End-Term Assessment (ETA) Report

MONITORING AND EVALUATION OF APART

Submitted to:

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Contents

List of Abbreviations

AACP	Assam Agricultural Competitiveness Project
AAGL	Assam Agribusiness Growth Lab
AAIF	Assam Agribusiness Investment Fund
AAPIAM	Allied Processors Industry Association of Morigaon
AAU	Assam Agricultural University
ABIP	Assam Bureau of Investment Promotion
ACFIFA	Assam Challenge Fund for Innovative Finance in Agriculture
ACZ	Agro climatic zone
AFCSCL	Assam Food and Civil Supplies Corporation Ltd
AHIDF	Animal Husbandry Infrastructure Development Fund
AHVD	Animal Husbandry & Veterinary Department
AI	Artificial Insemination
AIBTM	Assocom Institute of Bakery Technology & Management
AIDP	Agro Industrial Development Plan
AIF	Agriculture Infrastructure Fund
ALPCO	Assam Livestock & Poultry Corporation Ltd
AMIU	Agricultural Market Intelligence Unit
APART	Assam Agribusiness and Rural Transformation Project
APMC	Agriculture Produce Market Committees
ARIASS	Assam Rural Infrastructure and Agricultural Services Society
ASAMB	Assam State Agricultural Marketing Board
ASWC	Assam State Warehousing Corporation
ATMA	Agricultural Technology Management Agency
AWD	Alternate Wetting and Drying
AWP	Annual Work Plan
BBANIA	Barpeta and Bajali Nabajagaran Agro Industry Association
BDMC	Beel Development and Management Committee
BDS	Business Development Support
BFAC	Block Farmers Advisory Committee
BMC	Bulk Milk Coolers
BMP	Best Management Practices
BOD	Board of Directors
BVZ	Barak Valley Zone
CAAPIA	Cachar Agro & Allied Processors Industry Association
CATD	Computer-Aided Textile Design
CBVZ	Central Brahmaputra Valley Zone
CEO	Chief Executive Officer
CFC	Common Facility Centers
CHC	Custom Hiring Center
CIFA	Central Institute of Freshwater Aquaculture
CIIE.CO	Center for Innovation Incubation & Entrepreneurship
CIMAP	Central Institute of Medicinal and Aromatic Plants
CIP	International Potato Center
CMSGUY	Chief Minister’s Program Samagra Gramya Unnayan Yojana

CPIU	Core Project Implementation Units
CRI	Climate Resilient Infrastructure
CSC	Common Service Center
DCS	Dairy Cooperative Society
DDC	District Development Committee
DDD	Department/Directorate of Dairy Development
DEC	District Environment Coordinator
DEF	Digital Empowerment Foundation
DFL	Disease Free Layings
DICC	District Industries and Commerce Centers
DLCC	District Level Coordination Committee
DPIU	District Project Implementation Unit
DPMCU	Data Processor-Based Milk Collection Units
DPR	Detailed Project Report
DSR	Direct Seeding of Rice
EA	Environmental Assessment
EDPF	Enterprise Development and Promotion Facility
EMF	Environmental Management Framework
EMP	Environmental Management Plan
ETA	End-Term Assessment
FASAR	Food and Agribusiness Strategic Advisory & Research
FCI	Food Corporation of India
FDE	Field Data Enumerators
FEC	Financial Education and Counselling
FFHS	Farmers Financial Health Survey
FGD	Focus Group Discussion
FLD	Front Line Demonstration
FM	Fund Manager
FMD	Foot and Mouth Disease
FPC	Farmer Producer Company
FPO	Farmer Producer Organization
FSSAI	Food Safety and Standards Authority of India
FYM	Farm Yard Manure
GAMP	Good Agricultural Marketing Practices
GAP	Good Agricultural Practices
GB	Governing Body
GIAS	General Insurance Assurance Scheme
GIS	Geographical Information System
GMA	Gross Margin Analysis
GoA	Government of Assam
GST	Goods and Service Tax
GT	Grant Thornton
HMC	Hygiene Monitoring Committee
HMNEH	Horticulture Mission for North East & Himalayan States
HZ	Hills Zone
IA	Industry Association

