | 0.82 | 0.89 | 0.78 | 0.98 | 0.81 | 0.8 |
| 2 | Total phosphorous | kg/ha | 35.76 | 55.3 | 56.12 | 54.99 | 37.54 | 49.47 | 53.31 |
| 3 | Total Nitrogen | kg/ha | 483 | 495.6 | 604.8 | 592.2 | 571.2 | 564.9 | 531.3 |
| 4 | Potassium | kg/ha | 146 | 142 | 144 | 141 | 136 | 136 | 114 |
| 5 | Arsenic as As | ppm | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 6 | Lead as Pb | ppm | 0.042 | 0.024 | 0.044 | 0.041 | 0.036 | 0.032 | 0.031 |
| 7 | Iron as Fe | ppm | 9.216 | 8.848 | 6.656 | 7.28 | 8.592 | 7.888 | 5.328 |
| 8 | Zinc as Zn | ppm | 2.76 | 2.35 | 2.61 | 2.82 | 2.75 | 2.96 | 2.33 |
| 9 | Copper as Cu | ppm | 0.144 | 0.288 | 0.288 | 0.306 | 0.441 | 0.36 | 0.36 |
| 10 | Manganese as mn | ppm | 3.69 | 3.66 | 3.6 | 4.38 | 3.45 | 5.22 | 3.93 |

Annexure-3 Phytoplankton's Diversity of Recorded in Assam Beels

| Phytoplankton's Diversity Recorded during study | | BB 1 | BB 2 | BB 3 | BB 4 | BB 5 | BB 6 | BB 7 | BB 8 | BB 9 | BB 10 | BB 11 | BB 12 | BB 13 | BB 14 | BB 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Bacillariophyceae* | | | | | | | | | | | | | | | | |
| 1 | *Amphora sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 2 | *Asteronella sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 3 | *Bacillaria paradoxa* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 4 | *Cyclotella sp* | ++ | + | ++ | ++ | + | ++ | ++ | + | + | + | + | ++ | + | ++ | + |
| 5 | *Cymbella sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 6 | *Epithemia sp* | + | ++ | + | + | ++ | + | + | ++ | + | + | ++ | + | ++ | + | ++ |
| 7 | *Melosira sp* | + | ++ | + | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | ++ |
| 8 | *Pinnularia sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 9 | *Rhopalodia sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 10 | *S.armata* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 11 | *S.bijugatus* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 12 | *Synedra ulna* | ++ | + | + | ++ | + | + | ++ | + | + | ++ | + | ++ | + | ++ | + |
| Chlorophyceae | | | | | | | | | | | | | | | | |
| 1 | *A.falcatus* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 2 | *A.hantzschii* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 3 | *Botryococcus brauni* | + | + | + | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | ++ |
| 4 | *C.cambrium* | + | ++ | ++ | + | + | ++ | + | ++ | ++ | + | ++ | + | ++ | + | ++ |

| Phytoplankton's Diversity Recorded during study | | BB 1 | BB 2 | BB 3 | BB 4 | BB 5 | BB 6 | BB 7 | BB 8 | BB 9 | BB 10 | BB 11 | BB 12 | BB 13 | BB 14 | BB 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | Crucigenia.*crucifera* | + | ++ | ++ | + | + | ++ | + | ++ | ++ | + | ++ | + | ++ | + | ++ |
| 6 | *C.reticulatum* | + | ++ | ++ | + | + | ++ | + | ++ | ++ | + | ++ | + | ++ | + | ++ |
| 7 | *Characium limneticum* | + | ++ | ++ | + | + | ++ | + | ++ | ++ | + | ++ | + | ++ | + | ++ |
| 8 | *Chlorella sp* | + | +++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + |
| 9 | *Chlorococcum humicola* | + | ++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + |
| 10 | *Closteriopsis sp* | + | +++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + |
| 11 | *Closterium longissima* | + | ++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + |
| 12 | *Cosmarium sp* | + | ++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + |
| 13 | *Crucigenia sp* | + | ++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + |
| 14 | *Crucigenia tetrapaedia* | + | ++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + |
| 15 | *Denticulla sp* | + | ++ | ++ | + | + | + | + | + | + | + | + | + | + | + | + |
| 16 | *Euastrum denticulatum* | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | ++ |
| 17 | *Elkatothrix sp* | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | + |
| 18 | *Kirchneriella lunaris* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 19 | *Kirchnerilla sp* | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | + |
| 20 | *Oocystis sp* | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | + |

| Phytoplankton's Diversity Recorded during study | | BB 1 | BB 2 | BB 3 | BB 4 | BB 5 | BB 6 | BB 7 | BB 8 | BB 9 | BB 10 | BB 11 | BB 12 | BB 13 | BB 14 | BB 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | *Oedogonium sp* | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | + |
| 22 | *Oocystis crassa* | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | + |
| 23 | *Pediastrum simplex* | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | + |
| 24 | *Schroederia sp* | + | + | + | + | + | + | + | +++ | ++ | + | +++ | + | +++ | + | + |
| 25 | *Spirogyra sp* | + | | ++ | + | | ++ | + | | ++ | + | | + | | + | + |
| 26 | *Ulothrix sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 27 | *Volvox sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Cyanophyceae | | | | | | | | | | | | | | | | |
| 1 | *Anabaena sp* | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | + |
| 2 | *Anabaena spiroides* | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | + |
| 3 | *Gleocapsa punctata Nägel* | + | + | ++ | + | + | ++ | + | + | ++ | + | + | + | + | + | + |
| 4 | *Merismopedia sp* | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | + |
| 5 | *Microcystis aeruginosa* | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| 6 | *Microcystis flos-aquae* | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| 7 | *Mougeotia sp* | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | + | ++ | + | + |
| 8 | *Oscillatoria sp* | + | - | ++ | + | - | ++ | + | - | ++ | + | - | + | - | + | + |
| 9 | *Oscillatoria tenius* | + | - | + | + | - | + | + | - | + | + | - | + | - | + | + |
| 10 | *Pleodorina sp* | + | - | ++ | + | - | ++ | + | - | ++ | + | - | + | - | + | + |

| Phytoplankton's Diversity Recorded during study | | BB 1 | BB 2 | BB 3 | BB 4 | BB 5 | BB 6 | BB 7 | BB 8 | BB 9 | BB 10 | BB 11 | BB 12 | BB 13 | BB 14 | BB 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | *Spirulina major* | + | - | + | + | - | + | + | - | + | + | - | + | - | + | + |
| 12 | *Spirulina sp* | + | - | ++ | + | - | ++ | + | - | ++ | + | - | + | - | + | + |
| Euglenaphyceae | | | | | | | | | | | | | | | | |
| 1. | *Euglena acus* | - | - | - | - | + | - | - | - | - | - | - | - | - | - | - |
| 2. | *Tetradon sp* | - | - | - | - | - | - | - | + | + | - | - | - | - | - | - |

Annexure-4 Zooplankton's Diversity of Recorded in Assam Beels

| Zooplankton's Diversity Recorded during study | | BB 1 | BB 2 | BB 3 | BB 4 | BB 5 | BB 6 | BB 7 | BB 8 | BB 9 | BB 10 | BB 11 | BB 12 | BB 13 | BB 14 | BB 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Protozoa | | | | | | | | | | | | | | | | |
| 1 | *Arcella discoides* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 2 | *Arcella vulgaris* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 3 | *Centrocypris sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 4 | *Centrophyxis species* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 5 | *Centropyxis aculeate* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 6 | *Difflugia sp* | ++ | +++ | + | ++ | +++ | + | ++ | +++ | + | ++ | ++ | ++ | ++ | ++ | ++ |
| 7 | *Paramecium sp* | ++ | +++ | + | ++ | +++ | + | ++ | +++ | + | ++ | ++ | ++ | ++ | ++ | ++ |
| Rotifera | | | | | | | | | | | | | | | | |
| 1 | *Asplancha sp* | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | ++ | ++ | ++ | ++ | ++ |

| Zooplankton's Diversity Recorded during study | | BB 1 | BB 2 | BB 3 | BB 4 | BB 5 | BB 6 | BB 7 | BB 8 | BB 9 | BB 10 | BB 11 | BB 12 | BB 13 | BB 14 | BB 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | *Brachionus bidentata* | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| 3 | *Brachionus calyciflorus* | ++ | + | ++ | ++ | + | ++ | ++ | + | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| 4 | *Brachionus falcatus* | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| 5 | *Brachionus patalus* | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| 6 | *Keratella tropica* | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ | ++ |
| Copepoda | | | | | | | | | | | | | | | | |
| 1. | *Mesocyclops* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 2. | *Phyllodiaptomus* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 3. | *Cyclops sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Cladocera | | | | | | | | | | | | | | | | |
| 1. | *Alona sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 2. | *Bosmina sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 3. | *Ceriodaphnia sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 4. | *Daphnia sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| Ostracoda | | | | | | | | | | | | | | | | |
| 1 | *Stenocypris sp* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 2 | *Cypris sp.* | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |

Annexure 5-Zoo-benthos Diversity Recorded in Assam Beels

| S. No. | Taxonomic Status | BB1 | BB2 | BB3 | BB4 | BB5 | BB6 | BB7 | BB8 | BB9 | BB10 | BB11 | BB12 | BB13 | BB14 | BB15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PHYLUM ARTHROPODA | | | | | | | | | | | | | | | |
| 1 | Chironomidae | + | + | + | + | + | + | - | + | + | + | + | + | + | + | + |
| 2 | Tanabidae | + | - | - | + | - | - | - | - | - | + | - | - | - | - | - |
| 3 | Culicoidae | + | - | - | + | - | - | + | - | - | + | - | - | - | - | - |
| 4 | Tipulidae | - | + | - | - | + | - | - | + | - | - | + | + | + | + | + |
| 5 | Notonectidae | + | - | - | + | - | - | + | - | - | + | - | - | - | - | - |
| 6 | Hydrometridae | + | - | - | + | - | - | + | - | - | + | - | - | - | - | - |
| 7 | Philopotamidae | - | - | + | - | - | + | - | - | + | - | - | - | - | - | - |
| 8 | Dytiscidae | - | + | - | - | + | - | - | + | - | - | + | + | + | + | + |
| 9 | Sialidae | - | + | - | - | + | - | - | + | - | - | + | + | + | + | + |
| 10 | Ephemerellidae | + | + | - | - | + | - | - | + | - | - | + | + | + | + | + |
| 11 | Pothaminthidae | - | + | - | - | + | - | - | + | - | - | + | + | + | + | + |
| 12 | Atydae | - | + | + | - | + | + | - | - | + | - | + | + | + | + | + |
| 13 | Aeschnidae | - | + | - | - | + | - | - | - | - | - | + | + | + | + | + |
| 14 | Gomphidae | - | - | + | - | - | + | - | - | + | - | - | - | - | - | - |
| | PHYLUM ANNALIDA | | | | | | | | | | | | | | | |
| 1 | Glassiphonidae | - | + | + | - | + | + | - | + | + | - | + | + | + | + | + |
| 2 | Nanididae | - | - | + | - | - | + | - | - | - | - | - | - | - | - | - |
| 3 | Lumbriculidae | - | - | + | - | - | + | - | - | + | - | - | - | - | - | - |
| | PHYLUM MOLLUSCA | | | | | | | | | | | | | | | |
| 1. | Vivparidae | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 2. | Lymnaeidae | - | - | + | - | - | + | - | - | + | - | - | - | - | - | - |

Annexure 6- Flora and Fauna Recorded in and around the Selected Beels

The flora and fauna of the selected beels were studied through a combination of primary site visits and a review of secondary information from various research articles and reports. The primary site visits allowed for direct observation and data collection on the species present in the beels, while secondary sources provided additional insights into the biodiversity and ecological characteristics of the area. This approach ensured a comprehensive understanding of the existing ecosystems within the beels. The findings indicate that no threatened species were recorded within the examined village beels during the survey period. This suggests that the current biodiversity status in these areas does not include any species classified as threatened. Additionally, none of the studied beels were located within Protected Areas (PAs) or Key Biodiversity Areas (KBAs). Detailed list of flora and fauna recorded in individual beels are summarized below.

1. Flora and Fauna Recorded in and around Chalantapara Beel, Bongaigaon District

1.1. Flora

Trees

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Mangifera indica* | Mango Tree | Least Concern |
| *Azadirachta indica* | Neem Tree | Least Concern |
| *Tectona grandis* | Teak Tree | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit Tree | Least Concern |
| *Ficus benghalensis* | Banyan Tree | Least Concern |
| *Shorea robusta* | Sal Tree | Least Concern |
| *Syzygium cumini* | Jamun Tree | Least Concern |
| *Bombax ceiba* | Silk Cotton Tree | Least Concern |
| *Albizia lebbeck* | Siris Tree | Least Concern |
| *Carica papaya* | Papaya | Least Concern |
| *Bombax ceiba* | Red Silk Cotton Tree | Least Concern |
| *Shorea robusta* | Sal | Least Concern |
| *Terminalia arjuna* | Arjun Tree | Least Concern |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Centella asiatica* | Indian Pennywort | Least Concern |
| *Boerhavia diffusa* | Punarnava | Not Evaluated |
| *Calotropis gigantea* | Crown Flower | Least Concern |
| *Eclipta prostrata* | False Daisy | Least Concern |
| *Ocimum tenuiflorum* | Holy Basil (Tulsi) | Not Evaluated |
| *Clerodendrum viscosum* | East Indian Glory Bower | Not Evaluated |
| *Justicia adhatoda* | Malabar Nut | Least Concern |
| *Cassia tora* | Sickle Senna | Least Concern |
| *Nyctanthes arbor-tristis* | Night flowering Jasmine | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Cynodon dactylon* | Bermuda Grass | Least Concern |
| *Phragmites australis* | Common Reed | Least Concern |
| *Vetiveria zizanioides* | Vetiver Grass | Least Concern |
| *Chrysopogon zizanioides* | Khus Grass | Not Evaluated |
| *Panicum maximum* | Guinea Grass | Least Concern |
| *Setaria viridis* | Green Foxtail | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Not Evaluated |
| *Nelumbo nucifera* | Indian Lotus | Least Concern |
| *Hydrilla verticillata* | Hydrilla | Least Concern |
| *Nymphaea nouchali* | Red Water Lily | Least Concern |
| *Ipomoea aquatica* | Water Spinach | Least Concern |
| *Typha angustifolia* | Cattail | Least Concern |
| *Salvinia molesta* | Giant Salvinia | Not Evaluated |

1.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos taurus* | Domestic Cow | Not Evaluated |
| *Capra hircus* | Domestic Goat | Not Evaluated |
| *Canis lupus familiaris* | Domestic Dog | Not Evaluated |
| *Felis catus* | Domestic Cat | Not Evaluated |
| *Sus scrofa domesticus* | Domestic Pig | Not Evaluated |
| *Macaca mulatta* | Rhesus Macaque | Least Concern |
| *Herpestes edwardsii* | Indian Grey Mongoose | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Varanus bengalensis* | Bengal Monitor Lizard | Least Concern |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |
| *Naja kaouthia* | Monocled Cobra | Least Concern |
| Coelognathus radiatus | Copperhead Rat Snake | Least Concern |
| Eutropis multifasciata | Common Sun Skink | Least Concern |
| Hemidactylus frenatus | Asian House Gecko | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Not Evaluated |
| *Anas platyrhynchos domesticus* | Domestic Duck | Not Evaluated |
| *Corvus splendens* | House Crow | Least Concern |
| *Pavo cristatus* | Indian Peafowl | Least Concern |
| *Milvus migrans* | Black Kite | Least Concern |
| *Ardea cinerea* | Grey Heron | Least Concern |
| *Amaurornis phoenicurus* | White-breasted Waterhen | Least Concern |
| Vanellus indicus | Red-wattled Lapwing | Least Concern |
| Vanellus cinereus | Grey-headed Lapwing | Least Concern |
| Circaetus gallicus | Short-toed Snake-Eagle | Least Concern |
| Anas platyrhynchos | Mallard | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Euphlyctis cyanophlyctis* | Indian Skipper Frog | Least Concern |
| *Duttaphrynus melanostictus* | Common Asian Toad | Least Concern |
| *Rana temporalis* | Indian Pond Frog | Least Concern |
| *Fejervarya limnocharis* | Indian Rice Frog | Least Concern |
| *Uperodon globulosus* | Indian Balloon Frog | Least Concern |
| *Hylarana leptoglossa* | Green Frog | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead Fish | Least Concern |
| *Puntius sophore* | Pool Barb | Least Concern |
| *Amblypharyngodon mola* | Mola Carplet | Least Concern |

2. Flora and Fauna Recorded In and around Purani Beel, Dhubri District

2.1. Flora

Trees

| Scientific Name | 2 Common Name | 3 IUCN Status |
|---|---|---|
| *Bombax ceiba* | Red Silk Cotton Tree | Least Concern |
| *Ficus benghalensis* | Banyan Tree | Least Concern |
| *Mangifera indica* | Mango Tree | Least Concern |
| *Tectona grandis* | Teak Tree | Least Concern |
| *Dalbergia sisso* | Shisham Tree | Least Concern |
| *Azadirachta indica* | Neem Tree | Least Concern |
| *Ziziphus jujuba* | Jujube | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit | Not Evaluated |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Cyperus papyrus* | Paper reed | Least Concern |
| *Saccharum spontaneum* | Wild Sugarcane | Least Concern |
| *Hibiscus spontaneum* | Hibiscus | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Cynodon dactylon* | Bermuda Grass | Least Concern |
| *Phragmites australis* | Common Reed | Least Concern |
| *Vetiveria zizanioides* | Vetiver Grass | Least Concern |
| *Setaria viridis* | Green Foxtail | Least Concern |

