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FISH VALUE CHAIN
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Common Service Centres of Fishery FPCs under APART

Introduction

Farmer Producer Company (FPC) registered under the Companies Act is emerging as the most effective means for Farmer Producer Organizations (FPOs) to cater to the needs of farmers at the grass root level. FPCs offer a wide range of benefits compared to other formats of aggregation of the farmers. FPC members can leverage collective strength and bargaining power to access financial and non-financial inputs, services and appropriate technologies leading to a reduction in transaction costs. The objective of the

concept of FPC is to organize farmers into a collective to improve their bargaining strength in the market. The Producer companies can help smallholder farmers participate in emerging high-value markets, such as the export market and the unfolding modern retail sector. As elsewhere in the developing world, in India, small farmers' livelihoods are being threatened due to the liberalization and privatization of Indian agriculture and the increasing interest of private capital in the agribusiness sector.

Fishery sector in Assam

The State of Assam has an excellent sub-tropical climate for the development of freshwater fish culture practices in a variety of available water bodies. Quality fish seed is the main input for fish farming practices which determine the overall production scenario of fish. The Assam Agribusiness and Rural Transformation Project (APART) envisages to improve the agricultural service delivery to facilitate market-driven intensification and diversification of the broad agricultural sector in Assam with the objectives:

- » A. Linking markets with agriculture surpluses generated in different production clusters.
- » B. Developing a network of marketing intelligence and dissemination of information up to the farmers' level.

To strengthen backwards and forward linkages across value chains for agricultural & fish products, along with ensuring remunerative prices to the producers/farmers, the Project mandated a consortium as a part of the process for setting up 25 (twenty-five) Fishery FPCs in thirteen districts. Baseline survey (comprising around 20,000 respondents including farmers, supply chain intermediaries, district officials, etc.) including

Participatory Rural Appraisal (PRA) leveraging select tools like social mapping, problem ranking etc. across the identified districts viz. Barpeta, Cachar, Darrang, Goalpara, Hailakandi, Kamrup, Lakhimpur, Morigaon, Nagaon, Nalbari, Sonitpur Nagaon and Sonitpur to - Identify potential production clusters and fish varieties in terms of marketable surplus available and (I) Identify and prioritize key issues faced by farmers for access to (a) inputs, (b) credit (c) market linkages and (d) capacity building, (II) Understand the supply chain and assess price build-up from farm gate to end customers for fish varieties, (III) Assessment of skill levels of farmers on (a) production and productivity of crops/ fish, (b) marketing of agro produce/ fish and (c) access to finance and identifying their related capacity building requirements, (IV) Training modules development on key themes viz. (a) FPO Management, (b) Book Keeping and (c) Group Marketing and facilitated training of 130 Community Resource Persons (CRPs) (including 5 women) identified across 25 FPCs to help them develop as master trainers of their respective groups. Till now six In-house Fishery FPCs have established their Common Service Centres and started their business.

1. Uttaran Fishery FPC:

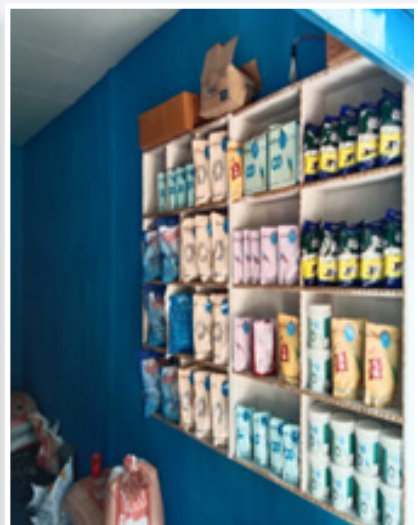


World Bank Senior Officials visit the - Common Service Centre (CSS)

2. Howly Agro-Fish Farmers Producers Company:



3. Bhaillabari Fishery Farmers Producers Company:



4. Samaria Farmers Producers Company:



Fish Feed Mill and Small Fish Dry powder production unit

5. Gohpur Farmers Producers Company



6. Barkhala Farmers Producer Company:



Beel Fishery And Its Impact On Increasing Fish Production And Economic Development

Among the schemes implemented by the Department of Fisheries, Assam under the Assam Agribusiness and Rural Transformation Project (APART) funded by the World Bank, the Beel Fisheries development schemes has made an important contribution to the Socio-Economic transformation in rural parts of the project districts. The objective of Beel Fishery development is the collective development of the residents living in and around the beel fishery, towards economic upliftment as well as the development of the local area through fish farming. To achieve that objective, the Department of Fisheries has been implementing the technology demonstration of the



beel fisheries development scheme under APART since 2019-20.

Assam is rich in natural water bodies for fish production but lack of proper utilization, although these resources, spread over a vast area are excellent and fertile sources for fish production. If these water bodies are used for scientific fish culture, they



will play a vital role in strengthening the economy of Assam and also contribute significantly to minimize the unemployment problem in the state. Given the above potential, the Department of Fisheries has taken steps to develop the available natural water resources and make them suitable for scientific fish farming under APART. According to the guidelines, water bodies within 7 hectares area were initially considered for development. However, the WorldBank authority later permitted the consideration of water bodies with an area of at least 5 hectares, so water bodies with an area of 7 hectares or less were initially taken into consideration for development.

Currently, the beel fisheries development scheme is being implemented in 14 districts and Sivsagar district in particular has been selected for the sole beel fisheries development scheme. As per norms laid down by the World

Bank, only water bodies under government are accepted and after obtaining the No Objection Certificate from the concerned government authority, the technical officer of the concerned District Fisheries department conducted the technical survey and screening on the social cum environmental aspects of the proposed area.