IAAST	Institute of Advance Study in Science and Technology
ICAR	Indian Council of Agricultural Research
ICCOA	International Competence Center for Organic Agriculture
ICCSPL	Innovative Change Collaborative Services Pvt Ltd
ICLARM	International Center for Living Aquatic Resources Management
ICMD	Integrated Crop Management Demo
IDBI	Industrial Development Bank of India
IDD	Institutional Due Diligence
IDI	In-Depth Interviews
IFCI	Industrial Finance Corporation of India
IFDC	International Fertilizer Development Center
IIHT	Indian Institute of Handloom Technology
IIT	Indian Institute of Technology
ILRI	International Livestock Research Institute
INM	Integrated Nutrient Management
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
ITR	Income Tax Return
JAAPIA	Jorhat Agro and Allied Processors Industry Association
KAAPIA	Karbi Anglong Agro Industries Association
KAMAIA	Kamrup Metro Agro Industry Association
KCC	Kishan Credit Card
KG	Kilogram
KII	Key Informant Interviews
KM	Kilometers
KPI	Key Performance Indicator
KVIC	Khadi and Village Industries Commission
KVK	Krishi Vigyan Kendra
LAAPIA	Lakhimpur Agro and Allied Product Industry Association
LBVZ	Lower Brahmaputra Valley Zone
LCD	Learning Center Demo
M&E	Monitoring and Evaluation
MAIT	Mobile Artificial Insemination Technician
MEL	Monitoring, Evaluation and Learning
MIS	Management Information System
MOP	Murate of Potash
MOU	Memorandum of Understanding
MPI	Milk Producers Institution
MSME	Micro Small and Medium Enterprise
MTA	Mid-Term Assessment
MTR	Material Test Report
NABARD	National Bank for Agriculture and Rural Development
NAIA	Nagaon Agro Industry Association
NBPZ	North Bank Plain Zone
NEIDS	North East Industrial Development Scheme
NIRDPR	National Institute of Rural Development and Panchayati Raj

NO	Nodal Officer
NPK	Nitrogen Phosphorus Potassium
NRC-P	National Research Center on Pig
NWR	Negotiable Warehouse Receipt
OBC	Other Backward Classes
ODOP	One District One Product
OFT	On Farm Trials
OPIU	Operational Project Implementation Unit
PCU	Project Coordination Unit
PDO	Project Development Objective
PGC	Project Guidance Council
PHM	Post-Harvest Management
PIA	Project Implementing Agency
PIAARA	Rangpur Agri And Allied Processors Industry Association
PIP	Project Implementation Plan
PIU	Project Implementation Unit
PMEGP	Prime Minister’s Employment Generation Program
PMFBY	Prime Minister Fasal Bima Yojana
PMFME	Pm Formalization of Micro Food Processing Enterprises
PMIS	Project Management Information System
PMMSY	Pradhan Mantri Matsya Sampada Yojana
PMS	Progress Monitoring Survey
PNB	Punjab National Bank
POP	Package of Practice
PQR	Premium Quality Rice
PRD	Partial Root Drying
QA	Quality Assurance
QC	Quality Control
RARS	Regional Agricultural Research Station
RFRI	Rain Forest Research Institute
RGVN	Rashtriya Gramin Vikas Nidhi
RMC	Rural Market Committee
SC	Scheduled Caste
SDG	Sustainable Development Goals
SIMFED	Sikkim State Co-operative Supply and Marketing Federation Ltd
SIPC	Strategic International Partnership Center
SLCC	State Level Coordination Committee
SME	Small And Medium Enterprise
SMF	Social Management Framework
SMU	Social Management Unit
SOP	Standard Operating Procedure
SPCC	State Project Coordination Committee
SPD	State Project Director
SPIU	State Project Implementation Unit
SPV	Special Purpose Vehicle
SSP	Single Super Phosphate

ST	Scheduled Tribe
STRV	Stress Tolerant Rice Variety
SWA	Single Window Agency
TAAPIA	Tezpur Agro and Allied Processors Industry Association
TEF	Technical Expert Fishery
TERI	The Energy and Resources Institute
TISS	Tata Institute of Social Science
UAM	Udyog Aadhaar Registration
UBVZ	Upper Brahmaputra Valley Zone
ULB	Urban Local Bodies
VC	Value Chains
VGR	Village Grazing Reserve
WAMUL	West Assam Milk Producers Cooperative Union Limited
WDRA	Warehousing Development and Regulatory Authority
WRF	Warehouse Receipt Financing
WVC	World Vegetable Center

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Executive Summary

The End Term Assessment (ETA) of the Assam Agribusiness and Rural Transformation Project (APART) aims to comprehensively assess the project's performance in terms of its overall objectives and intended outcomes.