Macrophytes

| | | |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |
| *Azolla pinnata* | Feathered Mosquito Fern | Least Concern |
| *Nymphea stellata* | Blue Lotus | Least Concern |
| *Nelumbo nucifera* | Lotus | Least Concern |
| *Pistia stratiotes* | Water Lettuce | Least Concern |
| *Vallisneria spiralis* | Tape Grass | Least Concern |

2.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos indicus* | Domestic Cow | Domesticated |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Ovis aries* | Domestic Sheep | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Domesticated |
| *Herpestes edwardsii* | Indian Grey Mongoose | Least Concern |
| *Rattus rattus* | Black Rat | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Naja Naja* | Indian Cobra | Least Concern |
| *Bungarus caeruleus* | Common Krait | Least Concern |
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| Hemidactylus frenatus | Asian House Gecko | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Anas platyrhynchos* | Domestic Duck | Domesticated |
| *Columbia livia* | Rock Pigeon | Least Concern |
| *Ardea cinerea* | Grey Heron | Least Concern |
| *Ardeola grayii* | Indian Pond Heron | Least Concern |
| *Corvus splendens* | House Crow | Least Concern |
| *Egretta garzetta* | Little Egret | Least Concern |
| *Pavo cristatus* | Indian Peafowl | Least Concern |
| *Passer domesticus* | House Sparrow | Least Concern |
| *Psittacula krameri* | Rose-ringed Parakeet | Least Concern |
| *Elanus caeruleus* | Black Winged Kite | Least Concern |
| *Tadorna ferruginea* | Ruddy Shelduck | Least Concern |
| *Anastomus oscitans* | Asian Openbill | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Clarias batrachus* | Magur | Least Concern |
| *Channa striata* | Striped Snakehead | Least Concern |
| *Mystus tengara* | Tengara Catfish | Least Concern |
| *Punitus sophore* | Pool Barb | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Euphyctis cyanophlyctis* | Indian Skittering Frog | Least Concern |
| *Bufo melanostictus* | Asian Common Toad | Least Concern |
| *Fejervarya limnocharis* | Rice Field Frog | Least Concern |
| *Microhyla ornata* | Ornate Narrow-mouthed Frog | Least Concern |

3. Flora and Fauna Recorded In and around Udmari Chora, Dhubri District

3.1. Flora

Trees

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bombax ceiba* | Red Silk Cotton Tree | Least Concern |
| *Ficus benghalensis* | Banyan Tree | Least Concern |
| *Mangifera indica* | Mango Tree | Least Concern |
| *Tectona grandis* | Teak Tree | Least Concern |
| *Dalbergia sisso* | Shisham Tree | Least Concern |
| *Azadirachta indica* | Neem Tree | Least Concern |
| *Ziziphus jujuba* | Jujube | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit | Not Evaluated |

4 Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Cyperus papyrus* | Paper reed | Least Concern |
| *Saccharum spontaneum* | Wild Sugarcane | Least Concern |
| *Hibiscus spontaneum* | Hibiscus | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Cynodon dactylon* | Bermuda Grass | Least Concern |
| *Phragmites australis* | Common Reed | Least Concern |
| *Vetiveria zizanioides* | Vetiver Grass | Least Concern |
| *Setaria viridis* | Green Foxtail | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |
| *Azolla pinnata* | Feathered Mosquito Fern | Least Concern |
| *Nymphea stellata* | Blue Lotus | Least Concern |
| *Nelumbo nucifera* | Lotus | Least Concern |
| *Pistia stratiotes* | Water Lettuce | Least Concern |
| *Vallisneria spiralis* | Tape Grass | Least Concern |

3.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos indicus* | Domestic Cow | Domesticated |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Ovis aries* | Domestic Sheep | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Domesticated |
| *Herpestes edwardsii* | Indian Grey Mongoose | Least Concern |
| *Rattus rattus* | Black Rat | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Naja Naja* | Indian Cobra | Least Concern |
| *Bungarus caeruleus* | Common Krait | Least Concern |
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| Hemidactylus frenatus | Asian House Gecko | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Anas platyrhynchos* | Domestic Duck | Domesticated |
| *Columbia livia* | Rock Pigeon | Least Concern |
| *Ardea cinerea* | Grey Heron | Least Concern |
| *Ardeola grayii* | Indian Pond Heron | Least Concern |
| *Corvus splendens* | House Crow | Least Concern |
| *Egretta garzetta* | Little Egret | Least Concern |
| *Pavo cristatus* | Indian Peafowl | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Passer domesticus* | House Sparrow | Least Concern |
| *Psittacula krameri* | Rose-ringed Parakeet | Least Concern |
| *Elanus caeruleus* | Black Winged Kite | Least Concern |
| *Tadorna ferruginea* | Ruddy Shelduck | Least Concern |
| *Anastomus oscitans* | Asian Openbill | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Clarias batrachus* | Magur | Least Concern |
| *Channa striata* | Striped Snakehead | Least Concern |
| *Punitus sophore* | Pool Barb | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Euphyctis cyanophlyctis* | Indian Skittering Frog | Least Concern |
| *Bufo melanostictus* | Asian Common Toad | Least Concern |
| *Fejervarya limnocharis* | Rice Field Frog | Least Concern |

4. Flora and Fauna Recorded In and around Moridesoi Beel, Jorhat District

4.1. Flora

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Azadirachta indica* | Neem | Least Concern |
| *Mangifera indica* | Mango Tree | Least Concern |
| *Tectona grandis* | Teak | Least Concern |
| *Ficus benghalensis* | Banyan Tree | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Syzygium cumini* | Jamun/Java Plum | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit Tree | Least Concern |
| *Terminalia arjuna* | Arjun Tree | Least Concern |
| *Dalbergia sissoo* | Indian Rosewood | Least Concern |
| *Tamarindus indica* | Tamarind Tree | Least Concern |
| *Bambusa vulgaris* | Common Bamboo | Least Concern |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Curcuma longa* | Turmeric | Least Concern |
| *Zingiber officinale* | Ginger | Least Concern |
| *Ocimum sanctum* | Holy Basil (Tulsi) | Least Concern |
| *Aloe vera* | Aloe | Least Concern |
| *Catha edulis* | Khat | Least Concern |
| *Catharanthus roseus* | Periwinkle | Least Concern |
| *Mentha arvensis* | Wild Mint | Least Concern |
| *Andrographis paniculata* | Kalmegh | Least Concern |
| *Eclipta prostrata* | False Daisy (Bhringraj) | Least Concern |
| *Lantana camara* | Lantana | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Cynodon dactylon* | Bermuda Grass (Dubori) | Least Concern |
| *Saccharum spontaneum* | Wild Sugarcane | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Phragmites karka* | Common Reed | Least Concern |
| *Arundinella nepalensis* | Nepalese Arundinella | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |
| *Nelumbo nucifera* | Indian Lotus | Least Concern |
| *Hydrilla verticillata* | Hydrilla | Least Concern |
| *Nymphaea nouchali* | Red Water Lily | Least Concern |
| *Ipomoea aquatica* | Water Spinach | Least Concern |
| *Pistia stratiotes* | Water Lettuce | Least Concern |
| *Lemna minor* | Common Duckweed | Least Concern |
| *Salvinia molesta* | Giant Salvinia | Least Concern |
| *Vallisneria spiralis* | Eelgrass | Least Concern |
| *Trapa natans* | Water Chestnut | Least Concern |

## 4.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos taurus* | Domestic Cow | Domesticated |
| *Bubalus bubalis* | Water Buffalo | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Least Concern |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Rattus rattus* | Black Rat | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gekko gecko* | Tokay Gecko | Least Concern |
| *Naja naja* | Indian Cobra | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| *Varanus bengalensis* | Bengal Monitor Lizard | Least Concern |
| *Hemidactylus frenatus* | Common House Gecko | Least Concern |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Columba livia* | Rock Pigeon | Least Concern |
| *Anastomus oscitans* | Asian Openbill | Least Concern |
| *Passer domesticus* | House Sparrow | Least Concern |
| *Corvus splendens* | House Crow | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |
| *Copsychus saularis* | Oriental Magpie Robin | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Halcyon smyrnensis* | White-throated Kingfisher | Least Concern |
| *Ardea cinerea* | Grey Heron | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |
| *Anabas testudineus* | Climbing Perch | Least Concern |
| *Puntius sophore* | Pool Barb | Least Concern |
| *Ctenopharyngodon idella* | Grass Carp | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |
| *Polypedates maculatus* | Chunam Tree Frog | Least Concern |
| *Microhyla ornata* | Ornate Narrow-mouthed Frog | Least Concern |

5. Flora and Fauna Recorded In and around Sawaguri Beel, Jorhat District

5.1. Flora

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Azadirachta indica* | Neem | Least Concern |
| *Mangifera indica* | Mango Tree | Least Concern |
| *Tectona grandis* | Teak | Least Concern |
| *Syzygium cumini* | Jamun/Java Plum | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit Tree | Least Concern |
| *Terminalia arjuna* | Arjun Tree | Least Concern |
| *Dalbergia sissoo* | Indian Rosewood | Least Concern |
| *Tamarindus indica* | Tamarind Tree | Least Concern |
| *Bambusa vulgaris* | Common Bamboo | Least Concern |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Curcuma longa* | Turmeric | Least Concern |
| *Zingiber officinale* | Ginger | Least Concern |
| *Ocimum sanctum* | Holy Basil (Tulsi) | Least Concern |
| *Aloe vera* | Aloe | Least Concern |
| *Catha edulis* | Khat | Least Concern |
| *Catharanthus roseus* | Periwinkle | Least Concern |
| *Mentha arvensis* | Wild Mint | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Andrographis paniculata* | Kalmegh | Least Concern |
| *Eclipta prostrata* | False Daisy (Bhringraj) | Least Concern |
| *Lantana camara* | Lantana | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Cynodon dactylon* | Bermuda Grass (Dubori) | Least Concern |
| *Saccharum spontaneum* | Wild Sugarcane | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Phragmites karka* | Common Reed | Least Concern |
| *Arundinella nepalensis* | Nepalese Arundinella | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |
| *Nelumbo nucifera* | Indian Lotus | Least Concern |
| *Hydrilla verticillata* | Hydrilla | Least Concern |
| *Nymphaea nouchali* | Red Water Lily | Least Concern |
| *Ipomoea aquatica* | Water Spinach | Least Concern |
| *Pistia stratiotes* | Water Lettuce | Least Concern |
| *Lemna minor* | Common Duckweed | Least Concern |
| *Salvinia molesta* | Giant Salvinia | Least Concern |
| *Vallisneria spiralis* | Eelgrass | Least Concern |
| *Trapa natans* | Water Chestnut | Least Concern |

5.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos taurus* | Domestic Cow | Domesticated |
| *Bubalus bubalis* | Water Buffalo | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Least Concern |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Rattus rattus* | Black Rat | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gekko gecko* | Tokay Gecko | Least Concern |
| *Naja naja* | Indian Cobra | Least Concern |
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| *Varanus bengalensis* | Bengal Monitor Lizard | Least Concern |
| *Hemidactylus frenatus* | Common House Gecko | Least Concern |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Columba livia* | Rock Pigeon | Least Concern |
| *Anastomus oscitans* | Asian Openbill | Least Concern |
| *Passer domesticus* | House Sparrow | Least Concern |
| *Corvus splendens* | House Crow | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Copsychus saularis* | Oriental Magpie Robin | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Halcyon smyrnensis* | White-throated Kingfisher | Least Concern |
| *Ardea cinerea* | Grey Heron | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |
| *Anabas testudineus* | Climbing Perch | Least Concern |
| *Puntius sophore* | Pool Barb | Least Concern |
| *Ctenopharyngodon idella* | Grass Carp | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |
| *Polypedates maculatus* | Chunam Tree Frog | Least Concern |
| *Microhyla ornata* | Ornate Narrow-mouthed Frog | Least Concern |

## 6. Flora and Fauna Recorded In and around Tiayakuri Beel Sribhumi District

### 6.1. Flora

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Azadirachta indica* | Neem | Least Concern |
| *Mangifera indica* | Mango Tree | Least Concern |
| *Ficus benghalensis* | Banyan Tree | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Syzygium cumini* | Jamun/Java Plum | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit Tree | Least Concern |
| *Tectona grandis* | Teak | Least Concern |
| *Terminalia arjuna* | Arjun Tree | Least Concern |
| *Bambusa vulgaris* | Common Bamboo | Least Concern |
| *Albizia lebbeck* | Siris Tree | Least Concern |
| *Dalbergia sissoo* | Indian Rosewood | Least Concern |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Ocimum sanctum* | Holy Basil (Tulsi) | Least Concern |
| *Zingiber officinale* | Ginger | Least Concern |
| *Curcuma longa* | Turmeric | Least Concern |
| *Catharanthus roseus* | Periwinkle | Least Concern |
| *Aloe vera* | Aloe | Least Concern |
| *Lantana camara* | Lantana | Least Concern |
| *Andrographis paniculata* | Kalmegh | Least Concern |
| *Mentha arvensis* | Wild Mint | Least Concern |
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Cynodon dactylon* | Bermuda Grass (Dubori) | Least Concern |
| *Saccharum spontaneum* | Wild Sugarcane | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Vetiveria zizanioides* | Vetiver Grass | Least Concern |
| *Eleusine indica* | Indian Goosegrass | Least Concern |
| *Echinochloa crus-galli* | Barnyard Grass | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |
| *Nymphaea nouchali* | Red Water Lily | Least Concern |
| *Pistia stratiotes* | Water Lettuce | Least Concern |
| *Lemna minor* | Common Duckweed | Least Concern |
| *Salvinia molesta* | Giant Salvinia | Least Concern |

6.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos taurus* | Domestic Cow | Domesticated |
| *Bubalus bubalis* | Water Buffalo | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Domesticated |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Rattus rattus* | Black Rat | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |
| *Macaca mulatta* | Rhesus Macaque | Least Concern |
| *Herpestes edwardsii* | Indian Grey Mongoose | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Naja naja* | Indian Cobra | Least Concern |
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| *Varanus bengalensis* | Bengal Monitor Lizard | Least Concern |
| *Hemidactylus frenatus* | Common House Gecko | Least Concern |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Columba livia* | Rock Pigeon | Least Concern |
| *Passer domesticus* | House Sparrow | Least Concern |
| *Corvus splendens* | House Crow | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |
| *Copsychus saularis* | Oriental Magpie Robin | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Halcyon smyrnensis* | White-throated Kingfisher | Least Concern |
| *Ardea cinerea* | Grey Heron | Least Concern |
| *Egretta garzetta* | Little Egret | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |
| *Anabas testudineus* | Climbing Perch | Least Concern |
| *Puntius sophore* | Pool Barb | Least Concern |
| *Ctenopharyngodon idella* | Grass Carp | Least Concern |
| *Wallago attu* | Wallago Catfish | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Euphlyctis cyanophlyctis* | Indian Skittering Frog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |

7. Flora and Fauna Recorded In and around Gojarala Beel Sribhumi District

7.1. Flora

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Azadirachta indica* | Neem | Least Concern |
| *Mangifera indica* | Mango Tree | Least Concern |
| *Ficus benghalensis* | Banyan Tree | Least Concern |
| *Syzygium cumini* | Jamun/Java Plum | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit Tree | Least Concern |
| *Tectona grandis* | Teak | Least Concern |
| *Terminalia arjuna* | Arjun Tree | Least Concern |
| *Bambusa vulgaris* | Common Bamboo | Least Concern |
| *Albizia lebbeck* | Siris Tree | Least Concern |
| *Dalbergia sissoo* | Indian Rosewood | Least Concern |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Ocimum sanctum* | Holy Basil (Tulsi) | Least Concern |
| *Zingiber officinale* | Ginger | Least Concern |
| *Curcuma longa* | Turmeric | Least Concern |
| *Catharanthus roseus* | Periwinkle | Least Concern |
| *Aloe vera* | Aloe | Least Concern |
| *Lantana camara* | Lantana | Least Concern |
| *Andrographis paniculata* | Kalmegh | Least Concern |
| *Mentha arvensis* | Wild Mint | Least Concern |
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Cynodon dactylon* | Bermuda Grass (Dubori) | Least Concern |
| *Saccharum spontaneum* | Wild Sugarcane | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Vetiveria zizanioides* | Vetiver Grass | Least Concern |
| *Eleusine indica* | Indian Goosegrass | Least Concern |
| *Echinochloa crus-galli* | Barnyard Grass | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Nelumbo nucifera* | Indian Lotus | Least Concern |
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |
| *Lemna minor* | Common Duckweed | Least Concern |
| *Salvinia molesta* | Giant Salvinia | Least Concern |