The Department of Fisheries has developed a total of 68 beel fisheries covering 1022.87 hectares of water area under APART and is successfully raising fish through respective Beel Development Management Committee (BDMC). The BDMCs have been able to produce a promising quantity of fish from the beel fisheries developed in the year 2019-20 & 2020-21 and are continuing culture practice with a scientific approach. The proceeds from the fish produced in the beel fishery have been able to provide financial relief to the residents living in the surrounding areas and many

unemployed youths living in the vicinity of the beel who are willing to become self-employed by raising fish in the beel.

The development of beel fisheries under APART is a pioneering step towards rapid increase in fish production by making better use of the natural fishery resources of the State. The BDMCs of various beel fisheries who have succeeded in strengthening the rural economy through fish culture have now become role models for many village development committees and organizations. Many have come forward for fish farming in abandoned natural water bodies and have even started the initial preparations for its development on their own. This is surely a very positive courage to pave the way for self-employment through increasing fish production in the state of Assam.



Earlier the residents used to get 300 to 350 Kg of fish per hectare from the beel fishery and now with the development under APART, they can produce 900 to 1000 Kg per hectare per year and also earn additional income from horticultural crops. As per plans, BDMCs are approaching to incorporate integrated pig cum fish, cattle cum fish culture and set up hatcheries for fish seed production, besides plans to establish a full-fledged fish farm in the distant future to produce fish and other crops on a commercial basis.

Capacity-Building And Value Addition Programs Conducted By The College Of Fisheries

Fish has been prioritized as one of the value chains for intervention under APART. Various activities are carried out by the College of Fisheries,

Raha under the Assam Agricultural University along with the Department of Fisheries, Assam with technical assistance from the World Fish.

Demonstration Program Conducted On Preparation Of Fish Pickle

Fish pickle is a popular dish of Assam, known for its rich biodiversity, with fish being an important part of the local cuisine. The preparation of fish pickles in Assam is similar to other parts of India, but it has its unique flavours and ingredients.

Overall, fish pickle is a delicious and nutritious part of the local cuisine in Assam, and it is prepared using traditional methods and ingredients that reflect the region's rich biodiversity and cultural heritage. It can be found in local markets and traditional restaurants; it is usually served as a side dish or as an accompaniment to rice.

Various hands holding Training Programs through technology demonstrations on the Preparation of Fish pickles have been conducted in different districts of Assam under the APART Project by the College of Fisheries, Raha in collaboration with the Dept. of Fisheries, Govt. of Assam. Mainly the women SHGs of the selected clusters of Barpeta, Morigaon, Nagaon & Darrang districts have been trained to make them self-sufficient in making fish pickles starting from cleaning, dressing, cooking including packaging and labelling.



Demonstration program conducted on preparation of fish pickle

Demonstration Program Conducted On Preparation Of Hygienic Dry Fish

The State of Assam is enriched with vast water resources offered by the Brahmaputra and Barak rivers with their numerous tributaries, large

numbers of floodplain wetlands, swamps and ponds. However, the occurrence of freshwater fish in these water bodies is not enough to



Demonstration program conducted on preparation of hygienic dry fish

meet the daily demand of the large section of the fish-eating population. Nearly 90% of the population prefers fresh fish for consumption. However, with recurring floods in the state and also during Jeng fishing (a traditional community fishing method in the state) a large number of different varieties of fishes are sold at a very cheap rate. In many parts of the State, these fishes are preserved using different traditional techniques to avoid wastage, where sun drying is one of the common methods. This traditional method of drying fish does not have a long shelf life and is unhygienic as well. As the quality of the sun-dried fish is not up to the mark, they are sold at a very low price which ultimately hampers the profit margin.

The importance and demand for dry fish in the diet of the population of the North East region, has led to the emergence of one of the largest

dry fish markets in Asia, situated at Jagiroad in the Morigaon district of Assam. Considering the existing viable market of dry fish in the region as well as for exporting such products to the South East Asian countries, a shift from the traditional method of drying fish to a scientific and hygienic method is the need of the hour. Drying fish in a Solar tent drier as a Project Development Objective of APART, the College of Fisheries, Raha, Assam Agricultural University has developed a technology for hygienically drying fish using a solar tent drier. This technology is being transferred to Self-Help Groups and Fishery cooperative societies through training and demonstration programs covering all the Project Districts. This program will cover the entire process from cleaning and preparing the fish up to packaging and labeling for marketing.

Training And Capacity Building Programme

Various training programs on Polyculture in pond Fisheries, Polyculture with Freshwater Prawn, Beel Fisheries Management and Climate Resilient Paddy Cum Fish Culture have been organized by the college of Fisheries, Raha.

A total number of 1000 project beneficiaries have attended various training programs at various districts under APART which were organized by the College of Fisheries, Raha.

List of beneficiaries trained during 2022-2023

Sl no.	Name of training	Total no. of participants
1	Beel fisheries management	738
2	Polyculture of Carp with Freshwater Prawn	40
3	Climate-resilient paddy cum fish culture	20
4	Polyculture in pond fisheries	202



Various training programs conducted by the College of Fisheries, Raha

Inclusion Of Small Fish Powder In ICDS Supplementary Nutrition Program “Matsya Paripushti”

Assam has sizable portions of its population living below the poverty line and nearly 86% population resides in rural areas. Despite its abundant natural resources and development trajectories, food insecurity and under nutrition remains one of Assam's most serious, yet poorly addressed developmental challenges. The health and nutrition indicators did not show much improvement in Assam and the situation has worsened in the case of young children and pregnant and lactating mothers. The recent National Family Health Survey-5 (2019-2021) reveals an alarming level of childhood under nutrition in Assam, with 35% of children under the age of five being stunted, 22% is wasted and 33% being underweight. Well over

66% of women between the ages of 15 to 49 suffer from anaemia, while 68% of children under 5 years are reported to be anaemic.