A **multi study-design framework,** aligned with the nature and availability of data, has been adopted for the End-Term Assessment Study:

a) **Comparison in productivity and revenue for the five focused commodities** (Paddy, Mustard, Potato (table variety), Fisheries (Polyculture) and Milk (Informal) was compared between baseline and endline (Intervention and Control) using the **Difference-in-Means approach.** Also, t-test (assuming unequal variances) has been conducted to statistically compare baseline and endline outputs.

b) **Greater comparison between intervention and control** was established using **Multivariate regression-based analysis** has also been adopted for the 5 focused commodities Paddy, Mustard, Potato (table variety), Fisheries (Polyculture) and Milk (Informal) to compare outcomes between intervention and control areas at the endline by controlling for observable household and contextual characteristics that may influence outcome.

c) **Operational efficiency** of crop cultivation has been calculated using **Gross Margin Analysis** and **Gross Margin Ratio** for all crops, milk and fisheries.

d) **Comparison with Baseline and End-Term Assessment (ETA) findings** - Control information was not collected for commodities like maize, black gram, lentil, pea, ginger, banana, pineapple, cabbage, cauliflower, tomato, pumpkin, brinjal, milk (formal), paddy-cum-fish, polyculture with freshwater prawns, beel fishery, sericulture and handloom. **Mann-Whitney U-test** and **non-parametric tests** have been conducted to ascertain statistical changes between baseline and end-term assessment.

e) For **new segments** including Formal Milk, Fish (Paddy-cum-fish and polyculture with prawn), potato (processed variety), enterprises, industry associations, farmer producer company (FPCs) and infrastructure, only ETA results with qualitative inputs were used as there is no baseline or control information.

The study was conducted in 18 project districts during July to September 2025. A total number of 15 questionnaires were designed and feedback from concerned leads was obtained. All the interview schedules were revised and detailed discussions with the OPIUs and APART technical leads were held and the tools were translated into Assamese.

A sample of 5,255 was attained from various value-chain interventions and a control of 2,257 was obtained for 5 commodities (paddy, milk, fish, potato and mustard). Further, a sample of 310 was drawn from other interventions. Hence, in this round, a total sample of 7,822 was achieved for the quantitative survey.

For the Qualitative Component, Key Informant Interviews (KIIs) were held with OPIU and PCU Coordinators, along with Focus Group Discussions (FGDs) with Farmer Producer Companies (FPCs), Common Service Centers (CSCs), Common Facility Centers (CFCs) and stakeholders related to roads, markets and warehouses.

The study also includes the analyses of Project Development Objective (PDO) indicators:

1. **Increase in price premium of commodities sold by beneficiaries (%)** estimated by comparing volume-weighted average prices at baseline and endline to assess percentage changes over time.
2. **Share of selected commodities sold through new marketing channels (%)** was calculated based on the proportion of total produce marketed through project-supported

channels. For paddy and maize, new marketing channels included project-supported procurement centers, Farmer Producer Companies (FPCs) and direct sales to processors and millers. In the case of potato, contract farming arrangements facilitated under the project enabled farmers to sell directly to processors and FPCs, alongside improved access to traders. For milk, the quantity of milk sold to Dairy Cooperative Societies (DCSs) established under the project was considered, while for fisheries, the quantity of fish sold to markets was included.

3. **Farmers adopting improved agricultural technology (%)** was calculated as the percentage of surveyed farmers who reported adopting either improved seed varieties or recommended packages of practices promoted by the project and any of the climate resilient technologies.

Results Indicators - Findings

The **Project Development Objective (PDO)** of APART is to "*add value and improve resilience of selected agriculture value chains, focusing on smallholder farmers and agro-entrepreneurs in targeted districts of Assam and to advance Assam's COVID-19 response*".

(1) Farmers reached with agricultural assets or services (number) (CRI)
Of which female beneficiaries (number)

APART has reached out to **6,32,086 farmers** at least with one service or asset across the lifespan of the project. But it had covered more than 8 lakh farmers (of which 30.5% were females) through various interventions like climate-resilient technology demonstrations, training and exposure visits, organizing farmers and enterprises into FPCs, IAs, DCSs, BDMCs, providing agri tools, saplings (sericulture), rearing houses, looms (handloom) among others. 125 FPCs were registered under APART with 60,702 shareholders (33% women).

(2) Increase in quality as measured by price premium of commodities sold by beneficiaries in the selected value chains (%)

	Intervention				Control			
	2025	**2019**	**Change**	**% Change**	**2025**	**2019**	**Change**	**% Change**
	Weighted Average				**Weighted Average**			
Paddy (Rs. per kg)	21.27	12.62	8.65	**68.54%**	21.46	12.34	9.12	**73.91%**
Mustard (Rs. per kg)	63.39	27.55	35.84	**130.09%**	64.15	28.31	35.84	**126.60%**
Potato (Table varieties) (Rs. per kg)	12.74	10.52	2.22	**21.10%**	13.53	10.13	3.4	**33.56%**
Milk (Formal) (Rs. per kg)	47.79	39.73	8.06	**20.29%**	43.49	38.06	5.43	**14.27%**
Fish (Polyculture) (Rs. per kg)	208.97	149.7	59.27	**39.59%**	209.44	176.13	33.31	**18.91%**
Total	**354.16**	**240.12**	**114.04**		**352.07**	**264.97**	**87.1**	
	Increased (%)			**47.49%**	**Increased (%)**			**32.87%**
Net increase in price premium: 47.49 % - 32.87% = **14.62 percentage points**								
Source: Baseline Study (2019), End Term Assessment (2025)								