## 7.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos taurus* | Domestic Cow | Domesticated |
| *Bubalus bubalis* | Water Buffalo | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Domesticated |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Rattus rattus* | Black Rat | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |
| *Macaca mulatta* | Rhesus Macaque | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Herpestes edwardsii* | Indian Grey Mongoose | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Naja naja* | Indian Cobra | Least Concern |
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| *Hemidactylus frenatus* | Common House Gecko | Least Concern |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Columba livia* | Rock Pigeon | Least Concern |
| *Passer domesticus* | House Sparrow | Least Concern |
| *Corvus splendens* | House Crow | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |
| *Copsychus saularis* | Oriental Magpie Robin | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Halcyon smyrnensis* | White-throated Kingfisher | Least Concern |
| *Ardea cinerea* | Grey Heron | Least Concern |
| *Egretta garzetta* | Little Egret | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Anabas testudineus* | Climbing Perch | Least Concern |
| *Puntius sophore* | Pool Barb | Least Concern |
| *Ctenopharyngodon idella* | Grass Carp | Least Concern |
| *Wallago attu* | Wallago Catfish | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Euphlyctis cyanophlyctis* | Indian Skittering Frog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |

8. Flora and Fauna Recorded In and around Mahara Anchilik beel, Lakhimpur District

8.1 Flora

Trees

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Azadirachta indica* | Neem | Least Concern |
| *Mangifera indica* | Mango Tree | Least Concern |
| *Tectona grandis* | Teak | Least Concern |
| *Ficus benghalensis* | Banyan Tree | Least Concern |
| *Syzygium cumini* | Jamun/Java Plum | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit Tree | Least Concern |
| *Terminalia arjuna* | Arjun Tree | Least Concern |
| *Dalbergia sissoo* | Indian Rosewood | Least Concern |
| *Bambusa vulgaris* | Common Bamboo | Least Concern |
| *Tamarindus indica* | Tamarind Tree | Least Concern |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Curcuma longa* | Turmeric | Least Concern |
| *Zingiber officinale* | Ginger | Least Concern |
| *Ocimum sanctum* | Holy Basil (Tulsi) | Least Concern |
| *Aloe vera* | Aloe | Least Concern |
| *Catharanthus roseus* | Periwinkle | Least Concern |
| *Andrographis paniculata* | Kalmegh | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Cynodon dactylon* | Bermuda Grass (Dubori) | Least Concern |
| *Saccharum spontaneum* | Wild Sugarcane | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Phragmites karka* | Common Reed | Least Concern |
| *Eleusine indica* | Indian Goosegrass | Least Concern |
| *Echinochloa crus-galli* | Barnyard Grass | Least Concern |
| *Arundinella nepalensis* | Nepalese Arundinella | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |
| *Nelumbo nucifera* | Indian Lotus | Least Concern |
| *Nymphaea nouchali* | Red Water Lily | Least Concern |
| *Hydrilla verticillata* | Hydrilla | Least Concern |
| *Pistia stratiotes* | Water Lettuce | Least Concern |
| *Lemna minor* | Common Duckweed | Least Concern |
| *Salvinia molesta* | Giant Salvinia | Least Concern |
| *Vallisneria spiralis* | Eelgrass | Least Concern |

8.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos taurus* | Domestic Cow | Domesticated |
| *Bubalus bubalis* | Water Buffalo | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Least Concern |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Rattus rattus* | Black Rat | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |
| *Herpestes edwardsii* | Indian Grey Mongoose | Least Concern |
| *Macaca mulatta* | Rhesus Macaque | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Naja naja* | Indian Cobra | Least Concern |
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| *Varanus bengalensis* | Bengal Monitor Lizard | Least Concern |
| *Hemidactylus frenatus* | Common House Gecko | Least Concern |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Columba livia* | Rock Pigeon | Least Concern |
| *Passer domesticus* | House Sparrow | Least Concern |
| *Corvus splendens* | House Crow | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Copsychus saularis* | Oriental Magpie Robin | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Halcyon smyrnensis* | White-throated Kingfisher | Least Concern |
| *Anas platyrhynchos domesticus* | Domestic Duck | Domesticated |
| *Ardea cinerea* | Grey Heron | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |
| *Ctenopharyngodon idella* | Grass Carp | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |
| *Fejervarya limnocharis* | Cricket Frog | Least Concern |

9. Flora and Fauna Recorded In and around Tekidubi beel, Lakhimpur District

9.1 Flora

Trees

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Azadirachta indica* | Neem | Least Concern |
| *Mangifera indica* | Mango Tree | Least Concern |
| *Tectona grandis* | Teak | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Ficus benghalensis* | Banyan Tree | Least Concern |
| *Syzygium cumini* | Jamun/Java Plum | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit Tree | Least Concern |
| *Terminalia arjuna* | Arjun Tree | Least Concern |
| *Dalbergia sissoo* | Indian Rosewood | Least Concern |
| *Bambusa vulgaris* | Common Bamboo | Least Concern |
| *Tamarindus indica* | Tamarind Tree | Least Concern |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Curcuma longa* | Turmeric | Least Concern |
| *Zingiber officinale* | Ginger | Least Concern |
| *Ocimum sanctum* | Holy Basil (Tulsi) | Least Concern |
| *Aloe vera* | Aloe | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Cynodon dactylon* | Bermuda Grass (Dubori) | Least Concern |
| *Saccharum spontaneum* | Wild Sugarcane | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Phragmites karka* | Common Reed | Least Concern |
| *Vetiveria zizanioides* | Vetiver Grass | Least Concern |
| *Eleusine indica* | Indian Goosegrass | Least Concern |
| *Echinochloa crus-galli* | Barnyard Grass | Least Concern |
| *Arundinella nepalensis* | Nepalese Arundinella | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |
| *Nymphaea nouchali* | Red Water Lily | Least Concern |
| *Hydrilla verticillata* | Hydrilla | Least Concern |
| *Pistia stratiotes* | Water Lettuce | Least Concern |
| *Lemna minor* | Common Duckweed | Least Concern |
| *Vallisneria spiralis* | Eelgrass | Least Concern |
| *Trapa natans* | Water Chestnut | Least Concern |
| *Ipomoea aquatica* | Water Spinach | Least Concern |

8.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos taurus* | Domestic Cow | Domesticated |
| *Bubalus bubalis* | Water Buffalo | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Least Concern |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Rattus rattus* | Black Rat | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |
| *Herpestes edwardsii* | Indian Grey Mongoose | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Naja naja* | Indian Cobra | Least Concern |
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| *Hemidactylus frenatus* | Common House Gecko | Least Concern |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Columba livia* | Rock Pigeon | Least Concern |
| *Passer domesticus* | House Sparrow | Least Concern |
| *Corvus splendens* | House Crow | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |
| *Copsychus saularis* | Oriental Magpie Robin | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Halcyon smyrnensis* | White-throated Kingfisher | Least Concern |
| *Anas platyrhynchos domesticus* | Domestic Duck | Domesticated |
| *Ardea cinerea* | Grey Heron | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |
| *Ctenopharyngodon idella* | Grass Carp | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |
| *Fejervarya limnocharis* | Cricket Frog | Least Concern |

10. Flora and Fauna Recorded In and around Bechamari Beel, Morigaon District

10.1. Flora

Trees

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Mangifera indica* | Mango Tree | Least Concern |
| *Azadirachta indica* | Neem Tree | Least Concern |
| *Ficus religiosa* | Peepal Tree | Least Concern |
| *Tectona grandis* | Teak Tree | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit Tree | Least Concern |
| *Ficus benghalensis* | Banyan Tree | Least Concern |
| *Syzygium cumini* | Jamun Tree | Least Concern |
| *Bombax ceiba* | Silk Cotton Tree | Least Concern |
| *Terminalia arjuna* | Arjun Tree | Least Concern |
| *Albizia lebbeck* | Siris Tree | Least Concern |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Solanum torvum* | Turkey Berry | Not Evaluated |
| *Centella asiatica* | Indian Pennywort | Least Concern |
| *Boerhavia diffusa* | Punarnava | Not Evaluated |
| *Calotropis gigantea* | Crown Flower | Least Concern |
| *Eclipta prostrata* | False Daisy | Least Concern |
| *Ocimum tenuiflorum* | Holy Basil (Tulsi) | Not Evaluated |
| *Clerodendrum viscosum* | East Indian Glory Bower | Not Evaluated |
| *Justicia adhatoda* | Malabar Nut | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Saccharum spontaneum* | Wild Sugarcane | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Cynodon dactylon* | Bermuda Grass | Least Concern |
| *Phragmites australis* | Common Reed | Least Concern |
| *Vetiveria zizanioides* | Vetiver Grass | Least Concern |
| *Oryza rufipogon* | Wild Rice | Least Concern |
| *Echinochloa colona* | Jungle Rice | Least Concern |
| *Chrysopogon zizanioides* | Khus Grass | Not Evaluated |
| *Panicum maximum* | Guinea Grass | Least Concern |
| *Setaria viridis* | Green Foxtail | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Not Evaluated |
| *Nelumbo nucifera* | Indian Lotus | Least Concern |
| *Hydrilla verticillata* | Hydrilla | Least Concern |
| *Nymphaea nouchali* | Red Water Lily | Least Concern |
| *Salvinia molesta* | Giant Salvinia | Not Evaluated |

## 10.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos taurus* | Domestic Cow | Domesticated |
| *Capra hircus* | Domestic Goat | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Domesticated |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Macaca mulatta* | Rhesus Macaque | Least Concern |
| *Bubalus bubalis* | Domestic water buffalo | Domesticated |
| *Herpestes edwardsii* | Indian Grey Mongoose | Least Concern |
| *Canis aureus* | Golden Jackal | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Varanus bengalensis* | Bengal Monitor Lizard | Least Concern |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |
| *Naja kaouthia* | Monocled Cobra | Least Concern |
| Coelognathus radiatus | Copperhead Rat Snake | Least Concern |
| *Bungarus fasciatus* | Banded Krait | Least Concern |
| Eutropis multifasciata | Common Sun Skink | Least Concern |
| Hemidactylus frenatus | Asian House Gecko | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Not Evaluated |
| *Anas platyrhynchos domesticus* | Domestic Duck | Not Evaluated |
| *Corvus splendens* | House Crow | Least Concern |
| *Pavo cristatus* | Indian Peafowl | Least Concern |
| *Milvus migrans* | Black Kite | Least Concern |
| *Ardea cinerea* | Grey Heron | Least Concern |
| *Amaurornis phoenicurus* | White-breasted Waterhen | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Vanellus indicus* | Red-wattled Lapwing | Least Concern |
| *Vanellus cinereus* | Grey-headed Lapwing | Least Concern |
| *Anastomus oscitans* | Asian Openbill | Least Concern |
| *Circaetus gallicus* | Short-toed Snake-Eagle | Least Concern |
| *Ardea alba* | Great Egret | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Anas platyrhynchos* | Mallard | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |
| *Ctenopharyngodon idella* | Grass Carp | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern (LC) |
| *Euphlyctis cyanophlyctis* | Indian Skipper Frog | Least Concern (LC) |
| *Duttaphrynus melanostictus* | Common Asian Toad | Least Concern (LC) |
| *Rana temporalis* | Indian Pond Frog | Least Concern (LC) |
| *Hylarana leptoglossa* | Green Frog | Least Concern (LC) |

11. Flora and Fauna Recorded In and around Morikolong Beel, Morigaon District

11.1. Flora

Trees

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Mangifera indica* | Mango Tree | Least Concern |
| *Azadirachta indica* | Neem Tree | Least Concern |
| *Ficus religiosa* | Peepal Tree | Least Concern |
| *Tectona grandis* | Teak Tree | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit Tree | Least Concern |
| *Ficus benghalensis* | Banyan Tree | Least Concern |
| *Syzygium cumini* | Jamun Tree | Least Concern |
| *Bombax ceiba* | Silk Cotton Tree | Least Concern |
| *Terminalia arjuna* | Arjun Tree | Least Concern |
| *Albizia lebbeck* | Siris Tree | Least Concern |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Solanum torvum* | Turkey Berry | Not Evaluated |
| *Centella asiatica* | Indian Pennywort | Least Concern |
| *Boerhavia diffusa* | Punarnava | Not Evaluated |
| *Calotropis gigantea* | Crown Flower | Least Concern |
| *Eclipta prostrata* | False Daisy | Least Concern |
| *Ocimum tenuiflorum* | Holy Basil (Tulsi) | Not Evaluated |
| *Clerodendrum viscosum* | East Indian Glory Bower | Not Evaluated |
| *Justicia adhatoda* | Malabar Nut | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Saccharum spontaneum* | Wild Sugarcane | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Cynodon dactylon* | Bermuda Grass | Least Concern |
| *Phragmites australis* | Common Reed | Least Concern |
| *Vetiveria zizanioides* | Vetiver Grass | Least Concern |
| *Oryza rufipogon* | Wild Rice | Least Concern |
| *Echinochloa colona* | Jungle Rice | Least Concern |
| *Chrysopogon zizanioides* | Khus Grass | Not Evaluated |
| *Panicum maximum* | Guinea Grass | Least Concern |
| *Setaria viridis* | Green Foxtail | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Not Evaluated |
| *Nelumbo nucifera* | Indian Lotus | Least Concern |
| *Hydrilla verticillata* | Hydrilla | Least Concern |
| *Nymphaea nouchali* | Red Water Lily | Least Concern |
| *Salvinia molesta* | Giant Salvinia | Not Evaluated |

11.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos taurus* | Domestic Cow | Domesticated |
| *Capra hircus* | Domestic Goat | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Domesticated |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Macaca mulatta* | Rhesus Macaque | Least Concern |
| *Bubalus bubalis* | Domestic water buffalo | Domesticated |
| *Herpestes edwardsii* | Indian Grey Mongoose | Least Concern |
| *Canis aureus* | Golden Jackal | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Varanus bengalensis* | Bengal Monitor Lizard | Least Concern |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |
| *Naja kaouthia* | Monocled Cobra | Least Concern |
| Coelognathus radiatus | Copperhead Rat Snake | Least Concern |
| *Bungarus fasciatus* | Banded Krait | Least Concern |
| Eutropis multifasciata | Common Sun Skink | Least Concern |
| Hemidactylus frenatus | Asian House Gecko | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Not Evaluated |
| *Anas platyrhynchos domesticus* | Domestic Duck | Not Evaluated |
| *Corvus splendens* | House Crow | Least Concern |
| *Pavo cristatus* | Indian Peafowl | Least Concern |
| *Milvus migrans* | Black Kite | Least Concern |
| *Ardea cinerea* | Grey Heron | Least Concern |
| *Amaurornis phoenicurus* | White-breasted Waterhen | Least Concern |
| *Vanellus indicus* | Red-wattled Lapwing | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Vanellus cinereus* | Grey-headed Lapwing | Least Concern |
| *Anastomus oscitans* | Asian Openbill | Least Concern |
| *Circaetus gallicus* | Short-toed Snake-Eagle | Least Concern |
| *Ardea alba* | Great Egret | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Anas platyrhynchos* | Mallard | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |
| *Ctenopharyngodon idella* | Grass Carp | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern (LC) |
| *Euphlyctis cyanophlyctis* | Indian Skipper Frog | Least Concern (LC) |
| *Duttaphrynus melanostictus* | Common Asian Toad | Least Concern (LC) |
| *Rana temporalis* | Indian Pond Frog | Least Concern (LC) |
| *Hylarana leptoglossa* | Green Frog | Least Concern (LC) |

12. Flora and Fauna Recorded In and around Bhagampur, Nagaon District

12.1 Flora

Trees

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Ficus benghalensis* | Banyan tree | Least Concern |
| *Shorea robusta* | Sal tree | Least Concern |
| *Mangifera indica* | Mango | Least Concern |
| *Acacia auriculiformis* | Acacia | Least Concern |
| *Terminalia bellirica* | Baheda | Least Concern |
| *Diospyros lotus* | Black sapote | Least Concern |
| *Cocos nucifera* | Coconut Palm | Not Evaluated |
| *Albizia lebbeck* | Siris tree | Least Concern |

Plant

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Nymphaea nouchali* | Blue water lily | Least Concern |
| *Nelumbo nucifera* | Lotus | Least Concern |
| *Azolla pinnata* | Water fern | Least Concern |
| *Eclipta prostrata* | False daisy | Least Concern |
| *Ricinus communis* | Castor Bean | Not Evaluated |
| *Catharanthus roseus* | Madagascar Periwinkle | Not Evaluated |
| *Hedychium coronarium* | Ginger lily | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Phragmites karka* | Common reed | Least Concern |
| *Typha angustifolia* | Bulrush | Least Concern |
| *Saccharum spontaneum* | Wild sugarcane | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eleocharis dulcis* | Chinese water chestnut | Least Concern |
| *Imperata cylindrica* | Cogon grass | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water hyacinth | Least Concern |
| *Salvinia molesta* | Giant salvinia | Least Concern |
| *Lemna minor* | Lesser duckweed | Least Concern |
| *Pistia stratiotes* | Water lettuce | Least Concern |