Fish is considered a superfood. Fish are an excellent source of protein, highly bio-available micronutrients, minerals, vitamins, and essential fatty acids that are difficult to replace with other foods. Surprisingly, many species of small fish are incredibly potent sources of micronutrients, minerals and vitamins necessary for human health and cognitive development. There is mounting evidence that including fish in sustainable healthy diets can help to lower the prevalence of undernourishment and covert hunger in many developing nations. Aquatic food can therefore play a



Launching & demonstration of ICDS SNP in Kukurmara Anganwadi Centre under the Chaygaon block, Kamrup district

crucial role in the fight against the malnutrition menace in Assam.

To accelerate the efforts on reducing malnutrition in Assam, WorldFish has collaborated with the Assam Rural Infrastructure and Agricultural Services (ARIAS) Society and the Department of Fisheries through the World Bank-funded Assam Agribusiness and Rural Transformation Project (APART). The promotion of small fish consumption among the most vulnerable members of the community is an important intervention under the project. WorldFish has provided technical support to APART, Departments of Fisheries and Social Welfare, Government of Assam to conduct a series of mass awareness campaigns on the health benefits of consumption of small fish during the first 1000 days of human life (the period from conception to a child's second birthday) and demonstrations on the inclusion of either dried or fresh small fish in the diet of, especially women, pregnant and lactating women, infants and young children. The resounding participation from the communities, as well as, the active support from Government showcased a bright future for fish-based nutrition in Assam, which necessitates scaling up the innovation.

India celebrates POSHAN Maah (nutrition month) across the country in September, every year. Poshan is a multi-Ministerial convergence

mission for propagating holistic nutrition through the ICDS Anganwadi Supplementary Nutrition Programme (SNP). The SNP is among the major services under the ICDS which aims to improve the health and nutrition of children aged 6 months to 6 years, as well as expectant and lactating women. The Government of Assam is promoting nutrition by providing hot cooked meals to children which are supplied through various Anganwadi Centers located across the state.

A breakthrough happened on 8 September 2022 when the 'Matsya Paripusti' pilot project was launched in Kukurmara Anganwadi Centre under the Chaygaon block of Kamrup district, Assam under Poshan which entails the inclusion of dried small fish powder in the ICDS SNP. The programme was launched by Smt. Keerthi Jalli, IAS, Deputy Commissioner, Kamrup District, Assam in presence of Smt. Shehnab Sahin, ACS, Assistant Commissioner, (In charge DSWO) Kamrup, CDPO and BDO Chaygaon block, Senior Fisheries officers of Dept. of Fisheries, Facilities of College of Fisheries, WorldFish, Farmers Producers Company (FPC), NGO, and ICDS field staff participated in the programme.

The major aim of "Matsya Paripusti" is to improve the dietary diversity and micronutrient intakes of children aged 3-6 years through hot cooked meals and comprehend the acceptability of

small fish powder (e.g., taste) with preschool children.

During the launch, Smt. Keerthi Jalli, IAS, Deputy Commissioner, Kamrup District, Assam expressed her happiness for an innovative initiative in Poshan month, to include locally available small fish powder in ICDS supplementary Nutrition Programme in Kamrup district. Fish, especially small fish are a highly nutritious animal-source food which contributes a wide range of micronutrients that benefit the health of women and children. She also emphasized including small fish powder, and other food items like chutneys such as sesame seed chutney, tomato chutney, curry leave chutney, and garlic chutney for pregnant women to overcome iron and anaemia.

Smt. Shehnab Sahin, ACS. Assistant Commissioner (In charge DSWO) Kamrup discussed the importance

of a balanced diet for a healthy life and the role of micronutrient intakes involving small fish powder for pregnant, lactating mothers and young children. She expected good acceptance among the children across the project. Because small fish has contained various sources of micronutrients such as iron, zinc, calcium, vitamin A, B12, Omega-3 fatty acids, iodine, and protein, which are very important for the nutritional gain of women and children, particularly first 1000 days of human life. She thanks the Fisheries department, College of Fisheries, WorldFish, FPC and local NGO for supporting ICDS to implement the pilot programme in Kamrup district.

Dr Sanjay Sarma, Fishery Coordinator (APART) in his speech told that the availability of small fish is so high in the state of Assam. For the first time, the Fisheries department has taken



Launching and demonstration of ICDS SNP in Kukurmara Anganwadi Centre under the Chaygaon block, Kamrup district

initiative to produce hygienic certified small fish powder through the support of Farmers Producers Company (FPC) under the World bank funded APART project. He assured the availability of small fish powder for a longer time if the pilot extended for more months for consumption by young children. He expressed his satisfaction to be a part of such an important programme.

The pilot project has been sponsored by Indian Oil Corporation Limited (IOCL) and implemented by the Department of Fisheries, Department of Social Welfare and the ARIAS Society and District Administration of Kamrup District with hands-on technical support from WorldFish and College of Fisheries, Assam Agricultural University, Raha. Local Farmers Producers Companies (FPC) have been trained to produce large quantities of fish powder from locally sourced small fish. The fish powder has been certified for its quality and safety by the Food Safety and Standards Authority of India (FSSAI). During the

pilot, local NGOs and Government field staff from various line Departments and Kamrup district administration participated in the programme.

WorldFish has provided strong technical support to the Government Departments to plan and implement the pilot program. Also, it has assisted them in conducting community awareness programs on the benefits of a nutrition-sensitive strategy for tackling malnutrition in women and children in Assam. Currently, this groundbreaking pilot is successfully being implemented in 293 Anganwadi centres spread throughout the Chaygaon block, with a projected beneficiary population of 7,000 children between the ages of 3 and 6. The small fish powder has been a part of this school feeding programme twice a week (on Mondays and Fridays) for three months. The outcome of the pilot project will be multifaceted by specifically addressing Sustainable Development Goals 2 and 3 – Zero Hunger, Good Health and well-being.