12.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Canis lupus familiaris* | Domestic Dog | Least Concern |
| *Bos taurus* | Domestic Cow | Domesticated |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Bubalus bubalis* | Water Buffalo | Least Concern |
| *Felis catus* | Domestic Cat | Least Concern |
| *Pteropus giganteus* | Indian Flying-Fox | Least Concern |
| *Equus ferus caballus* | Domestic Horse | Domesticated |
| *Rattus rattus* | Black Rat | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| *Naja naja* | Indian Cobra | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gekko gecko* | Tokay Gecko | Least Concern |
| *Hemidactylus frenatus* | Common House Gecko | Least Concern |
| *Eutropis carinata* | Keeled Indian Mabuya | Least Concern |
| *Fowlea piscator* | Chequered Keelback | Not Evaluated |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Corvus splendens* | House Crow | Least Concern |
| *Passer domesticus* | House Sparrow | Least Concern |
| *Columba livia* | Rock Pigeon | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Copsychus saularis* | Oriental Magpie Robin | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |
| *Ardeola grayii* | Indian Pond Heron | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus cirrhosus* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |
| *Anabas testudineus* | Climbing Perch | Least Concern |
| *Puntius sophore* | Pool Barb | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |
| *Euphlyctis cyanophlyctis* | Indian Skittering Frog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |

13. Flora and Fauna Recorded In and around Sapekhality Beel, Nagaon District

13.1. Flora

Trees

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Ficus benghalensis* | Banyan tree | Least Concern |
| *Shorea robusta* | Sal tree | Least Concern |
| *Mangifera indica* | Mango | Least Concern |
| *Acacia auriculiformis* | Acacia | Least Concern |
| *Terminalia bellirica* | Baheda | Least Concern |
| *Diospyros lotus* | Black sapote | Least Concern |
| *Cocos nucifera* | Coconut Palm | Not Evaluated |
| *Albizia lebbeck* | Siris tree | Least Concern |

Plant

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Nymphaea nouchali* | Blue water lily | Least Concern |
| *Nelumbo nucifera* | Lotus | Least Concern |
| *Azolla pinnata* | Water fern | Least Concern |
| *Eclipta prostrata* | False daisy | Least Concern |
| *Ricinus communis* | Castor Bean | Not Evaluated |
| *Catharanthus roseus* | Madagascar Periwinkle | Not Evaluated |
| *Hedychium coronarium* | Ginger lily | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Phragmites karka* | Common reed | Least Concern |
| *Typha angustifolia* | Bulrush | Least Concern |
| *Saccharum spontaneum* | Wild sugarcane | Least Concern |
| *Eleocharis dulcis* | Chinese water chestnut | Least Concern |
| *Imperata cylindrica* | Cogon grass | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water hyacinth | Least Concern |
| *Salvinia molesta* | Giant salvinia | Least Concern |
| *Lemna minor* | Lesser duckweed | Least Concern |
| *Pistia stratiotes* | Water lettuce | Least Concern |

13.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Canis lupus familiaris* | Domestic Dog | Least Concern |
| *Bos taurus* | Domestic Cow | Domesticated |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Bubalus bubalis* | Water Buffalo | Least Concern |
| *Felis catus* | Domestic Cat | Least Concern |
| *Pteropus giganteus* | Indian Flying-Fox | Least Concern |
| *Equus ferus caballus* | Domestic Horse | Domesticated |
| *Rattus rattus* | Black Rat | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| *Naja naja* | Indian Cobra | Least Concern |
| *Gekko gecko* | Tokay Gecko | Least Concern |
| *Hemidactylus frenatus* | Common House Gecko | Least Concern |
| *Eutropis carinata* | Keeled Indian Mabuya | Least Concern |
| *Fowlea piscator* | Chequered Keelback | Not Evaluated |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Corvus splendens* | House Crow | Least Concern |
| *Passer domesticus* | House Sparrow | Least Concern |
| *Columba livia* | Rock Pigeon | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Copsychus saularis* | Oriental Magpie Robin | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |
| *Ardeola grayii* | Indian Pond Heron | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus cirrhosus* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |
| *Anabas testudineus* | Climbing Perch | Least Concern |
| *Puntius sophore* | Pool Barb | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |
| *Euphlyctis cyanophlyctis* | Indian Skittering Frog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |

14. Flora and Fauna Recorded In and around 3 No Borhullung Lonkadeep, Tinsukia, District

14.1. Flora

Trees

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Azadirachta indica* | Neem | Least Concern |
| *Mangifera indica* | Mango Tree | Least Concern |
| *Ficus benghalensis* | Banyan Tree | Least Concern |
| *Syzygium cumini* | Jamun/Java Plum | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit Tree | Least Concern |
| *Tectona grandis* | Teak | Least Concern |
| *Terminalia arjuna* | Arjun Tree | Least Concern |
| *Bambusa vulgaris* | Common Bamboo | Least Concern |
| *Albizia lebbeck* | Siris Tree | Least Concern |
| *Dalbergia sissoo* | Indian Rosewood | Least Concern |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Ocimum sanctum* | Holy Basil (Tulsi) | Least Concern |
| *Zingiber officinale* | Ginger | Least Concern |
| *Curcuma longa* | Turmeric | Least Concern |
| *Catharanthus roseus* | Periwinkle | Least Concern |
| *Aloe vera* | Aloe | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Lantana camara* | Lantana | Least Concern |
| *Andrographis paniculata* | Kalmegh | Least Concern |
| *Mentha arvensis* | Wild Mint | Least Concern |
| *Eclipta prostrata* | False Daisy (Bhringraj) | Least Concern |
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Cynodon dactylon* | Bermuda Grass (Dubori) | Least Concern |
| *Eleusine indica* | Indian Goosegrass | Least Concern |
| *Echinochloa crus-galli* | Barnyard Grass | Least Concern |
| *Arundinella bengalensis* | Bengal Arundinella | Least Concern |
| *Phragmites karka* | Common Reed | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |
| *Nymphaea nouchali* | Red Water Lily | Least Concern |
| *Vallisneria spiralis* | Eelgrass | Least Concern |
| *Hydrilla verticillata* | Hydrilla | Least Concern |
| *Lemna minor* | Common Duckweed | Least Concern |
| *Salvinia molesta* | Giant Salvinia | Least Concern |
| *Trapa natans* | Water Chestnut | Least Concern |
| *Ipomoea aquatica* | Water Spinach | Least Concern |

14.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos taurus* | Domestic Cow | Domesticated |
| *Bubalus bubalis* | Water Buffalo | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Least Concern |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Rattus rattus* | Black Rat | Least Concern |
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |
| *Herpestes edwardsii* | Indian Grey Mongoose | Least Concern |
| *Macaca mulatta* | Rhesus Macaque | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Naja naja* | Indian Cobra | Least Concern |
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| *Varanus bengalensis* | Bengal Monitor Lizard | Least Concern |
| *Hemidactylus frenatus* | Common House Gecko | Least Concern |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |
| *Chrysopelea ornata* | Ornate Flying Snake | Least Concern |
| *Trimeresurus albolabris* | White-lipped Pit Viper | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Columba livia* | Rock Pigeon | Least Concern |
| *Passer domesticus* | House Sparrow | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Corvus splendens* | House Crow | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |
| *Copsychus saularis* | Oriental Magpie Robin | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Halcyon smyrnensis* | White-throated Kingfisher | Least Concern |
| *Anas platyrhynchos domesticus* | *Domestic Duck* | *Domesticated* |
| *Ardea cinerea* | Grey Heron | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |
| *Anabas testudineus* | Climbing Perch | Least Concern |
| *Puntius sophore* | Pool Barb | Least Concern |
| *Ctenopharyngodon idella* | Grass Carp | Least Concern |
| *Mystus tengara* | Tengara Catfish | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Euphlyctis cyanophlyctis* | Indian Skittering Frog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |

15. Flora and Fauna Recorded In and around Dalpung beel, Dhemaji District

Flora

Trees

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Azadirachta indica* | Neem | Least Concern |
| *Mangifera indica* | Mango Tree | Least Concern |
| *Tectona grandis* | Teak | Least Concern |
| *Ficus benghalensis* | Banyan Tree | Least Concern |
| *Syzygium cumini* | Jamun/Java Plum | Least Concern |
| *Artocarpus heterophyllus* | Jackfruit Tree | Least Concern |
| *Terminalia arjuna* | Arjun Tree | Least Concern |
| *Dalbergia sissoo* | Indian Rosewood | Least Concern |
| *Bambusa vulgaris* | Common Bamboo | Least Concern |
| *Tamarindus indica* | Tamarind Tree | Least Concern |

Plants

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Curcuma longa* | Turmeric | Least Concern |
| *Zingiber officinale* | Ginger | Least Concern |
| *Ocimum sanctum* | Holy Basil (Tulsi) | Least Concern |
| *Aloe vera* | Aloe | Least Concern |
| *Catharanthus roseus* | Periwinkle | Least Concern |
| *Andrographis paniculata* | Kalmegh | Least Concern |

Grasses

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bambusa balcooa* | Bhaluka Bamboo | Least Concern |
| *Cynodon dactylon* | Bermuda Grass (Dubori) | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Saccharum spontaneum* | Wild Sugarcane | Least Concern |
| *Imperata cylindrica* | Cogon Grass | Least Concern |
| *Phragmites karka* | Common Reed | Least Concern |
| *Vetiveria zizanioides* | Vetiver Grass | Least Concern |
| *Eleusine indica* | Indian Goosegrass | Least Concern |
| *Echinochloa crus-galli* | Barnyard Grass | Least Concern |
| *Arundinella nepalensis* | Nepalese Arundinella | Least Concern |

Macrophytes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Eichhornia crassipes* | Water Hyacinth | Least Concern |
| *Nelumbo nucifera* | Indian Lotus | Least Concern |
| *Nymphaea nouchali* | Red Water Lily | Least Concern |
| *Hydrilla verticillata* | Hydrilla | Least Concern |
| *Pistia stratiotes* | Water Lettuce | Least Concern |
| *Lemna minor* | Common Duckweed | Least Concern |
| *Salvinia molesta* | Giant Salvinia | Least Concern |

8.2. Fauna

Mammals

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Bos taurus* | Domestic Cow | Domesticated |
| *Bubalus bubalis* | Water Buffalo | Domesticated |
| *Canis lupus familiaris* | Domestic Dog | Domesticated |
| *Felis catus* | Domestic Cat | Least Concern |
| *Capra aegagrus hircus* | Domestic Goat | Domesticated |
| *Sus scrofa domesticus* | Domestic Pig | Domesticated |
| *Rattus rattus* | Black Rat | Least Concern |

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Pteropus giganteus* | Indian Flying Fox | Least Concern |
| *Herpestes edwardsii* | Indian Grey Mongoose | Least Concern |
| *Macaca mulatta* | Rhesus Macaque | Least Concern |

Reptiles

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Naja naja* | Indian Cobra | Least Concern |
| *Calotes versicolor* | Oriental Garden Lizard | Least Concern |
| *Varanus bengalensis* | Bengal Monitor Lizard | Least Concern |
| *Hemidactylus frenatus* | Common House Gecko | Least Concern |
| *Ptyas mucosa* | Indian Rat Snake | Least Concern |

Birds

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Gallus gallus domesticus* | Domestic Chicken | Domesticated |
| *Columba livia* | Rock Pigeon | Least Concern |
| *Passer domesticus* | House Sparrow | Least Concern |
| *Corvus splendens* | House Crow | Least Concern |
| *Acridotheres tristis* | Common Myna | Least Concern |
| *Copsychus saularis* | Oriental Magpie Robin | Least Concern |
| *Pycnonotus cafer* | Red-vented Bulbul | Least Concern |
| *Halcyon smyrnensis* | White-throated Kingfisher | Least Concern |
| *Anas platyrhynchos domesticus* | Domestic Duck | Domesticated |
| *Ardea cinerea* | Grey Heron | Least Concern |

Fishes

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Labeo rohita* | Rohu | Least Concern |
| *Catla catla* | Catla | Least Concern |
| *Cirrhinus mrigala* | Mrigal | Least Concern |
| *Channa punctata* | Spotted Snakehead | Least Concern |
| *Ctenopharyngodon idella* | Grass Carp | Least Concern |

Amphibians

| Scientific Name | Common Name | IUCN Status |
|---|---|---|
| *Hoplobatrachus tigerinus* | Indian Bullfrog | Least Concern |
| *Duttaphrynus melanostictus* | Asian Common Toad | Least Concern |
| *Fejervarya limnocharis* | Cricket Frog | Least Concern |

## Annexure A21: Administrative Documents- Mariampur Eco-tourism Lake

**GOVT. OF ASSAM**
**Department of Environment, Forest & Climate Change, Assam**
**OFFICE OF THE DIVISIONAL FOREST OFFICER ::GOALPARA DIVISION (T)::GOALPARA**
E-mail: dfo.t.goalpara@gmail.com

**No. B/GLP (T)/Mariampur JFMC/ 3896-97** **Dated the Goalpara,18th November/2025**

To,

The District Fishery Development Officer,
Goalpara

**Sub: Regarding No objection related to the ecotourism development project under Goalpara Forest Division.**

**Ref: Your Office Letter No- AFGG.511/2022-23/948 Dtd Goalpara the 12 th November/2025**

Sir,

With respect to the subject cited above, I would like to inform you that that this office has no objection related to the said ecotourism project - proposed items of works in the DPR - implemented through the JFMC. It should however be ensured that the operation are run within the eco tourism guidelines and should be operated by JFMC/village committee. The revenue generated should also accrue to the JFMC/Village Committee.

Further provision should be made for hand holding and capacity Building of the JFMC members to run the operations effectively. Rather than a one time training, there should be proper hand holding by expert groups for a period of at least 2/3 years post commencement of the operations.

This is submitted for your kind information and necessary action.

Yours faithfully,

(Tejas Mariswamy, IFS)
Divisional Forest Officer,
Goalpara Division(T)::Goalpara

Copy to the District Commissioner, Goalpara, for favour his kind information.

Divisional Forest Officer,
Goalpara Division(T)::Goalpara

Page 1 of 1

GOVT. OF ASSAM
Environment & Forest Department
OFFICE OF THE DIVISIONAL FOREST OFFICER (T):GOALPARA DIVISION::GOALPARA
E-mail:

No. B/GLP (T)/JFMC Genl/ 2683

Dated Goalpara, 16th September/2025

**Name of FDA: Goalpara**

This is to certify that **Mariampur Joint Forest Management Committee** which has been constituted as per provision of Rule 7 of Assam Joint (People Participation) Forestry Management Rule, 1998 has been registered under the seal and signature of the Divisional Forest Officer, Goalpara Division (T), Goalpara cum Member Secretary, Goalpara FDA as per direction of Chief Conservator of Forests (T), Central Assam Circle, Guwahati-29 cum Chairperson, Goalpara FDA vide office letter No. FG.4/CAC/JFMC/2024 Dated Guwahati 7th Oct, 2024.

Date: 16th September, 2025
Place: Goalpara

(Tejas Mariswamy, IFS)
Divisional Forest Officer,
Goalpara Division(T)::Goalpara
Cum
Member Secretary, Goalpara FDA
Assam

Divisional Forest Officer
Goalpara Division

GOVERNMENT OF ASSAM
OFFICE OF THE CIRCLE OFFICER
RANGJULI REVENUE CIRCLE, GOALPARA DISTRICT

## TO WHOM IT MAY CONCERN

This is to certify that the land measuring 297B-3K-15L covered by Dag No. 71 of Revenue Village Bardamal Athiabari falls in "Saloni" as per record of Chitha. However, upon field verification by the concerned land recorder, it is seen that there is a pond situated in an area measuring 61B-2K-11L (approx.) which falls in the same Dag No.

Dated 16th September 2021

Circle Officer
Rangjuli Revenue Circle
Rangjuli

## Update of JFMC Formation, Moriompur Eco Tourism Lake

On 19th May, the Moriompur Beel Committee met with the Beat Officer, Forest Department, to discuss the formation of the Joint Forest Management Committee (JFMC). During the meeting, the Beat Officer requested the committee to collect and submit the following information:

- Number of households
- Landholding category
- Livestock population
- Human population of the area
- The committee was asked to submit this information to the Divisional Forest Officer (DFO). The Beat Officer assured the committee of his full support and assistance in the formation of the JFMC."
- The Divisional Forest Officer (DFO) has convened a meeting on 23rd May 2025. The purpose of the meeting is to discuss and finalize the formation of the Joint Forest Management Committee (JFMC) of Moriompur Beel.



# Annexure A22: Human–Animal Conflict Management Plan (HACMP)

## 1. Introduction

Assam Sustainable Wetland and Integrated Fisheries Transformation (SWIFT) Project involves the development of at least 102 beels across Assam. As these beels are ecologically sensitive wetland ecosystems supporting diverse aquatic and terrestrial biodiversity, construction and operational activities may create opportunities for interactions between humans and wildlife. Potential human–animal conflict (HAC) situations may arise due to increased human presence, movement of construction vehicles, habitat disturbance, noise, lighting, and improper waste management.

This Human–Animal Conflict Management Plan (HACMP) has been prepared as part of the Environmental Management Plan (EMP) to prevent, minimize, and manage potential conflicts between project activities and wildlife while ensuring the safety of workers, local communities, and biodiversity.

## 2. Objectives

The objectives of the HACMP are to:

- Prevent and minimize human–animal conflict during construction and operation of project facilities.
- Protect workers, local communities, and wildlife from injury or harm.
- Ensure compliance with environmental safeguard requirements and biodiversity conservation principles.
- Integrate biodiversity and wildlife survey recommendations into project planning and implementation.
- Establish clear procedures for monitoring, reporting, and responding to wildlife-related incidents.

## 3. Applicability

This plan shall apply to:

- All project-supported beels.
- Contractors, subcontractors, workers, consultants, local community and project staff.
- Construction and operation of seed rearing facilities, pen culture units, fish landing sheds, community centres, habitat management structures, hume pipe installations, vermi-compost units, solar lighting systems, approach roads, and associated infrastructure.

Special attention shall be given to beels located near wetlands, riverine habitats, forest patches, grasslands, wildlife movement routes, and other ecologically sensitive areas.

## 4. Regulatory Framework

The HACMP shall be implemented in accordance with:

- Wildlife (Protection) Act, 1972 (as amended).
- Biological Diversity Act, 2002.
- Environment (Protection) Act, 1986.
- Assam Forest Regulations and relevant State Government notifications.
- ADB Safeguard Policy Statement (SPS), 2009.
- Project Environmental Management Framework (EMF).
- Biodiversity Survey and Wildlife Survey recommendations.

## 5. Potential Human–Animal Conflict Risks

Potential risks include:

- Disturbance of wildlife due to construction activities.
- Encounters between workers and wild animals.
- Disruption of wildlife movement corridors.
- Disturbance to nesting, breeding, feeding, and resting habitats.
- Attraction of animals due to food waste and improper waste disposal.
- Vehicle collisions with wildlife.
- Disturbance caused by artificial lighting and noise.
- Community-wildlife interactions resulting from project activities.

Potential wildlife groups may include:

- Elephants
- Wild boars
- Moneys
- Jackal/Fox/Fishing cats
- Otters
- Reptiles (including snakes and turtles)
- Migratory and resident birds
- Small mammals and other wetland-dependent fauna

## 6. Biodiversity and Wildlife Survey Requirements

Prior to commencement of construction activities, the findings and recommendations of the Biodiversity Survey and Wildlife Survey conducted for the project beels shall be strictly reviewed and incorporated into site-specific Environmental Management Plans (EMPs) and construction methodologies.

The Biodiversity and Wildlife Surveys shall serve as the primary basis for:

- Identification of sensitive habitats.
- Identification of wildlife movement routes.
- Mapping of breeding and nesting locations.

- Identification of species of conservation significance.
- Identification of seasonal congregation areas.
- Assessment of human–animal conflict hotspots.

The contractor shall strictly comply with all recommendations arising from the Biodiversity Survey and Wildlife Survey.

Where the surveys identify sensitive ecological receptors, additional site-specific mitigation measures shall be prepared and implemented before commencement of works.

No construction activity shall commence until the relevant biodiversity and wildlife management recommendations have been integrated into the site-specific EMP and approved by the Project Implementation Unit (PIU).

## 7. Mitigation Measures

### 7.1 Pre-Construction Phase

1. Conduct site-specific environmental briefings before mobilization.
2. Review Biodiversity Survey and Wildlife Survey findings.
3. Identify wildlife-sensitive zones and movement routes.
4. Consult local communities, Beel Development Committees (BDCs), Forest Department officials, and village institutions regarding wildlife occurrence and conflict history.
5. Develop site-specific HAC measures wherever required.
6. Train workers on wildlife awareness and conflict avoidance.
7. Establish communication protocols with local Forest Department officials.
8. Avoid locating construction camps in sensitive wildlife habitats.

### 7.2 Construction Phase

**General Measures**

1. Restrict construction activities to daylight hours wherever feasible.
2. Avoid unnecessary vegetation clearance.
3. Minimize disturbance to wetland habitats.
4. Prohibit hunting, trapping, harassment, feeding, or collection of wildlife.
5. Maintain speed limits for construction vehicles.
6. Install wildlife caution signage where required.
7. Avoid stockpiling materials in wildlife movement areas.
8. Ensure proper housekeeping and waste management.
9. Prevent discharge of pollutants into wetland ecosystems.
10. Minimize noise and vibration levels.

**Waste Management**

1. Store food waste in covered containers.
2. Remove waste regularly from construction sites.
3. Prohibit open dumping.
4. Prohibit feeding of wildlife.

**Lighting Management**

1. Minimize night-time lighting.
2. Direct lights away from wetland habitats.
3. Avoid high-intensity floodlights near ecologically sensitive areas.

**Vehicle Management**

1. Maintain designated transportation routes.
2. Enforce speed restrictions.
3. Avoid unnecessary vehicle movement at night.
4. Stop vehicles immediately if wildlife is observed crossing roads.

**7.3 Operation Phase**

1. Continue awareness programmes for BDCs and local communities.
2. Maintain proper waste management around project facilities.
3. Monitor wildlife interactions periodically.
4. Maintain habitat management interventions established under the project.
5. Review conflict incidents annually and implement corrective measures.

**8. Emergency Response Procedure**

In case of wildlife encounters:

**Step 1: Stop Work**

- Immediately suspend nearby construction activities.
- Shut down equipment if necessary.

**Step 2: Maintain Safe Distance**

- Keep workers away from the animal.
- Prevent crowd formation.

**Step 3: Inform Authorities**

- Notify Site Engineer.
- Notify Environmental Safeguard Officer.
- Notify local Forest Department officials.

**Step 4: Follow Forest Department Instructions**

- Do not attempt to capture, chase, or harm wildlife.
- Allow authorized personnel to manage the situation.

**Step 5: Resume Work**

- Resume work only after clearance from responsible authorities.

**9. Community Consultation and Awareness**

Public consultations have been conducted during:

- Beel selection.
- Environmental and social screening.
- Preparation of safeguard documents.
- Formation of Beel Development Committees (BDCs).

Consultation records and stakeholder feedback are provided in the relevant sections of the IEE Report.

Consultation shall continue throughout project implementation regarding:

- Construction schedules.
- Access and hauling routes.
- Construction camps.
- Community safety concerns.
- Wildlife-related issues.

Stakeholder concerns and recommendations shall be incorporated into project implementation wherever feasible.

**10.Institutional Responsibilities**

| **Activity** | **Responsibility** |
|---|---|
| Biodiversity and wildlife survey review | PIU / Environmental Safeguard Team |
| Site-specific HAC planning | Contractor |
| Worker awareness training | Contractor |
| Community consultation | PIU / BDC / Contractor |
| Incident monitoring | Contractor and Environmental Safeguard Team |
| Wildlife emergency response | Contractor and Forest Department |
| Compliance monitoring | PIU / Environmental Safeguard Team |
| Reporting | Contractor |

**11.Monitoring Indicators**

The following indicators shall be monitored:

- Number of wildlife sightings.
- Number of HAC incidents.

- Number of workers trained.
- Number of awareness programmes conducted.
- Compliance with Biodiversity Survey recommendations.
- Compliance with Wildlife Survey recommendations.
- Waste management compliance.
- Vehicle speed compliance.
- Number of consultations conducted.
- Corrective actions implemented.

**12. Reporting Requirements**

The Contractor shall maintain records of:

- Wildlife sightings.
- Human–animal conflict incidents.
- Wildlife-related complaints.
- Training programmes.
- Awareness activities.
- Corrective actions undertaken.

The information shall be included in monthly site reports and environmental monitoring reports submitted to the PIU.

Any significant wildlife incident, injury, mortality, or conflict event shall be reported immediately to the Forest Department and PIU within 24 hours.

**13. Budget Provision**

The Contractor shall include adequate budget provisions for:

- Worker training and awareness programmes.
- Wildlife signage and safety measures.
- Community consultations.
- Monitoring and reporting activities.
- Emergency response actions.
- Implementation of recommendations arising from Biodiversity and Wildlife Surveys.

# Part-B

# Site Selection Criteria and Environmental Safeguards Due Diligence Procedure for Upcoming Beels and Other Infrastructures under SWIFT Project

# 1. ENVIRONMENTAL ASSESSMENT PROCEDURE

## 1.1. Overview

1. The SWIFT Project, through its on-beel and off-beel infrastructure development components, aims to enhance fish production, post-harvest handling, and eco-tourism capacities while integrating long-term conservation measures to sustain the beel ecosystem. Under Sub-activity 2.2.1 of Output 2, nursery rearing ponds and in-situ pens will be established within the beels to support localized fingerling production and indigenous species stocking, boosting biological productivity through controlled fish culture. Fishing boats will be provided to enable efficient harvesting, particularly during peak seasons, while fish landing sites equipped with sanitation amenities, insulated storage, and handling crates will ensure hygienic post-harvest management.

2. Complementing this, Sub-activity 2.2.2 of Output 2 supports off-beel infrastructure that enhances value chain linkages and promotes eco-tourism. Auction centers equipped with sanitation and storage facilities, weighing scales, and transparent price displays will facilitate hygienic, organized fish marketing. Eco-tourism components will include the development of visitor centers near ecologically significant beels to showcase local biodiversity and culture, along with nature trails, birdwatching platforms, and guided boating or kayaking services. Eco-lodges and homestays will offer environmentally responsible accommodation, creating alternative income streams while fostering conservation awareness.

3. To ensure long-term environmental resilience, Output 3: beel conservation and restoration planned and managed introduces key interventions. This includes demarcation infrastructure such as satellite mapping and boundary pillars to curb encroachment and clearly define beel boundaries. De-weeding equipment, both manual and mechanical, will manage excessive aquatic vegetation like water hyacinth, restoring ecological function. Earthen mounds sourced from desilted material will enhance avian habitats, while embankments or peripheral bunds will protect against floods and soil erosion. Silt traps at inlet points will control sediment and nutrient inflows, improving water quality. Further, water retaining structures including sluice gates and gabions will regulate water flow and erosion, and Hume pipes will improve connectivity and drainage. Together, these interventions ensure that conservation goals are integrated with fisheries development and community-based livelihoods.

4. As part of the project implementation arrangements, infrastructure improvements will be undertaken to support institutional strengthening and coordination functions at various administrative levels. These works include the the construction of office buildings for the CPIUs and PMU to enhance operational capacity and ensure adequate working space and facilities. These infrastructure activities fall under the project financing and will be designed in accordance with relevant building codes and environmental standards.

5. Site-specific environmental assessment for the beels under Output 3, infrastructure development interventions under Output 2 and office buildings of the project will be carried out in full alignment with the requirements of ADB's Safeguard Policy Statement (SPS), 2009. This process will ensure that all subprojects not yet confirmed and subject to detailed design (62 beels) and other undergo environmental assessment in accordance with category B project requirements. This annexure of the IEE serves as a guiding document outlining the requirements for updating Initial Environmental Examination (IEE), Environmental Management Plans (EMPs),

and for conducting public consultations and disclosure while ensuring consistency with national and state environmental regulations.

### 1.2. Selection Criteria for Subprojects/Beels

6. Environmental criteria will form the first stages of selection process for the upcoming beels. Therefore, the CPIUs and PIU will use the following criteria to select beels under the project:

I. Any scheme or activity classified as Environment Category A under ADB's Safeguard Policy Statement (SPS), 2009, and included in ADB PIAL must not be considered under the Project.
II. Any areas that fall within Protected Areas (such as national parks, wildlife sanctuaries, tiger reserves, and elephant reserves), their notified eco-sensitive zones (ESZs), or within 10 km of their boundaries if no ESZ is notified. It will also exclude Ramsar Sites, world heritage sites, key biodiversity areas (KBAs), and important bird areas (IBAs) [this is with the exception of the three beels already selected and included in the draft IEE on Majuli island and Bera Na Beel - located in Dhemaji District inside Dibru-Saikhowa Complex].
III. Located within Village Grazing Reserves (VGRs), Professional Grazing Reserves (PGRs), or similar areas protected through traditional practices or legal frameworks will be avoided.
IV. No project components will be located within 300 meters of sites protected by the Archaeological Survey of India (ASI) or other historically significant monuments and areas.
V. Situated in locations with existing social conflicts or disputes over land use will not be considered.
VI. Any project activities that require land acquisition will not be selected.
VII. Locations that may result in disturbance to historical, cultural, or religious sites or values will be avoided.
VIII. Areas that are severely degraded and economically non-viable for rejuvenation will not be included.
IX. Located in areas very close to the Brahmaputra River or its tributaries, where created infrastructure could face damage during floods, will be excluded.
X. Within areas inaccessible or remote locations where logistical challenges make project implementation impractical will not be considered.
XI. Situated on private land or under unresolved ownership disputes will not be included.
XII. Sites already covered under other ongoing development projects or programs will be excluded to avoid duplication.

### 1.3. Environmental Assessment Process for Subproject

7. The remaning 62 subproject beels to be confirmed are expected to be of a same scale and setting to those be implemented, and other infrastructure development of Output 2. The selection criteria will prioritize minimizing potential environmental impacts. The following sections detail the environmental assessment process, the preparation of necessary reports, and the safeguards requirements for these subproject beels. These measures will also apply to any changes in scope or location that may occur during detailed design and implementation. For reference, subproject selection and environmental assessment checklist is provided in Annexure B1 while Figure 1.1 illustrates the environmental safeguards compliance process.

8. **Environmental Assessment.** The SWIFT project is classified as Category B for environmental safeguards under ADB's Safeguard Policy Statement (2009). To ensure compliance with Category B requirements, all upcoming new batch of 62 beels and other infrastructures (i.e.,

on-beel and off-beel, eco-tourism and government buildings) selected based on subproject selection criteria will undergo site specific environmental assessment. The environmental assessment process includes updating the Initial Environmental Examination (IEE), Environmental Management Plan (EMP) as required, and conducting public consultations and disclosure of documents.

9. During project implementation, environmental assessments for these subprojects will be carried out in accordance with the requirements of both ADB and the Government of India, ensuring harmonization of environmental procedures. The PIU, with support from from CPIUs, will be responsible for updating the existing IEE prepared during project processing to include these subprojects. The EMP will also be revised to address site-specific risks and mitigation measures for the newly included beels and associated infrastructure. Beyond general environmental considerations, the assessments will examine potential impacts on biodiversity and natural resources. The IEE will cover any concerns related to natural or critical habitats, including proximity to protected areas or their buffer zones. In such cases, relevant management plans will be reviewed, and consultations will be conducted with protected area authorities, local communities, and other key stakeholders, with findings documented in the IEE. The IEE must also identify and discuss on physical cultural resources and possible impacts and impacts on health and safety of both laborer and communities. IEE must discuss on 'chance find' and management measures.

10. The PMU will review and endorse the updated IEE to ADB for review and clearance for disclosure in ADB website and on the SWIFT website. Outline and content of an IEE report is given in Annexure B4.

11. **Biodiversity Conservation and Sustainable Natural Resource Management.** Under the SWIFT project, the PMU and CPIUs, with support from contractual staff, must evaluate the significance of subproject impacts and risks on biodiversity and natural resources. This assessment should focus on major threats to biodiversity, including disturbances to the beel aquatic ecosystem and its associated flora and fauna. The PMU and CPIUs will identify measures to avoid, minimize, or mitigate these potential impacts and risks. If necessary, compensatory measures such as biodiversity offsets will be proposed to ensure no net loss or achieve a net gain, particularly in critical habitat areas. Sustainable management of natural resources involves balancing the use of land, water, soil, and vegetation for productive and other purposes while maintaining their long-term health and functionality. This includes protecting, conserving, and preserving ecosystem capacity to support life and development.

12. **Pollution Prevention and Abatement**. Subprojects involving beels, off-beel and on-beel and components such as rearing ponds and hatcheries, pollution prevention and control technologies and practices must align with international good practices. These measures should be integrated into subproject design, construction, and operation to ensure compliance with relevant standards and guidelines. Pollution prevention and abatement are essential if the subprojects have the potential to generate pollution, especially in sensitive ecosystems like beels. During construction, it is critical to ensure that no wastewater or contaminants are discharged into the beel or surrounding aquatic ecosystems. Appropriate measures must be implemented to manage wastewater effectively and prevent pollution. The pollution prevention strategies should address subproject impacts and risks following internationally recognized standards and guidelines. The primary reference standards include national environmental regulations and the World Bank Group's Environment, Health, and Safety (EHS) Guidelines[112]. These standards aim

[112] Word Bank Group. Environment, Health, and Safety Guidelines.

to protect water quality and aquatic ecosystems, ensuring that subprojects support sustainable conservation and resource management while minimizing environmental harm.

13. **Occupational and Community Health and Safety.** The environmental assessment should include an analysis of the subprojects' potential impacts and risks on occupational and community health and safety, and develop preventive and protective measures. The assessment should consider all stages of the project cycle (design, construction, operation, and decommissioning). The depth and breadth of analysis and the preventive measures should be commensurate with the identified risks and impacts. Special consideration should be made on possible chances of spread of communicable diseases due to project activities and what measures need to be taken to avoid and where avoidance is not possible mitigate contagious conditions.

14. **Physical Cultural Resources (PCR).**[113] For any presence of PCRs at subproject locations, the environmental assessment should include an analysis of the potential impacts and propose conservation and impact avoidance measures as needed.