State-Level Workshop On Fish Nutrition To Human Health To Support Fishery Interventions

Compiled by – Ms. Neeta Beypi, Technical Expert Fisheries, WorldFish

A one-day State Level Workshop on fish nutrition to human health to support the Fisheries interventions under APART was organized by WorldFish in collaboration with the Department of Fisheries and Assam Rural Infrastructure & Agricultural Services (ARIAS) Society, Govt. of Assam under the World Bank-funded APART on 23rd September 2022 at Indian Institute of Bank Management (IIBM), Khanapara, Guwahati.

The main objectives of the workshop were to create awareness to build a comprehensive overview of the potential role of small fresh fish and small dry fish in improving nutrition concerning certain micronutrient deficiencies throughout Assam.

Dr Shakuntala Thilsted, Global lead, Nutrition Expert, WorldFish served as Resource Person for the workshop. The workshop was attended by Smt. Roshni Aparanji Korati, IAS, State Project Director (SPD), Dr B.K. Bhattacharjya, Principal Scientist & Head, ICAR-CIFRI, Guwahati, Mr Sanjib Choudhary, Joint Director of Fisheries, Dr. Chayan Kr. Acharjee, Deputy



Director of Fishery, Dr. Dhrubajyoti Sharma, Nodal Officer, APART, Dr. Sanjay Sarma, Fishery Coordinator, ARIAS Society, Dr. Baishnaba C. Ratha, Senior Nutrition Specialist, WorldFish, DFDOs and FDOs from Department of Fisheries, NFDB representative, Block Development Officer, Technical Coordinator, WorldFish, Technical Expert Fisheries (TEFs) and Engineer Consultant Fisheries (ECF) of APART Project Districts, FPC members, GIZ representatives, NGOs and College of Fisheries representatives.

Dr. Shakuntala Thilsted, Global lead, Nutrition expert, WorldFish spoke extensively on the aquatic food systems for nourishing people and the planet and supported the fisheries interventions under APART.

Dr. Shakuntala Thilsted stated that aquatic food systems have the potential to contribute to social, environmental, and economic development holistically for sustainable development. She also mentioned that Aquatic Foods are Superfoods as they contain highly bioavailable micronutrients and essential fatty acids.

Smt. Roshni Aparanji Korati, IAS, State Project Director (SPD), ARIAS Society expressed her gratitude to Dr. Sakuntala as she overviewed the role of fish in human nutrition. Additionally, she stated that though the production of fish meets the demand of Assam, fisheries still need to do more to increase production for export earnings as well as to prepare other value-added products. A Recipe Booklet on Small Fish of Assam was released by an internationally reputed fishery scientist during the workshop. Dr. B.K. Bhattacharjya, Principal Scientist & Head, ICAR-CIFRI, Guwahati, shared his diverse research experiences as well as the importance of fish and other aspects to the sustainable development of the



Assam fisheries sector and Dr. Dipesh Debnath, Senior Scientist, ICAR-CIFRI, Guwahati, gave a brief overview of fish resources, production, and consumption in Northeast India.

Dr. Baishnaba Charan Ratha, Senior Nutrition Expert at WorldFish, presented the nutritional importance of small fish and provided basic information on small fish nutrition to pregnant and lactating women and children. Dr. Sanjay Sarma, Fishery Coordinator, ARIAS and Dr. Dhrubajyoti Sharma, Nodal Officer, OPIU, Fishery, shared their experience about the pilot programme and incorporation of small dried fish powder in the mid-day meal of two Anganwadi centre at the Kamrup districts (No.2 Kukurmara Anganwadi center and Doloipara Anganwadi centre).



Innovative Carp – Mola Polyculture And The Impact Of Mola Fish On Economic Growth Of Farmers And Human Nutrition

The most notable and effective innovative addition initiated by the Department of Fisheries (DoF), Assam under the Assam Agribusiness and Rural Transformation Project (APART) is the technology of Mola fish farming with carp fish. APART has been implementing the technology demonstration of the Carp Mola Polyculture scheme since 2019-20 under the technical guidance of WorldFish.

Mola locally known as Mowa, is a Small Indigenous Species commonly found in the natural water bodies of Assam. This fish is rich in vitamins and minerals essential for the human body and has medicinal properties. According to a scientific analysis of WorldFish, Mola is very useful for providing nutrition to



pregnant and lactating women and children. Although Mola fish is naturally available, fish farmers did not consider it for culture as they were not aware of its benefits and requirements. In addition, the fish farmers couldn't rear this fish due to a lack of practical and technical knowledge of Mola fish farming in ponds.

In view of the above, WorldBank funded APART under the technical guidance of WorldFish, decided to introduce Carp Mola Polyculture on a pilot basis in certain districts and accordingly instructed the District Fisheries Departments to select the beneficiaries. The DoF in collaboration with WorldFish conducted field training on Mola fish farming and its benefits while





implementing the scheme. To increase public awareness of the nutritional benefits of mola fish and how they may affect children's and pregnant women's diets, awareness campaigns and training were also held in several locations. WorldFish nutrition experts participated in the training and distributed Better Management Practices (BMPs), leaflets and manuals to the general public about the importance of mola fish in nutrition.

Thereafter the technical officials of the District Fisheries Department selected the fish farmers in the potential areas and formed the Farmers Producer Group (FPG) and proceeded towards a subsequent phase of culture. Therefore, under the supervision of WorldFish, the District Fisheries Department identified some sources of naturally available Mola fish so that the required Mola fish could be collected from the source and released into the ponds. WorldFish experts provided the field training to the beneficiaries on how to

transport Mola fish from one place to another without mortality following the Better Management Practice manuals developed by WorldFish. The advantage of Mola fish farming is that they do not need to be fed separately as the residue left after Carp fish feeding is sufficient for Mola fish. Another advantage is that Mola fish is a prolific breeder and therefore they breed every two to three months. So, harvesting Mola fish every two to three months will increase its quantity very quickly due to natural breeding.

The beneficiaries release seeds of fingerling size of six species of carp seed into the pond and after a few days, they release the specified quantity (50 kg per hectare) of Mola fish brought from selected sources to the pond. They could start partial harvesting of Mola fish after stocking for three months and sell some in the local market in addition to consuming it at home. Twice the quantity of Mola fish harvested was produced again through natural

breeding. Accordingly, they harvested the three to four times a year and finally harvest the whole together with the carp and sell it for domestic consumption. The beneficiaries became extremely excited and began making plans for Mola fish farming for the following year after realizing that they could sell Mola fish in better price, without any extra expense or effort. Moreover, when the women realized the importance of Mola fish in terms of nutrition to children and women, they too became motivated towards Mola fish farming and also advised the people of the neighboring areas to culture Mola fish.

After the success of the first year, the DoF decided to implement the scheme in all the districts from the year 2020-21 and included the Carp-Mola demonstration in Ponds, Paddy as well as in Beel Fisheries. The joint efforts of the DoF and WorldFish have shown promising results in Mola fish farming and the farmers especially women have taken the lead in this regard.

The DoF has now initiated necessary demonstrations on the preparation and packaging of dried Mola fish powder and pickles in collaboration with WorldFish and CoF because Mola fish powder and pickles have great quality and are very tasty, making them easily eaten by children and others. It is a very notable observation that recently the Farmers Producer Companies formed under APART have started preparations for the commercial production of Mola fish powder and pickles because of the increasing demand for Mola fish besides its farming.

According to the income generated by the beneficiaries in the last two years, they have been producing about 5000 KG of carp and about 300 KG of Mola fish per hectare of water area through Carp Mola polyculture. The data shows that the fish farmers can earn an additional more than Rs. 40,000.00 from Mola fish alone besides producing for domestic consumption.

If the farmers continue to culture



Mola fish, it will become an integral practice for the farmers within a very short period and the benefits of its consumption will attract the majority of the people of Assam. This

potential will undoubtedly contribute significantly to increasing the income of fish farmers and protecting the health of children and women.

Success Story Of Innovative Polyculture Of Carps With Freshwater Prawn Demonstration

The Assam Agribusiness and Rural Transformation Project (APART) have been successfully implemented in 16 districts of Assam in collaboration with the Department of Fisheries, Govt. of Assam, technical supported by WorldFish and funded by the World Bank. In this scheme, the most notable innovative approach is the technology demonstration of the Polyculture of Carps with Freshwater Prawns. The Polyculture of Carps with Freshwater Prawns demonstration, which began in 2020-21, has already attracted fish farmers across the state. This is because farmers can earn money and double their income with the same time and effort using this innovative farming technology. Furthermore, the market value and demand for freshwater prawns in Assam are higher than for other fish. Initially APART had demonstrated the Polyculture of carp with Freshwater



Prawns in five districts of Assam: Nalbari, Barpeta, Goalpara, Kamrup and Darrang. The Department of Fisheries, in collaboration with WorldFish, developed a manual on the scientific Polyculture of carp with Freshwater Prawns and directed district officials to follow the technical procedures outlined in the manual. Under the supervision of the district



fishery department, selected farmers prepared the ponds and stocked a specified number of quality prawn seeds imported from sources certified by the Central Institute of Freshwater Aquaculture, Bhubaneswar, as well as applied proteinous feed, probiotic and minerals as per WorldFish's Better Management Practice (BMP). Normally, six species of carp seeds are released into ponds, but because prawn is a bottom feeder species, it is recommended that only four species of carp seed is to be cultured, except for two species of bottom feeder carp seed, so that there is no threat to prawn food and habitat. As a result, a few weeks after the release



of prawn seeds, a predetermined number of carp seeds from four species are released into the pond, and proteinous feed and geolite are applied on time.

Farmers begin prawn harvesting six months after prawn seeds are released. When the farmers noticed an average growth of prawns of about 85 gm to 120 gm, they were encouraged by the very positive and fruitful results of prawn growth. After prawn harvesting, carp farming was continued and at the specified time started fish harvesting. The farmers became more confident and aware of the financial benefits of Polyculture of carp with Freshwater Prawns due to the higher-than-expected production.

According to district data and farmer statements observed during field visits, approximately 400 KG to 450 KG of prawns and 2000 KG to 2500

KG of carp fish are produced per hectare per year.

Following the unprecedented success of the first year, APART extended the Polyculture of Carps with Freshwater Prawns demonstration in 2021-22 and 2022-23 and included a more districts for implementation based on the response. The inclusion of innovative Carp Polyculture with Freshwater Prawn farming was able to double the farmer's income, which encouraged both the farmers and the APART project to continue this initiative. Many other farmers have become interested in the Polyculture



of Carps with Freshwater Prawns farming as a result of this farming and have contacted district fishery officials for information on technical aspects and prawn seed availability.

Success Story : Rangman Meen Palak Farmers Producer Group

Compiled by: Gunajit Talukdar, Technical Expert Fishery, APART, Nalbari

Shri Sultan Hakimul Haque is a well-educated youth from the Pub-Kalakuchi village in Assam's Nalbari district. He was mentally depressed and unable to find work in the government sector after finishing his education. Despite this, he continued to seek government employment while also attempting to engage in

agriculture because he inherited land for cultivation. However, the land was low-lying and remained abandoned for the majority of the year, with only a small amount of paddy production. As a result, he was unable to make the final decision to pursue agriculture as a source of self-sufficiency.



At that disappointing juncture in life, he came to know about the World Bank-funded Assam Agribusiness and Rural Transformation Project (APART) implemented by the Department Of Fisheries, Assam and contacted the Office of the District Fishery Development Officer, Nalbari for details. At his request, the concerned fishery official inspected the farmland and conducted the technical survey and his land was found to be excellent for integrated paddycumfishfarming. Because most of the land in the area is suitable for paddy fish culture, the district fishery department proposed implementing a technology demonstration of a climate-resilient paddy fish farming scheme under APART. As a result, a Farmers Producer Group (FPG) of 24 farmers, including Sultan Hakimul Haque of Pub-Kalakuchi village, was formed in the year 2019-20. Sultan Hakimul assumed the responsibility and formed the Rangman Meen Palak FPG group committee. Following that, all FPG

members receive scientific training on technical aspects of paddy-fish farming, as well as manuals on Better Management Practices.