15. **Environmental Management Plan (EMP).** ADB requires that EMP must be developed along with IEE. EMP describes the environmental management measures that will be carried out to mitigate negative impacts or enhance the environment during implementation of the subprojects. It will outline specific mitigation measures, environmental monitoring requirements, and related institutional arrangements, including budget requirements for implementation of EMP. The level of detail and complexity of the environmental planning documents and the priority of the identified measures and actions will be commensurate with subproject's impacts and risks. The PIU, with the help of CPIUs, will update the EMP as required based on the site specific assessments, which will be reviewed and approved by the PMU. The PMU will also review and endorse the updated IEE and EMP for submission to ADB for review and clearance for disclosure on the ADB website and SWIFT website.

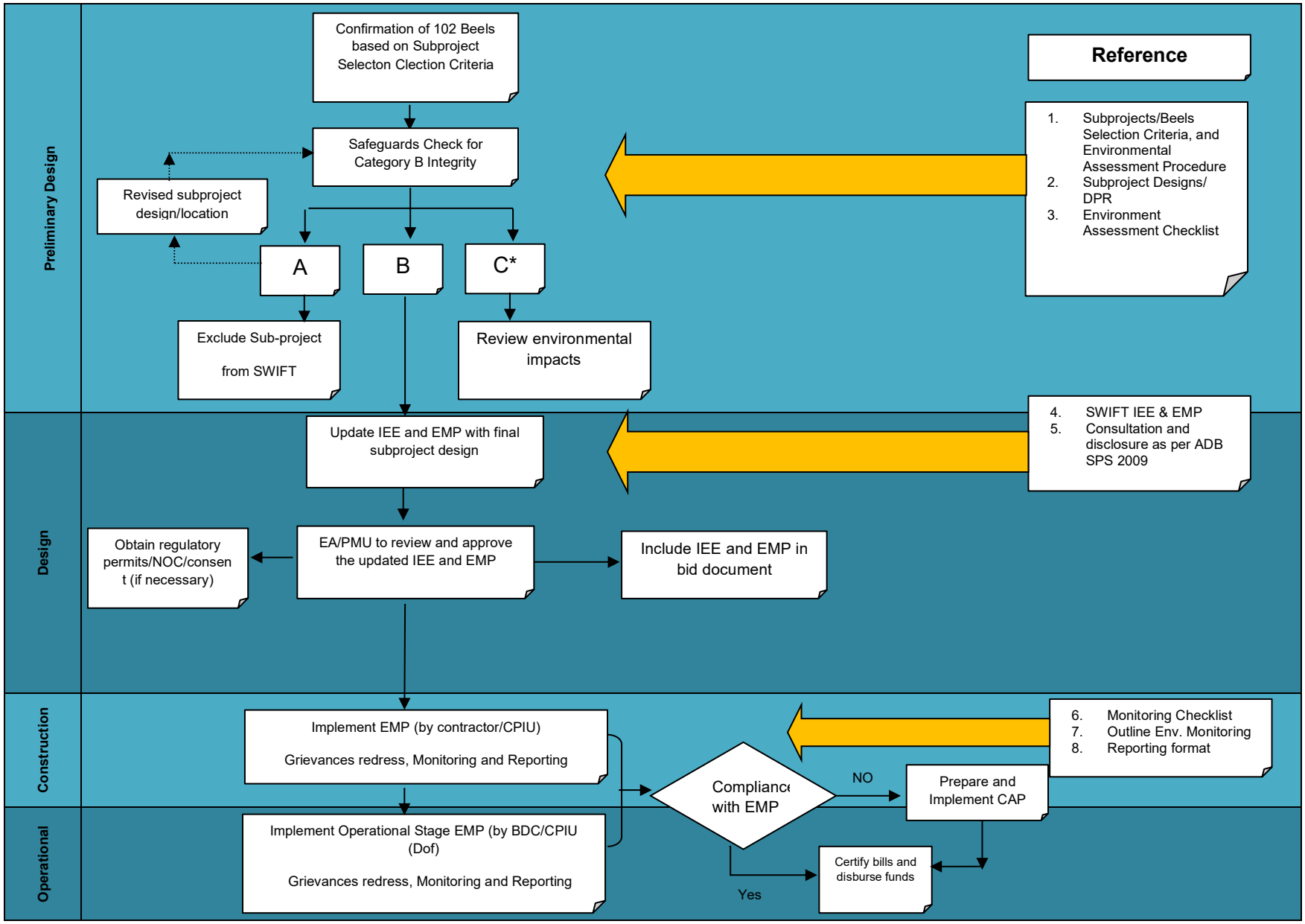
16. Bid documents will include EMP to ensure necessary resources to implement mitigation measures during civil works. The EMP will form part of the contract document, and, if required will need to be further updated during the construction stages. If there are any unanticipated environmental impacts and risks for any beels that are not already covered by the IEE and EMP, then IEE and EMP will be updated.

17. The EMP should cover all phases of project implementation from preparation through construction and operation and set out potential environmental impacts and corresponding environmental protection measures to: (i) avoid, and (ii) where avoidance is not possible, mitigate environmental impacts, and (iii) achieve compliance with national environmental regulations and ADB SPS 2009. The EMP will be considered as part of the contract document. Implementation and effectiveness of the measures as described in EMP will be carefully monitored to ensure they are effective and to make adjustments, if required. With PMU's administration, The PIU and CPIUs and its contractual staff will be primarily responsible for supervision and monitoring of

[113] Broadly defined as covering all types of tangible cultural heritage, including movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic or other cultural significance. PCR are human-made objects, natural features, or a mix of the two both. They may be located in urban or rural areas and may be above or below ground or underwater. PCR are sources of valuable scientific and historical information, assets for economic and social development, and integral parts of a people's cultural identity and practices. Their cultural interest may be at the local, provincial, national or international level. The value of PCR is partly indicated by the fact that once lost, it cannot be replaced.

project-related environmental activities during the pre-construction, construction and operation phases. Environmental monitoring during operation of the project in the longer term is the responsibility of the PMU and CPIUs. Annexure 6 shows the outline of environmental monitoring report.

Fig.1.1- Environmental safeguards compliance process for SWIFT




*Considering the nature of the subprojects, it is expected that none of the SWIFT subprojects will fall under Category C

## 2. INSTITUTIONAL ARRANGEMENT AND RESPONSIBILITIES

### 2.1. Institutional Arrangement

18. The project's executing agency is the Government of Assam, represented by the Assam Rural Infrastructure and Agricultural Services (ARIAS) Society. The Directorate of Fisheries (DoF), Government of Assam, serves as the implementing agency. The Project Management Unit (PMU), based in Guwahati and hosted by the ARIAS Society, will be led by the State Project Director (SPD) of the ARIAS Society. The Project Implementation Unit (PIU), hosted by the DoF and headed by the Director of Fisheries, will manage the activities of five Cluster Project Implementation Units (CPIUs). Each CPIU will be led by a Zonal Project Coordinator (Deputy Director, Zonal Office) and include the District Fisheries Development Officer (DFDO) of the respective district as part of its team.

### 2.2. Environmental Responsibilities

19. **Executing Agency (EA):** The executing agency for the project is the Government of Assam, represented by the Assam Rural Infrastructure and Agricultural Services (ARIAS) Society. EA responsibilities will mainly be focused on addressing national and state level environmental safeguards issues and decisions concerning the subprojects regulatory compliances. Executing agency will also oversee implementation of environmental safeguards measures, documentation and compliance of ADB SPS 2009.

20. The PMU of the project is responsible for ensuring that the project fully conforms with the loan agreement, ADB's SPS 2009, IEE and all applicable government legal and regulatory requirements. Safeguards compliance will be required for the project to be on track, timely identification of any safeguard issues and implementation of corrective action is a performance indicator that is monitored by ADB. To ensure compliance with the environmental safeguards provided in this PAM and IEE, the PMU will seek the support of the environmental safeguards specialist of the PIU. The PMU shall:

(i) adhere to all government regulations, standards, and other environmental-related legal requirements for the project;
(ii) ensure compliance with national and local laws, ADB SPS 2009, loan covenants, and IEE and EMP;
(iii) coordinate closely with state and district-level agencies and line departments to streamline environmental clearances, permit processes, and ensure adherence to local environmental policies;
(iv) ensure compliance with international good practices per the following the requirements of the International Finance Corporation's General EHS Guidelines, their guidelines on agribusiness/food production/forestry/water and sanitation, and the International Labour Organization's Code of Practice on Safety and Health in Construction;
(v) with the support of of an environmental safeguards specialist of the PIU , review and approve IEE/s and EMP(s), before submitting to ADB for concurrence and review and disclosure respectively;
(vi) ensure grant recipients with category B subprojects prepare and (as required) update IEEs and EMPs of their subprojects and have capacity for EMP implementation;
(vii) with the support of of an environmental safeguards specialist of the PIU, review and approve environmental safeguard related clauses and sections to be included in tender documents and civil works contracts of contractor(s);
(viii) with the support of of an environmental safeguards specialist of the PIU, evaluate and approve the construction environmental management plan (CEMP) that the contractor(s) have prepared;
(ix) ensure that the project and all contractors obtain permits, licenses, etc. for activities before the implementation of the respective construction activity;
(x) be in charge of applying for important documents and sending them to government offices for the processing of permits and clearances, such as environmental clearance certificates, tree-cutting permits, and other pertinent licenses and permits;

(xi) ensure environmental clearances obtained for subprojects before issuing bidding documents and awarding any work contracts to any contractors;
(xii) with support from PIU, conduct training and workshops on environmental management and site induction for all staff and workers involved in the project implementation;
(xiii) carry out regular (at least quarterly) field verification and review environmental compliances and contractor during project implementation, in coordination with the PIU, CPIUs and the contractor's environmental focal person;
(xiv) carry out regular (at least quarterly) field verification and review environmental compliances by the grant recipients during project implementation, in coordination with the PIU, recipients and their contractors.
(xv) close supervision and monitoring of all components during the implementation with a zero-tolerance approach to health and safety risk management, ensuring adequate health and safety supervision.
(xvi) make sure that EMRs are prepared, reviewed, and submitted for publication locally and on the ADB website as specified in the loan agreement;
(xvii) implement effective environmental monitoring during the pre-construction, construction, and operation phases, guided by the IEEs submitted to ADB. This includes, but is not limited to, inspections, reviews of monitoring forms prepared by the PIU, CPIUs, contractors, and documentation of the issues received through GRM;
(xviii) provide and record environmental observations during any site visits that may include, but are not limited to, excessive dust, loud noises, improper disposal of waste, chemical or oil spills, camp hygiene, health and safety, and improper borrow area management;
(xix) in case of potential risks and hazards to health, environmental quality, and properties that may result from poor EMP implementation, immediately guide PIU, CPIUs or grant recipients to cease the construction or operational activities that pose risk and conduct immediate containment and mitigation activities;
(xx) take proactive and timely measures to address any environmental safeguards-related challenges at the national, state, or district levels, such as (a) delays in the processing of clearances during the pre-construction stage and (b) significant grievances during the construction and operation stages;
(xxi) review and approve corrective action plans (CAPs) for environmental safeguard noncompliance;
(xxii) coordinates and facilitates public consultations to engage stakeholders, ensure transparency, and integrate community feedback into project planning and implementation;
(xxiii) inform ADB of any unanticipated environmental impact(s) that occurred during the project implementation phase;
(xxiv) ensure GRM, as envisaged in the IEE, is in place and fully operational from the onset of project implementation; and
(xxv) perform other tasks relevant with environmental safeguards of ADB and Government of India.

21. The Project Implementation Unit (PIU) will be hosted by the DOF and headed by the Director of Fisheries. The PIU will oversee and manage the activities of five Cluster Project Implementation Units (CPIUs), each led by a Zonal Project Coordinator (Deputy Director, Zonal Office). Under the PIU, the CPIUs will support the project to perform environmental safeguards activities, including:

(i) CPIUs will select beels and other infrastructures based on subprojects selection criteria, with support from environmental safeguards coordinators. The proposed selections will then be submitted to the PIU for review;
(ii) PIU will identify on-beel and off-beel infrastructures, ecotourism and matching grant subprojects by using the selection criteria with the support from an environmental safeguards specialist of the PIU and submit to PMU for review and approval;
(iii) PIU, with CPIUs' support, will prepare and update IEE and EMPs of subprojects through, but not limited to, reconnaissance survey, collecting data from the proposed subproject sites, government requirements and public consultations;
(iv) PIU will ensure grant recipients with category B subprojects prepare and (as required) update IEEs and EMPs of their subprojects and have capacity for EMP implementation;

(v) CPIUs will ensure that the project, and all contractors obtain permits, licenses, etc. before the implementation of the respective construction activity;
(vi) CPIUs will ensure environmental safeguard clauses are included in bidding documents and contracts, in coordination with the PMU, to hold contractors and grant recipients accountable for EMP compliance;
(vii) CPIUs will maintain a site-specific environmental compliance file for each subproject, including permits, inspection records, consultation minutes, and environmental observations;
(viii) PIU will assist in identifying and addressing unanticipated environmental impacts, including recommending adjustments to mitigation measures in coordination with the PMU;
(ix) PIU will support PMU in the preparation of CAPs in case of non-compliance, and ensure follow-up implementation at the field level;
(x) PIU and CPIUs will monitor the implementation of climate adaptation and disaster risk reduction measures integrated into the EMP, particularly for flood-prone beel areas;
(xi) PIU and CPIUs will facilitate coordination with local government bodies and regulatory agencies at the district level to streamline permitting and address location-specific environmental issues;
(xii) CPIUs will carry out regular field verification and review of environmental compliances by contractors, in coordination with the contractors' environmental focal person, and report to PMU on the results and findings;
(xiii) PIU will ensure that the project, and all grant recipients obtain permits, licenses, etc. before the implementation of the respective construction activity;
(xiv) PIU will carry out regular field verification and review of environmental compliances by grant recipients, in coordination with the CPIUs and the recipients, and report to PMU on the results and findings;
(xv) with support from an environmental safeguards specialist, PIU will conduct training and workshops on environmental management and site induction for all staff, workers and grant recipients involved in the project implementation;
(xvi) PIU and CPIUs will implement effective environmental monitoring during the pre-construction, construction, and operation phases. This includes, but is not limited to, inspections, reviews of monitoring forms prepared by the contractors and grant recipients, and documentation of the issues received through GRM;
(xvii) With support from contractual staff PIU and CPIUs will gather information from the implementation of the EMP to be included in the EMR preparation by the PMU;
(xviii) PIU and CPIUs will provide and record environmental impact observations during any site visits;
(xix) in case of potential risks and hazards to health, environmental quality, and properties that may result from poor EMP implementation, PIU will immediately guide CPIUs and grant recipients to resolve construction activities that pose risk and conduct immediate containment and mitigation activities;
(xx) PIU will take proactive and timely measures to address any environmental safeguards-related challenges at the national, state, or district levels, such as (a) delays in the processing of clearances during the pre-construction stage and (b) significant grievances during the construction and operation stages;
(xxi) CPIUs and PIU support the PMU by organizing, facilitating, and documenting public consultations at the local level, ensuring meaningful participation of affected communities and stakeholders, and integrating community feedback into the project design, planning, and implementation processes;
(xxii) PIU and CPIUs will be part of the process and operations of GRM as envisaged in the IEE; and
(xxiii) PIU and CPIUs will perform other tasks relevant with environmental safeguards of ADB and Government of India.

22. Comprising various experts, contractual staff of the ARIAS Society will support the capacity and operational effectiveness of the PMU, PIU and CPIUs including for environmental safeguard matters. The

environmental safeguards experts (contractual staff) will support the project on supervision, compliance, and monitoring of environmental safeguards and preparation of IEE and EMP. Contractual staff will support the review of matching grant components as well as setting up the systems for supervision, compliance and monitoring of environmental safeguards, providing capacity building to the PMU, PIU, and CPIUs. Also, contractual staff will support supervision and monitoring activities; and undertake quality assurance role for safeguards documents. Particularly, the contractual staff shall:

(i) ensure schemes and subprojects will conform to national policies and ADB's requirements for environmental safeguards;
(ii) ensure schemes and subprojects are following social, technical, environmental and economic criteria;
(iii) provide support to PMU, PIU and CPIUs for the collection of environmental information to be used in the feasibility assessment and IEE/EMP of proposed subprojects;
(iv) provide technical expertise, implement and monitor environmental safeguard requirements;
(v) assist PIU and CPIUs on the updating and preparation of IEE and EMPs and other category B subprojects
(vi) assist PMU with the review of IEE and EMPs prepared by PIU and grant recipients;
(vii) support the PMU, PIU, CPIUs, contractors and community to implement EMPs, the recommendations of IEE/s;
(viii) support the project on monitoring of environmental safeguards at subproject sites;
(ix) provide technical expertise to PMU, PIU, CPIUs in the preparation of environmental safeguard requirements;
(x) support PMU, PIU and CPIUs to (a) conduct environmental site inductions to contractors, and (b) ensure understanding of EMPs, government's environmental laws and requirements, and ADB SPS requirements;
(xi) assist the PMU to prepare the environmental monitoring reports for timely submission to ADB;
(xii) participate and/or lead public consultations; and
(xiii) provide support on any environmental management and safeguards matters of the project.