According to the technical instructions, the beneficiaries, led by Sultan Hakimul, prepared their plots for paddy fish farming and purchased seeds of the improved BINA-11 variety of paddy from the Krishi Vigyan Kendra in Nalbari, as well as prepared seedlings. The seeds were planted in rows at the appropriate spacing in the prepared plots at the appropriate time and in a specific quantity.

In parallel, the initial steps for fish farming began in a deep section of the same plots that had already been prepared as a pond and four species of carp fish seeds were released in a prescribed ratio in due time. Mustard Oil Cake and Rice Polish were used as supplemental feed and lime, raw cow dung, urea and super were also used to maintain water quality and improve fish growth.

Sultan Hakimul Haque and other

members began harvesting ripe paddy on time and also carried out fish farming activities. Hakimul is overjoyed that he will be able to produce more than twice as much paddy this year as he did last. When the fish grow properly, he begins fishing and can produce more fish than he expected. Sultan Hakimul appears to have discovered a sea of work. This is because he previously earned very little money from that land and now earns many times more from the same land that had been abandoned for most of the year and has now become productive all year round.

Hakimul and others began planning for the following year with more enthusiasm and with the money earned; Hakimul purchased new land and broadened the scope. On the advice of district APART officials, he also planted Sali paddy on the same plot so that paddy could be produced twice in one year. Similarly, he began farming genetically improved varieties of Jayanti rohu and Amur carp with Small Indigenous Fish Species namely Mola along with paddy.

Following the Rangmon Meen Palak FPG, which achieved unprecedented success in paddy fish farming, many farmers in neighbouring villages are now adopting the same technology. Members of the FPG who are still active are known throughout the



region as an ideal group for farming collectively and earning more with less cost and labour. And Sultan Hakimul, who can produce three crops in a year from an abandoned plot of land, is ideal for today's fish farmers. Currently, Sultan Hakimul produces approximately 5000 KG to 6000 KG paddy and approximately 3000 KG to 3500 KG fish per hectare per year.

Rangmon FPG's remarkable financial progress through integrated fish farming has inspired many farmers, who have already begun farming using similar techniques. On the other hand, many unemployed educated youths, like Hakimul, want to become self-sufficient through fish farming. Furthermore, many farmers who had land but were falling apart due to its unsuitability for paddy production have been encouraged by Rangmon FPG's example and have begun paddy fish farming.

In addition to the then-State Project Director of the ARIAS Society, World Bank representatives visited the FPG

sites to observe farming technology at various times and were satisfied. As a result of the technical know-how and financial support given by

APART, Sultan Hakimul Haque and other members of the FPG have become self-sufficient. We wish them a bright future.

Visit of WorldFish Global Lead (Nutrition And Public Health) to Anganwadi Centers

Compiled by – Ms. Nabamika Sonowal, Technical Expert Fisheries, WorldFish

Apart from increasing the production and productivity, increasing accessibility, availability, and affordability of fish among consumers will lead to an increase in fish consumption, and reduce malnutrition and hidden hunger as experienced by many nations.

With this aim, under APART, WorldFish has conducted a series of mass awareness programs on the health benefits of small fish consumption and the inclusion of small fish-based nutrition in the diet of young children, women especially,

pregnant, and lactating women. In the pilot initiative, WorldFish is providing technical support and sensitizing the Department of Fisheries, Govt. of Assam and ICDS for the inclusion of small, dried fish powder in the hot cooked meal (HCM) program of the Anganwadi centres (AWC). The AWCs provide supplementary nutrition, preschool education, nutrition, health education, immunization, health check-up and referral services of which the last three are provided in convergence with public health systems.





To have first-hand information and observation on the acceptance of dried small fish powder in the hot-cooked meal program at Anganwadi centres, Dr. Shakuntala Haraksing Thilsted, Global Lead for Nutrition and Public Health at WorldFish, along with the Assam WorldFish team members, officials from APART, Department of Fisheries, CDPO and Mukhya Sevika of Anganwadi visited two Anganwadi centres namely Kukurmara AWC and Doloipara AWC of Chaygaon block under Kamrup rural district during September 2022. At the very beginning Mr. Sandeep Duwara, CDPO, Kamrup District, greeted and welcomed all the participants and dignitaries and initiated the session with an explanation of the purpose and objective of the visit. Dr. Thilsted narrated that proper nutrition during the initial days of life is the only way to nourish and overcome malnutrition, especially in communities living in rural villages. She briefly described how the consumption of small fish

with high micronutrient content significantly can be benefited pregnant women, lactating mothers as well as children's health. After the healthy gathering and discussion, the team interacted with the Anganwadi workers, parents, and young children and observed their activities at the centre. The team also observed the ready acceptance of incorporated dried small fish powder in the hot cooked meal (Khichiri) by the young children. Along with young children the team had also tasted and had a bite of dried small fish powder incorporated meal. During the feeding session, the team interacted and took feedback from the young children's mothers and caretakers about the taste, smell and acceptance of dried small fish powder incorporated meal served at the centre. The team visited the kitchen and meal preparation areas and interacted with Anganwadi workers about the activities they perform regularly for non-formal preschool education and the ingredients incorporated

into children's diets to nourish their nutrition.

Dr. Thilsted also had a good interaction with the entire pilot project ICDS Supervisors and received their opinion, and feedback on the acceptance of dried fish powder in Khichidi among children and

their caretakers. The Fish Producer Company from Kamrup district was also present and shared their views and discussed the value chain process involved in the production and supply of dried fish powder to AWCs. The visit ended with a vote of thanks from Dr. Sanjay Sarma.