23. The contractor is the main body to implement the EMP and environmental quality monitoring during the pre-construction and construction stages. Specifically, the contractor shall:

(i) appoint environment, health, and safety focal person and attend the site induction workshop to be organized by the PMU, PIU, and CPIUs;
(ii) oversees environmental management activities on the construction site, including pollution prevention, waste management, and environmental monitoring;
(iii) obtain the necessary environmental license(s), permits, etc. from relevant agencies;
(iv) ensure the construction site complies with all relevant environmental, health, and safety regulations, standards, and codes of practice;
(v) as part of a detailed survey, collect baseline data on the environmental quality of the construction sites before the start of physical works and continue the collection of information (e.g., air quality, noise level, and water quality) during civil works as specified in the approved EMP;
(vi) conducts risk assessments and hazard identification to identify potential environmental, health, and safety risks associated with construction activities. This involves assessing workplace hazards, environmental hazards, and potential exposure pathways for workers and the surrounding community;
(vii) based on risk assessments, develops safety plans, procedures, and protocols to mitigate identified risks and hazards. The contractor will revise and finalize the construction EMP and environmental quality monitoring plan based on site-specific conditions;
(viii) implement and document all mitigation measures in the EMP and environmental quality monitoring plan;
(ix) ensure that all workers and site agents, including site supervisors and management, participate in all environmental safeguard related training sessions;
(x) provides training and awareness sessions to construction workers, sub-contractors, and other staff on environmental, health, and safety practices and procedures;
(xi) conducts regular inspections and audits of the construction site to monitor compliance with

environmental, health, and safety requirements.

(xii) ensure compliance with environmental statutory requirements and contractual obligations;
(xiii) conducts investigations to determine the root causes and contributing factors in the event of accidents, incidents, or near misses. This includes documenting incidents, analyzing data, and developing corrective actions to prevent recurrence. Contractor will ensure that all incidents are documented and reported to relevant authorities as required by regulations;
(xiv) maintain an on-site environmental logbook and records, documenting inspections, training, EMP implementation, and grievance redress actions for review by the PIU, and CPIUs;
(xv) participate in resolving issues as a member of the GRM;
(xvi) respond promptly to grievances raised by the local community or any stakeholder and implement environmental corrective actions or additional environmental mitigation measures as necessary and inform PIU and CPIUs;
(xvii) based on the results of EMP monitoring, cooperate with CPIUs and PIU to implement environmental corrective actions plans, as necessary;
(xviii) develop and implement health promotion and wellness programs to support the physical and mental well-being of construction workers;
(xix) engages with local communities, regulatory agencies, and other stakeholders to address concerns, communicate project related information, and promote transparency and accountability;
(xx) promotes a culture of continuous improvement in environmental, health, and safety performance on the construction site; and
(xxi) provide other environmental safeguards activities as indicated in the contract.

24. Construction will be responsible for ground-level implementation of mitigation measures indicated in EMP. Contractor needs to follow environmental, health and safety (EHS) provisions mentioned in the various sections of bid /contract documents. With the support from CPIU, and, the contractor will be required to develop a Beel Specific Environmental, Health and Safety Management Plan (BSEHSMP) and will recruit qualified full-time environment and health safety officer (EHS officer) responsible for environment, health and safety related actions during implementation of the project. The contractor will ensure to implement the ADB-cleared EMP and BSEHSMP during construction stage of the Project. Both will work under supervision of the environment staff focal, under the PIU and CPIU.

25. The responsibilities of the EHS officers will include the following:

(i) Directly reporting to the Project Manager of the Contractor, and Environmental Specialists of CPIU and PIU on safeguard matters;
(ii) Prepare BSEHSMP, fill construction site checklist for implementation and monitoring, prepare traffic management plan (if needed), health and safety plans for workers another relevant plans to manage the risks on environment, health and safety as part of their work program;
(iii) Ensure contractor's compliance with the BSEHSMP stipulations and conditions of relevant government bodies;
(iv) Discussing various environmental issues and environmental mitigation, enhancement and monitoring actions with all concerned directly or indirectly;
(v) Ensure contractor's compliance with borrow and quarry area operation and management;
(vi) Assist contractor/ project manager to ensure environmentally sound and safe construction practices;
(vii) Assist contractor in setting of labor camp particularly for compliance of Building and Construction Workers (Regulation of Employment and Conditions of Service) Act, and Rules,1996;
(viii) Assist contractor/ project manager to ensure the timely procurement of materials that are included in the Bill of Quantities relating to environmental mitigation and enhancement measures;
(ix) Conducting periodic environmental and safety training for contractor's engineers, supervisors and workers;
(x) Preparing a register for material sources, labour and public complaints etc.;
(xi) Ensure timely environmental monitoring activities;

(xii) Preparation and submitting of reports to CPIU on status of implementation safeguard measures; and
(xiii) Perform other functions to support PIU and CPIU on implementing environmental safeguards activities of the subproject.

26. **ADB's Responsibilities:** ADB is responsible for the following:
(i) review updated IEE for direct investment components and disclose on ADB's website;
(ii) provide approval for matching grant subprojects based on the review of IEE reports and safeguard categorization;
(iii) undertake environmental safeguard monitoring, including review of EMP and ESMS implementation during regular review and monitoring missions;
(iv) provide assistance to the EA; and PMU, PIU and CPIUs on subprojects environmental compliances (if required), carrying out its responsibilities under ADB's SPS, and for building capacity for safeguard compliance;
(v) monitor overall compliance of the project with ADB's SPS, loan covenants, and agreed environmental safeguard measures;
(vi) review and provide comments on environmental monitoring reports (EMRs) submitted by the PMU, ensuring timely feedback;
(vii) disclose environmental monitoring reports on ADB's website;
(viii) provide assistance to the EA, PMU, PIU and CPIUs in ensuring that the GRM is functioning and responsive;
(ix) advise on corrective actions in coordination with the PMU, in case of major non-compliance or unanticipated environmental impacts, including requiring additional assessments or revisions to safeguard documents;
(x) support knowledge sharing and capacity development by offering guidance notes, training opportunities, and technical advice on environmental safeguard issues; and
(xi) If necessary, provide further guidance to the content, and scope of the IEE and annual and/or semi-annual monitoring reports for submission to ADB.

## 2.3. Environmental Safeguards Reporting Requirements

27. Environmental monitoring, inspection activities and findings shall be documented for purposes of reporting, recording, verifying, referring on and evaluating the environmental performance of the Project. The documentation shall also be used as basis in correcting and enhancing further environmental mitigation and monitoring.

28. CPIUs and PIU will support the PMU in monitoring environmental safeguards compliance through regular site inspections. This involves scheduled and unscheduled visits to subproject sites to ensure that all EMP provisions are being followed by contractor. The visits will be taken by the environment safeguard coordinators of the CPIUs on a weekly basis completing checklists developed by the environment staff and making a photographic record, PIU on a monthly basis with more detailed review again using checklists and keeping a photographic record, with quarterly checks to all active subprojects by PMU. For category B grant-funded subprojects, the PIU shall conduct monthly inspections, while the PMU will undertake quarterly visits for verification and support. The CPIUs will prepare and submit reports to the PMU on a quarterly basis, summarizing monitoring activities, findings, incidents of non-compliance, and relevant environmental safeguards matters. The PIU will prepare and submit reports to the PMU for the grant-funded subprojects reporting on the grants approved and categories as well as summarizing monitoring activities, findings, incidents of non-compliance, and relevant environmental safeguards matters.

29. PMU, with support of an environmental safeguards specialist, will prepare the EMRs based on the inputs received and their quarterly site visits, then submit them to ADB semi-annually to document the progress of the EMP implementation. When all subprojects are in the operation stage, the EMRs will be prepared and submitted to the ADB on an annual basis. The environmental safeguards staff of the project will support the PMU, PIU and CPIU to monitor the EMP implementation (pre-, during-, and post-construction) as well as supporting them with IEE compliance.

30. An outline of the EMR is provided in annexure B4. This outline is a template, but additions, such as additional text, tables, charts, and figures, may be made to ensure appropriate documentation of (i) project implementation progress, (ii) compliance with safeguard measures and their progress, and (iii) necessary corrective actions. Health and safety incident statistics and grievance records will be included, along with evidence of consultations, trainings etc. The semi-annual EMRs will be due for submission to ADB within one month following the end of the EMR period (e.g. on 30 July for Jan-Jun period and 30 January for Jul-Dec period). Up until the time that ADB issues the project completion report, EMR submission to ADB will continue. The EMRs will be disclosed locally and on the ADB's websites after review and acceptance by the ADB. Timely submission of the EMRs is a performance indicator that is monitored by ADB. The environmental reporting plan for the Project is at Table 2.2 and the environmental safeguards reporting requirements are defined below.

**Table 2.2: Environmental Safeguards Reporting Plan**

| Reports | From | To | Frequency |
|---|---|---|---|
| **Pre-construction Phase** | | | |
| Project Readiness | ARIAS Society | ADB | 1st Environment Monitoring report |
| **Construction Phase** | | | |
| **Contractor record keeping and reporting**:<br><br>Safeguard specialist of contractor will fill construction Site Checklist for BEMP implementation maintain records of emissions, spills, accidents and complaints, and provide copies to the CPIU as part their monthly progress report (Site Checklist for EMP implementation given **Annexure B2**) | Contractor | CPIU | Monthly |
| Environmental monitoring as per monitoring plan given in EMP/BEMP and Environmental Monitoring Report Format given in **Annexure B3** | Contractor | CPIU | As per frequency mentioned in EMP |
| Quarterly Environmental Progress and Monitoring reports (Format given **Annexure B4**) | CPIUs | PMU | Quarterly |
| Semi Annual Environment progress and monitoring reports (EMR) (Format given **Annexure B5**) | PMU/ ARIAS Society | ADB | Semi-Annually |
| **Operational Phase** | | | |
| Environment progress and monitoring reports (EMR) (Format given **Annexure B5**) | PMU/ ARIAS Society | ADB | Semi-Annually |
| Project Closure Report | PMU/ ARIAS Society | ADB | Annually until PCR |

## 2.4. Institutional strengthening and training

Concerned CPIUs, PIU and PMU staff, contractor's Environmental Health and Safety Supervisors and BDCs representative will require training in the management of environment and social safeguards issues. The training program is to be coordinated and anchored by PMU with support from agencies/individuals

experienced in safeguard aspects on conducting training programs. The formal training will cover EHSMP implementation, supervision, and reporting, and the Grievance Redress Mechanism (Table 2.3).

**Table 2.3: Training Program for Safeguards Compliances and Reporting for Subproject**

| Training | Attendees | Contents | Times | Total Days |
|---|---|---|---|---|
| Beel (Wetland) Conservation and Management | - Concerned CPIU and PMU staff<br>- Contractor's Environmental Health and Safety Supervisors | – Concept of Beel Conservation and Management<br>– Wetland Conservation and Management Rules 2017<br>– Beel Monitoring | Once, prior to project implementation and after 1 year of project progress | 1 day for each |
| EMP Implementation and Compliance of National and ADB SPS 2009 requirements | - Concerned CPIU and PMU staff,<br>- Contractor's Environmental Health and Safety Supervisors | EMP/EHSMP measures, roles and responsibilities, monitoring, supervision, reporting procedures.<br>Site management plans, including worker and community health and safety, and emergency planning | Once, prior to project implementation and after 1 year of project progress | 1 day for each |
| EMP Implementation and Reporting at subproject level | - Contractor's Environmental Health and Safety Supervisors<br>- Concerned Environmental officer and specialist of CPIU/PMU | Site specific EMP/EHSMP measures, roles and responsibilities, monitoring, supervision, reporting | Once, prior to implementation for subproject | 1 day for each |
| Grievance Redress Mechanism | - Contractor's Environmental Health and Safety Supervisors<br>- Concerned Environmental officer and specialist of CPIU/PMU | Roles and responsibilities, Procedures | Once, prior to project implementation and after 1 years of project progress | 1 day for each |

# 3. CONSULTATION AND INFORMATION DISCLOSURE

## 3.1. Public Consultation

31. ADB SPS, 2009 requires meaningful consultation which is part of the preparation and implementation strategy. Consultations and participation of local stakeholders, beneficiaries and others will ensure information is provided and feedback is obtained and considered on the implementation. Public consultation process includes:

- identifying stakeholders who have interest on the project and affected people,
- informing and providing the stakeholders with sufficient background and technical information regarding the proposed development,
- creating opportunities and mechanisms whereby they can participate and raise their viewpoints (issues, comments, and concerns) with regard to the proposed beel development
- giving the stakeholders feedback on process findings and recommendations, and
- ensuring compliance to process requirements with regards to the environmental and related legislation.

32. Primary stakeholders are village communities mainly fishermen (who likely to be impacted or benefited), members of the Beel Development Committee (BDC) and affected persons located in close proximity of subproject components or construction activities. Secondary stakeholders are mainly (i) ARIAS Society as the EA, (ii) PMU, (iii) DFDOs of DOF as CPIUs, (iv) State Wetland Authority (SWA) (v) CIFRI (vi) ASLRM (vii) other relevant government and non-government organizations (NGOs), university/college professors and community-based organizations (CBOs) working in the affected communities.

33. Public consultation will remain a continuous process throughout the project implementation and to be focused to achieve following objecting:

(i) To disclose subproject information to the villagers, BDC and other concerned stakeholders and record feedback regarding the proposed subproject
(ii) Ensure public and community participation in the subproject environmental policy objectives and decision making
(iii) Ensure public confidence in the project administration by demonstrating the role of ARIAS Society, PMU, CPIU and contractor to enforce the environment management plan and grievance redressal
(iv) Grant the citizenry access to environmental information and data, thereby promoting the quality of environmental management and compliance monitoring
(v) Have interaction for primary and secondary data collection with project affected persons and other stakeholders
(vi) Begin establishing communication and an evolving mechanism for the resolution of social and environmental problems at the local and project level
(vii) Involve project stakeholders in an inclusive manner and
(viii) Receive feedback from the primary stakeholders on mitigation and enhancement measures for environmental and social impacts.

34. Focus group discussions will be organized with affected persons and other stakeholders to hear their views and concerns, so that these can be addressed in the design of proposed sites during project implementation wherever necessary. outcomes of these consultations will be recorded ensuring gender disaggregated information in the IEE, summarize the manner in which consultations were conducted, key topics discussed, and the decisions arrived at. These decisions will be incorporated into the IEE and EMPs. Photographic records and signatures of participants will be recorded in the IEE report.

35. The Executing agency and PMU will conduct information dissemination sessions in the project areas during design and IEE preparation stage. During EMP implementation, CPIUs with the help of BDC and contractor will organize public meetings and will apprise the communities about the progress of the implementation of EMP in the project works of the investment program.

36. Public meetings with affected people or communities will be held to discuss and plan to resolve issues once construction has started. Small-scale meetings with local communities will aim to discuss and plan construction works to reduce disturbance and other impacts, and provide a mechanism where stakeholders can participate in monitoring. Local communities will be continuously consulted regarding environmental impacts during construction.

37. In case of any increase of COVID-19 and other wide-spread disease, adaptive mechanisms will be used to address limitations on public consultations due to potential government restrictions and health risks.

38. Proposed minimum consultation activities are summarized in Table 3.1. This is indicative and project agencies can also adopt more effective methods and approaches, which are locally appropriate. Consultations will be conducted in an atmosphere which is conducive to the development of the subprojects and beneficial to the affected persons and other stakeholders. The implementing agency will ensure that the consultations are free of coercion and intimidation, gender-inclusive, and tailored to the needs of disadvantaged and vulnerable group if any.

**Table 3.1. Proposed Minimum Consultation activities for Subprojects**

| Project Stage | Consultation activities | Remark |
|---|---|---|
| Selection of Beel for feasibility or preliminary design | Individual meeting, FGD with BDC and community members | Already carried out for 1st phase of subprojects to be followed for other subprojects |
| Detailed Design Stage | Individual meetings, focus group discussions (FGDs) and community and candid meeting | Already carried out for 1st phase to be followed for other subprojects beels |
| | Individual meetings, focus group discussions (FGDs) and community and candid meeting with Affected persons, community members, beneficiaries and members of BDC etc. This stage public consultation will be focused mainly on environmental risk and IEE components including:<br>- Subproject extent and footprints<br>- Probable environment impacts<br>- Downstream impacts<br>- Project cost and benefits<br>- Environmental Management and Monitoring Plan<br>- Flora and fauna in catchment and subproject area<br>- Socio-economic standing of the local people<br>- Role of BDC and their Role in implementation and | During IEE Stage<br>(Suggestions and outcome of consultations should be updated and included in Final IEE) |

| | | |
|---|---|---|
| | O&M<br>- Role of PMU, CPIU and contractor in implementation of EMP<br>- Grievance redressal mechanism and<br>- Cooperation during execution of the work<br>- Community lead O and M | |
| Subproject Implementation | Focus group discussions with BDC/fisherman/ beneficiaries/affected persons | During the EMP monitoring at work sites |
| | Informal discussions with the construction workers and construction supervision staff (contractor, consultants and CPIU) | During the EMP monitoring at work sites |

## 3.2. **Information Disclosure**

39. Stakeholder consultations must be continued during the construction and operational stages of the subproject. The project EA will be responsible for the disclosure of this IEE in compliance to ADB's Communication Policy 2011 and ADB SPS 2009. The institutional responsibilities for construction and post-construction stage consultation lie with the Executing Agency through the contractor.