WorldFish Team Visit to Anganwadi Centers' Fish Powder Production Unit

Compiled by – Ms. Neeta Beypi, Technical Expert Fisheries, WorldFish

WorldFish Assam team consisting of Dr. Bishnaba Charan Ratha, WorldFish Senior Nutrition Specialist, Ms. Neeta Beypi, Technical Expert Fisheries and Ms. Nabamika Sonowal, Technical Expert Fisheries visited 3 Anganwadi Centres (AWCs) in Chaygaon Block, Kamrup District to observe the ICDS feeding programme, where the inclusion of small fish powder has been incorporated in regular diet i.e on Monday & Friday of Anganwadi Centres (AWCs). The ICDS Supervisor of the Doloipara ICDS Sector of Chaygaon assisted the WorldFish team during the visit.

The main purpose of the visit to the Anganwadi Centres was to observe and witness how the Anganwadi Workers (AWW) and the Anganwadi



Helpers (AWH) prepared the khichdi with fish powder in the Anganwadi Centres (AWCs) and to provide the guidance accordingly. The AWW and AWH cooked the khichdi under the guidance of worldFish, and in accordance, the worldfish team described each step that must be followed when cooking the khichdi. The team also explained in detail the

amount of quantity of fish powder required for each child. The team mentioned the hygiene that should be followed during the cooking process. The team also evaluated and tested the khichdi and examines its taste and flavour, appearance, texture colour and odour.

The team observed that fish powder is stored according to safety standards and in a hygienic manner. Cleanliness is maintained throughout the cooking process and in the kitchen.

The team interacted with each child to find out if they loved and liked the khichdi made with fish powder. Children accepted and liked the inclusion of fish powder to khichdi.

In the afternoon the team then visited the Fish powder production Unit, Chamaria FPC of Kamrup District to observe and examine the Fish



powder-making process by the FPC member. The team examined the quality of the dry fish that was supplied to the FPC from two Hygienic Fish Drying Centers. The FPC showed the fish powder they had produced and mentioned that they had followed the WorldFish methods and procedure of fish powder making. The team checked the texture, appearance as well as odour of the fish powder. The team observed the powder is of good quality and the texture is very fine.



Post-Harvest Management Of Potato

(A report by CIP- Knowledge Partner- APART)

Introduction

Potato is a valuable crop and plays a vital role in our daily nutrition. However, the presence of a high volume of water ($\approx 80\%$) provides a severe impediment to the protracted storage of potatoes in uncontrolled ambient conditions, resulting in a considerable part of the yearly crop going to waste from harvest to consumption. In Assam, the total post-harvest losses are estimated to be 30-35% during harvest and on-farm storage of up to 3 months. It is important to increase potato availability by lowering post-harvest losses from farm to fork. Post-harvest quality and losses in potatoes, like other horticultural crops, are strongly influenced by soil and weather conditions throughout

growth, harvesting, handling, transit, storage and distribution. Moreover, these losses are variety dependent. Varieties with better keeping quality show lower post-harvest losses compared to varieties with low keeping quality. Post-harvest losses can be lowered by using a suitable variety and by following scientific protocols for post-harvest management.

Protocols for Post-Harvest Management of Potato

Potato requires a cool climate for cultivation, therefore, it is grown in winter in plains and in summer in hilly areas. It is a short-duration crop and matures in 90-110 days but tubers can be harvested any time after about 60 days.

Variety

Post-harvest losses are directly linked to keeping the quality of potato varieties. Potato varieties show a large variation in keeping quality. Varieties with thick periderm or

skin are resistant to bruising during harvest and handling and show less rotting during storage. The other characteristics of good keeping quality are dry matter content,

dormancy period, sprouting intensity and sprout growth rate. Kufri Surya and Kufri Chandramukhi have very good keeping quality whereas Kufri Pukhraj and Kufri Mohan have poor keeping quality.

Therefore, varietal characteristics should also be taken into consideration while storing potatoes.

Maturity Indices:

- » The dying of the aerial part of the potato plant, also known as vine senescence indicates the maturity of the potato.
- » The resistance of tubers to abrasion during harvest is also a maturity indicator.
- » The sugar content of the tubers should be lower (less than 150 mg reducing sugar per 100 g) and the starch content higher at the time of maturity.

Quality Indices:

- » Good shape, bright colour (yellow, red or white (depending on variety)), uniformity of the bulk, firmness, without any soil adherence, non-bruised, non-infested by pests and microbe, free from diseases, sprouting and greening.

Harvesting:

- » The optimum soil temperature for harvest is 12–18°C. Harvest temperatures greater than 25°C or lower than 8°C can lead to bruising
- » Irrigation is stopped 15 days before dehaulming.
- » Dehaulming practice where the aerial/above-ground part of the plant is either cut through a sickle or machine is done when the plant starts turning yellow at around 80- 90 days and it should be done 10-15 days before harvest.
- » Harvesting must be done at the proper maturity level in dry weather with proper care to avoid bruising.

Harvesting Methods:

- » Potato can be harvested manually by using a shovel or plough.
- » For the mechanical harvest, tractor-drawn potato diggers are most commonly used. It spreads the tubers on the soil surface which are picked manually.
- » Combine harvesters are also available which dig as well as collect the tubers which can be bagged or transferred to trollies.



Post-Harvest Operations Drying, Curing & Sorting:

- » If the potatoes are exposed to moisture or rain after harvest, bulk storage must be avoided without drying.
- » Shed drying of potatoes is a must after harvest, but exposure to sunlight is to be avoided to avoid greening.
- » After drying the potatoes are aggregated for curing at around 25° C and 90% relative humidity to condition them to have tighter skins and to mend the bruises.
- » The sweating during curing can be controlled by keeping the tubers spread under the fan.
- » The damaged, green and diseased tubers are to be discarded through sorting.

Grading: After harvest, potatoes are stored in heaps for 10-15 days to allow minor bruises to heal before grading. Tubers can be graded manually or mechanically.