40. Executive summary of the IEE will be made available at the offices of implementing agency, PMU, office of CPIUs, BDC and also displayed on their notice boards. Hard copies of the IEE will be accessible to citizens as a means to disclose the document and at the same time creating wider public awareness. Electronic version of the IEE in English and executive summary will be placed in the official website of the ARIAS Society /PMU after approval of the IEE by government and ADB. Stakeholders will also be made aware of grievance register and redress mechanism.

41. Public disclosure meetings will be conducted at key project stages to inform the public of progress and future plans. Prior to start of construction, the PMU/PIU will issue notification on the start date of implementation in local newspapers or informed the BDC and community in advance. A board showing the details of the project will be displayed at the construction site for the information of general public.

42. Local communities will be continuously consulted regarding location of construction camps, access and hauling routes and other likely disturbances during construction. All suggestions, opinions and responses from the community on the project should be taken into account and feedback provided on how concerns and recommendations have been addressed.

43. The following documents will be submitted to ADB for disclosure on its website:

(i) Final IEE (including EMP) for the project.
(ii) Semi-annual environmental monitoring reports (EMRs) during project implementationuntil ADB issues project completion report
(iii) Updated IEE
(iv) Corrective action plan prepared during project implementation,if any.

44. PMU will send written endorsement to ADB to disclose these documents on ADB's website.

# Annexures of Part-B

## Annexure B1: Subproject Site Selection Checklist

This checklist will be used for subproject site selection and environmental safeguards eligibility to ensure compliance with Category B requirements under ADB's Safeguard Policy Statement. If the answer to any of the subproject selection criteria is "Yes", the subproject will not be considered for inclusion under the project. Potential environmental impacts have already been identified at the project level, and corresponding mitigation measures are included in the Environmental Management Plan (EMP). Therefore, only site-specific or locational issues require further examination. If the answer to any of the environmental impact questions is "Yes" or "Not Known", a site-specific environmental assessment may be required during the update of the Initial Environmental Examination (IEE) and EMP. This assessment should identify the significance of the potential impacts and determine the need for any additional site-specific mitigation measures. In such cases, further consultation must be undertaken with the ADB.

**Subproject Name:**

**Location:**

**Geographical Coordinates:**

| Subproject Selection and Environmental Assessment Checklist | Yes | No | Remarks |
|---|---|---|---|
| **A- Subproject Selection Criteria** | | | |
| 1. Is the subproject classified as Environment Category A under ADB's SPS (2009) or does it include any activity listed in ADB's Prohibited Investment Activities List (PIAL)? ▪ | | | |
| 2. Is the subproject located within Protected Areas (National Parks, Wildlife Sanctuaries, Tiger/Elephant Reserves), their ESZs, or within 10 km if no ESZ is notified; or within Ramsar Sites, World Heritage Sites, KBAs, or IBAs? ▪ | | | |
| 3. Is the subproject located in Village Grazing Reserves (VGRs), Professional Grazing Reserves (PGRs), or other areas protected by tradition or law? ▪ | | | |
| 4. Is the subproject located within 300 m of ASI-protected or historically significant monuments? ▪ | | | |
| 5. Is the subproject situated in areas with existing social conflicts or land use disputes? ▪ | | | |
| 6. Does the subproject require land acquisition? ▪ | | | |
| 7. Is the subproject located where it may disturb historical, cultural, or religious sites or values? ▪ | | | |

| Subproject Selection and Environmental Assessment Checklist | Yes | No | Remarks |
|---|---|---|---|
| 8. Is the subproject situated in severely degraded or economically non-viable areas for rejuvenation? ▪ | | | |
| 9. Is the subproject located near the Brahmaputra River or its tributaries in flood-prone zones where infrastructure may be damaged? ▪ | | | |
| 10. Is the subproject located in remote or inaccessible areas with logistical challenges for implementation? ▪ | | | |
| 11. Is the subproject proposed on private land or land with unresolved ownership disputes? ▪ | | | |
| 12. Is the subproject already covered under other ongoing development projects or programs? ▪ | | | |
| **B. Potential environmental impacts Will the project (with the disclosed version of the project EMP implemented) cause**: | | | |
| ▪ impairment of historical/cultural areas; disfiguration of landscape, or potential loss/damage to physical cultural resources? | | | |
| ▪ disturbance to precious ecology (e.g., sensitive or protected areas)? | | | |
| ▪ alteration of surface water hydrology of waterways resulting in increased sediment in streams affected by increased soil erosion at construction site? | | | |
| ▪ deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction? | | | |
| ▪ increased air pollution due to project construction and operation? | | | |
| ▪ noise and vibration due to project construction or operation? | | | |
| ▪ involuntary resettlement of people (physical displacement and/or economic displacement)? | | | |
| ▪ disproportionate impacts on the poor, women and children, indigenous peoples, or other vulnerable groups? | | | |
| ▪ poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as sexually transmitted infections and HIV/AIDS) from workers to local populations? | | | |
| ▪ creation of temporary breeding habitats for mosquitoes and rodents that may transmit diseases? | | | |
| ▪ social conflicts if workers from other regions or countries are hired? | | | |
| ▪ large population influx during project construction and operation that causes an increased burden on social infrastructure and services (such as water supply and sanitation systems)? | | | |
| ▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation | | | |

| Subproject Selection and Environmental Assessment Checklist | Yes | No | Remarks |
|---|---|---|---|
| ▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel, and other chemicals during construction and operation? | | | |
| ▪ community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation, and decommissioning? | | | |
| ▪ generation of solid waste and/or hazardous waste | | | |
| ▪ use of chemicals? | | | |
| ▪ generation of wastewater during construction or operation? | | | |

| Submitted by: | Reviewed by: |
|---|---|
| | |

**Annexure B2: Construction Site Checklist for EMP implementation and Compliance Monitoring**

**(to be used by contractor in field)**

Subproject/Beel Name:

Contractor Name:

Filled by:

| S.No | Action/Activities | Status (Yes/No) | Additional Measures required as per EMP | Frequency | Remarks |
|---|---|---|---|---|---|
| 1. | EHS supervisor appointed by contractor and available on site since joining | | | Prior to start of construction and monthly thereafter | |
| 2. | EHS supervisor/contractor staff/labours attended training/workshop related to EMP and safeguard compliances | | | Prior to start of construction and after joining of any new staff or labour force | |
| 3. | Whether all consents/NOCs as applicable are taken prior to work execution including tree cutting permission, CTO/CTE? | | | Prior to start of construction and monthly thereafter | |
| 4. | Whether shifting or dismantling of utilities viz. electric lines, poles, telephone lines, water pipes etc. are done properly and alternative provided? | | | Once prior to start of construction | |
| 5. | Whether uncultivated areas/waste land used for storage and/or handling of construction materials, and construction camp? | | | Once prior to setting of material storage site and construction camp | |
| 6. | Verify that site for composting is marked and ready for composting process prior de-weeding operation | | | Once prior to start of de-weeding | |
| 7. | Whether borrow pits (if any) are located at upstream side? | | | Once prior to start of borrowing | |
| 8. | Is there any impact on water availability for during construction? | | | Monthly | |
| 9. | Site management plan (Labour, safety, material, schedule, equipment etc.,) prepared | | | Prior to start of construction and monthly thereafter | |
| 10. | Is material sourcing being done from authorized sources? | | | Monthly | |
| 11. | Is material transfer route to the site identified and able to vehicle carry load? | | | Monthly | |
| 12. | Whether any additional tree cutdown to provide access road or working area? | | | Monthly | |
| 13. | Whether mitigation measures suggested to minimize the impacts on topography and drainage patterns are taken properly? | | | Monthly | |

| S.No | Action/Activities | Status (Yes/No) | Additional Measures required as per EMP | Frequency | Remarks |
|---|---|---|---|---|---|
| 14. | Schedule de-weeding and desilting activities during the dry season to minimize water disturbance | | | Prior to start of operation | |
| 15. | Confirm that desilting is planned to avoid sensitive areas such as spawning grounds, nesting sites, | | | Prior to start of operation | |
| 16. | Ensure sediment barriers (e.g., silt curtains) are used around the desilting areas to prevent suspended solids from spreading. | | | Daily during operation | |
| 17. | Confirm that excavated earth material is prioritized for bund strengthening, following suitable engineering analysis | | | Daily during operation | |
| 18. | Air/Dust under control plan is in place | | | Daily | |
| 19. | PUC of construction vehicle checked | | | Monthly | |
| 20. | Excavated soil properly placed within minimum space | | | Daily | |
| 21. | Check that desilted material is stored in designated areas before reuse. | | | Daily during desilting operation | |
| 22. | Confirm that desilted material is used primarily for bund strengthening and is transported in lined or covered vehicles to avoid spillage | | | Daily during operation | |
| 23. | Verify that harvested weeds are collected and Store at designated place only | | | Daily during operation | |
| 24. | Check that all composting activities health and safety standards to avoid contamination and environmental impact | | | Daily during operation | |
| 25. | Construction area is confined; no traffic/pedestrian entry observed | | | Daily | |
| 26. | Surplus soil/debris/waste is disposed without delay as per provisions mentioned in EMP | | | Daily | |
| 27. | Tarpaulins used to cover sand and other loose material when transported by vehicles after unloading, wheels and undercarriage of vehicles cleaned prior to leaving the site | | | Daily | |
| 28. | Noise control measures taken at site | | | Daily | |
| 29. | Drainage and storm water management measures are in place | | | Daily | |
| 30. | Hazardous waste viz. lubricant/Oil management is being done by EMP measures | | | Daily | |
| 31. | whether landslides/erosion prone area, stability of bank checked? | | | Daily | |

| S.No | Action/Activities | Status (Yes/No) | Additional Measures required as per EMP | Frequency | Remarks |
|---|---|---|---|---|---|
| 32. | Any discharge of wastewater from construction site/labour camp? | | | Monthly | |
| 33. | Are there any oil spillages/leakages? | | | Daily | |
| 34. | No pipes disturbed/removed during excavation | | | Daily | |
| 35. | No chance finds encountered during excavation | | | Daily | |
| 36. | Work is planned in consultation with village administration | | | Prior to start of construction and monthly thereafter | |
| 37. | Trenches are not kept open unduly | | | Daily | |
| 38. | No public/unauthorized entry observed in work site | | | Daily | |
| 39. | Safety measures (barricades, security) in place at work sites | | | Daily | |
| 40. | Workers using appropriate PPE (boots, masks, gloves, helmets, ear muffs etc) | | | Daily | |
| 41. | Workers conducting or near heavy noise work is provided with ear muffs | | | Daily | |
| 42. | Is contractor staff following standard and safe construction practices? | | | Daily | |
| 43. | First aid facilities are available on site | | | Daily | |
| 44. | Drinking water provided at the site | | | Daily | |
| 45. | Toilet facility provided at the site Separate toilet facility is provided for women workers | | | Weekly | |
| 46. | Worker's camp (if any) is maintained cleanly adequate toilet and bath facilities provided | | | Weekly | |
| 47. | Contractor employed local workers as far as possible | | | Prior to start of construction and monthly thereafter | |
| 48. | Whether any incident of poaching/hunting/forest fire/mass fishing? | | | Monthly | |
| 49. | Keep the photographic /video records of each of the project activities | | | Daily | |

Checked By:

**Annexure B3: Environmental Monitoring Report Format (to be used by PIU/PMU)**

- Brief discussion on the basis for monitoring
- Indicate type and location of environmental parameters to be monitored
- Indicate the method of monitoring and equipment to be used
- Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements

*As a minimum the results should be presented as per the tables below.*

## I- Air Quality Results

| Site No. | Date of Testing | Site Location | Parameters (Government Standards) | | | | |
|---|---|---|---|---|---|---|---|
| | | | PM10 µg/m3 | PM2.5 µg/m3 | SO2 µg/m3 | NO2 µg/m3 | CO (mg/m3) |
| Site Name and Coordinates | | | | | | | |
| Site Name and Coordinates | | | | | | | |

## II- Water Quality Results for Surface (Beel) and Drinking Water

| Site No. | Date of Sampling | Site Location | Parameters | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Key Parameters as per IS 10500:2012 for Drinking water | | | Key Parameters as IS 2296 for Surface water | | |
| Site Name and Coordinates | | | | | | | | |
| Site Name and Coordinates | | | | | | | | |

## III- Noise Quality Results

| Site No. | Date of Testing | Site Location | LAeq (dBA) (Government Standard) | |
|---|---|---|---|---|
| | | | Day Time | Night Time |
| Site Name and Coordinates | | | | |
| Site Name and Coordinates | | | | |

## IV- Soil/Sediment/Compost Quality Results

| Site No. | Date of Testing | Site Location | Soil Quality Parameters | | | | |
|---|---|---|---|---|---|---|---|
| | | | Macro and Micro Nutrients and Heavy Metals | | | | |
| Site Name and Coordinates | | | | | | | |
| Site Name and Coordinates | | | | | | | |

*Note: add more tables to show results of other monitoring activities.

**Summary of Environmental Monitoring Activities (for the Reporting Period)**a

| Impacts (List from IEE) | Mitigation Measures (List from IEE) | Parameters Monitored (As a minimum those identified in the IEE should be monitored) | Method of Monitoring | Location of Monitoring | Date of Monitoring Conducted | Name of Person Who Conducted the Monitoring |
|---|---|---|---|---|---|---|
| **Design Phase** | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **Pre-Construction Phase** | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **Construction Phase** | | | | | | |
| | | | | | | |
| | | | | | | |

a Attach Laboratory Results and Sampling Map/Locations

**Annexure B4: Template for Quarterly Environmental Progress and Monitoring Report (to be used by CPIU/PIU)**

| Key Question | Yes/No/Not Applicable | Remarks |
|---|---|---|
| **A- Contract and Pre-Construction** | | |
| 1. Are there any work contract that has been awarded in this Quarter? | | |
| 2. whether bid EMP(s) cleared by ADB? | | |
| 3. Is IEE/EMP of each subproject prepared? | | |
| **B- Project Execution- Safeguard Compliance and EMP implementation:** | | |
| 1. Whether regulatory permits/NOC/consent (if any) obtained before construction? (Provide subproject wise list) | | |
| 2. Whether Construction Site Checklist for EMP implementation and Monitoring is being filled and submitted by contractor? | | |
| 3. **Implementation of Environmental Management Plan**. Provide discussions on the implementation of mitigation measures to reduce impacts of project activities, and attach sample photographs of these measures and discuss them briefly | | |
| **C- Project Execution: Grievances** | | |
| 1. Does the Project have a functioning GRM? | | |
| 2. Is there any complain received and resolved? if yes provide numbers | | |
| **Grievance Redress Mechanism Information:** Indicate the any grievance/s received at the period of the QPR and status of ongoing grievance. | | |
| **D- Project Execution: Project Safeguards Non-Compliance** | | |
| 1. Does the Project have any outstanding non- compliances on environmental safeguards? | | |
| 2. If yes, is there a time-bound Corrective Action Plan agreed between ADB and PMU? | | |
| 3. Is the implementation ofcorrective actions on track? | | |
| **E- Project Execution: Monitoring** | | |
| 1. Are the environmental monitoring reports submitted as per agreed schedule, commencing from project effectiveness? | | |
| 2. If no, for how long has it been overdue? | | |

## Annexure B5: Environmental Monitoring Report (EMR) Outline

The PMU is required to prepare semiannual monitoring reports that describe progress on implementation of the project EMP and compliance issues and corrective actions (if needed). A sample outline which can be adapted as necessary is provided below.

**I. Introduction**

A. Overall Project Description and Components

B. Location of the Subproject (*use maps and pictures*)

C. Environmental Category (*discuss categorization based on ADB SPS and national law*)

D. Project Implementation Progress (*summary of activities and construction progress and main civil works during reporting period*)

**II. Institutional Arrangement for Environmental Safeguards**

C. Institutional Arrangement (description of the project institutional arrangement as a whole; use figure/framework)

D. Environmental Safeguard Staff/Personnel

**III. Statutory Environmental Requirements**

A. Government Policy Compliance (discuss status of clearance/s, permit/s, etc. and compliance of the project; include all permits and clearances as appendices)

B. Compliance Issues (indicate any noncompliance on national/state and reason of noncompliance)

**IV. Loan Covenants**

**V. Construction Progress**

**VI. Implementation of Environmental Management Plan**

A. Summary of Inspection Activities

B. Compliance with Construction Environmental Management Plans (CEMPs).

C. CEMP implementation issues

**VII. Summary of Environmental Monitoring**

C. Environmental Monitoring Plan (emission and ambient)

1. Summary of Monitoring
2. Results
3. Assessment

D. Other Monitoring Program (if relevant)

1. Summary of Monitoring
2. Results

3. Assessment

**VIII. Information Disclosure and Consultations (only applicable if any consultations are performed during reporting period)**

**IX. Grievance Redress Mechanism (GRM)**

A. GRM Framework, members and access

B. Grievances Received (*if any*)

C. Status of Current Grievances (*if any*)

**X. Conclusion**

A. Overall Progress of Implementation of Environmental Management Measures

B. Unanticipated Environmental Risks and Impacts

C. Corrective Action Plan (footnote 1)

**XI. Annexes (as appropriate)**

- Copies of ambient and/or emission monitoring results
- Clearances and permits
- Photographs
- Other