As per AGMARK specification, grading can be done based on the size as follows:

Size Code	Equatorial diameter in mm
A	18.1 - 28.0
B	28.1 - 45.0
C	45.1 - 65.0
D	65.1 - 80.0
E	more than 80

Note: The size code 'A' shall be marked as 'Baby Potato', sizes C and D are useful for processing chips.

- » For processing purposes, tubers are graded into processing grade 45-85 mm.
- » For seed certification tubers are graded into seed size (30-55 mm), large seed size (>55 mm)

Treatment:

- » Fresh market tubers are not treated with any chemical and are sold unwashed or after washing with water to remove adhering soil.
- » Seed tubers are generally treated with 3% boric acid solution (30 min dip) after grading.

Packaging:

- » In general, potatoes are packed in jute bags and leno/ nylon bags of 50 kg capacity.
- » Potatoes meant for exporting and quality selling are packed in corrugated boxes (with holes) of 10 kg capacity.
- » Graded baby potatoes may be packed in 1, 2 and 5 kg perforated LDPE packing materials with proper sealing.

Transportation:

- » Vehicles must ensure good ventilation, be shaded, prohibit overstacking, free from rodents and insects.
- » Regular cleaning of transportation vehicles is a must in potato transportation and it should be ensured that the vehicle is moisture free from the inside.
- » For long-distance transportation, refrigerated vehicles are preferable.

Storage: After harvest, tubers can be stored for the short term (2-3 months) on the farm or long-term (3-9 months) in cold stores.

- » Short-term storage is used to tide over the low-price period immediately after harvest. Tubers are heaped and covered with a 10-15 cm thick layer of rice straw. Perforated pipes are placed in the heaps for gaseous exchange. The heaps can be made in rooms or under the shade of trees in the open field. Short-term storage is used for tables and processing potatoes.
- » Long-term storage is used for table, processing as well as seed potatoes. Here tubers are stored in cold storage at different temperatures depending upon end use.
 - o Table potatoes 7 C
 - o Processing potatoes 8-12 C
 - o Seed potatoes 2-4 C
- » To avoid the most common problem of sprouting in storage, sprouting suppressants like Isopropyl N-Chlorophenyl Carbamate (CIPC) are used when potatoes are stored at 7-12 C



Cold store with bags for seed



Bulk store for processing potatoes

Short-Term Potato Storage in Country Stores

More than 85% of potatoes are harvested in India from January to March from Punjab to Assam. Wholesale and retail prices during this period are lowest due to the flooding of potatoes in all markets. Therefore, fresh potatoes are consumed from December-January to April-May. Potato prices start to improve after mid-May. By following the post-harvest protocols,



Country potato store

potatoes can easily be stored for about three months from March to May with minimal losses. Nine community country stores with 10-ton capacity and 60 individual stores with 0.3 - 0.5-ton capacity was built in Assam and farmers were trained on the post-harvest management practices to reduce post-harvest

losses and to successfully store potatoes for three months.

Kufri Surya has very good keeping quality and minimal post-harvest losses in the country store compared to Kufri Pukhraj. By following the post-harvest protocols with Kufri Surya, farmers have brought down losses to about 13%.





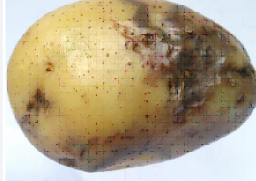
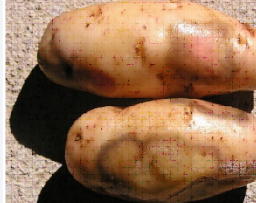

Country store with a heap of potatoes



Individual rack store

Post-harvest stages	Kufri Surya - following post-harvest protocols	Kufri Pukhraj - with farmer's practice
Field losses - harvest to packing (leftovers, cut, bruises, greening, rottage, curing and packing)	4.8%	9.6%
3-month ambient temperature storage losses (weight loss, rottage, sprouting)	8.3%	17.8%
Total post-harvest losses	13.1%	27.4%

Major Post-Harvest Diseases:

<p>Tuber Moth Infestation:</p> <ul style="list-style-type: none"> » Description: The moth penetrates through the eyes and eats up the inner portion causing weight loss. » Spreading: Through tuber moth eggs. » Treatment: Avoid harvested potato to be stored on the field overnight, coverage of stored potatoes with Lantana or Eupatorium, Methyl Bromide fumigation in @4.8 kg/ 100 cubic meter for 3 hours 	
<p>Charcoal Rot:</p> <ul style="list-style-type: none"> » Description: Dark spots/ patches which soak water. » Spreading: Soil and through bruised/insect-damaged skin. » Treatment: Requires early harvesting, avoid bruising during harvest and post-harvest handling, low-temperature storage 	
<p>Late Blight of Potato:</p> <ul style="list-style-type: none"> » Description: Brown colour development in potato, wet rotting in storage. » Spreading: Through seeds, tubers and infected soil » Treatment: Avoiding bruising at the time of harvest 	
<p>Soft Rot/ Black Leg:</p> <ul style="list-style-type: none"> » Description: Infection of tubers through wounds » Spreading: Infected tuber and soil, transfer through flies, an ambient temperature of 21- 29° C and 94% RH. » Treatment: Treating seed tubers and stored tubers with 3% Boric Acid for 30 minutes, washing with chlorinated water before storage 	
<p>Dry Rot:</p> <ul style="list-style-type: none"> » Description: Sunken dry spot with irregular rings, internal tissues become brown, dried out lightweight shrivelled tubers » Spreading: Infected soil and tubers, air and floor of contaminated tuber storage » Treatment: Avoiding tuber injuries, before storage proper drying of potatoes should be ensured, for the first 2-3 weeks of storage low temperature of 10-15° C with good ventilation and 95% relative humidity is good for injury healing and avoiding diseases 	

KRISHI RUPANTAR

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ARIAS SOCIETY

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