The increase in price premium of commodities sold by farmers from the selected value chains was assessed using producer-level primary survey data. For both intervention and control areas, weighted average prices were computed at the producer level by weighting individual selling prices with the corresponding quantities sold, ensuring that price estimates reflect actual volumes transacted.

Overall, the findings suggest that project interventions have contributed meaningfully to enhancing farm-gate prices beyond general market movements.

(3) Share of selected commodities sold through new marketing channels (%)

The indicator measured the proportion of total produce marketed through new marketing channels supported under the project. The total quantity of produce sold through the new marketing channels was aggregated across all surveyed farmers and expressed as a percentage of the total quantity of produce generated.

The outcome shows a meaningful shift towards new marketing channels across all commodities, with nearly **28.17% of total produce** being sold through these channels. The intervention group clearly outperforms the control group, with 30.78% of total produce routed through new channels compared to 20.98% in control, reflecting differences in commodity mix and market access dynamics. High volumes of **potato and fish** dominate new-channel sales, underscoring their strong market linkage potential, while paddy and mustard show moderate but steady uptake. Overall, the findings suggest that project interventions have strengthened market integration, enhanced producers' exposure to diversified marketing avenues, and laid a foundation for improved price realization and reduced dependence on traditional intermediaries.

(4) Farmers adopting improved agricultural technology (number) CRI
Of which female beneficiaries (number)

Adoption of improved practices across APART-supported commodities is high, with over 80% of total beneficiaries adopting project interventions, indicating strong acceptance of the promoted technologies and services. Adoption rates are particularly strong in maize, ginger, vegetables and mustard, reflecting effective extension support and relevance of interventions. Female adoption levels closely mirror overall adoption (80.6%), demonstrating meaningful participation of women farmers across value chains. Lower adoption in fruits and fisheries suggests the need for more targeted handholding and risk mitigation in these sectors. Overall, the adoption trends confirm the effectiveness of APART's farmer-centric approach while highlighting areas for focused improvement.

Component A: Enabling Agri Enterprise Development

A1: Enhancing State Capacity to Attract Private Investment

A1.1 Support to Private Investment at State Level

65 Investors facilitated with Investment of Rs 4,399 Cr.

Key sectors-

- **Agri-based sectors:** 45 Nos./Rs 2529.96 crores. (Egg, Ready to cook food, Hatcheries, Rice mill, Spices, Agarwood oil, Food processing, Cold storage, Poultry feed, Processed meat, Brewery, Stevia, Feed mill, Bamboo processing, Herbal extract, Juice, Silk)
- **Ethanol:** 7 Nos. / Rs 1154 crores
- **Other manufacturing:** 8 Nos. / Rs 640.60 crores

Key achievement-

- Lead generation: 466
- G2B meetings held: 155
- Investment summit: Support to APART & State Investment Summits
- Manpower support to EoDB by APART: 6

Support provided to Investors for end-to-end facilitation (Investor outreach, Land identification, Site selection, Policy incentives, Coordination with EoDB for approvals).

A1.2 Strengthening DICCs

- DICC offices upgraded - 14
- 49 DICC officials went for exposure visits

A2: Setting-up Enterprise Development Promotion Facility (EDPF)

A2.1 Kshyamata Program

In this initiative, 1803 enrolments have been completed so far; Light touch-up support has been provided to 611 Nos; Business Development Support (BDS) has been provided to 1641 Nos and access to finance has been facilitated for 916 nos.

Loans amounting to Rs 24.5 Cr have been disbursed across 8 districts.

BDS support includes UDYAM registration, FSSAI registration, GST registration, preparation of DPR for loan application. Access to finance includes facilitating loan application and availing subsidy under PMFME, PMEGP, MUDRA, KCC etc. Other than the regular district level trainings and workshops, various exposure visits cum entrepreneurship development programs (EDPs) were organized on commodities/value chain within the project. Notable programs include Processing and Value Addition of Millets in Bangalore, Greenhouse Management in Pune and Mushroom Spawn Production in Guwahati, among others.

ETA Study (N=30)

- The key focus commodities of the enterprises include Rice (23%), Dairy (30%), Fruits (27%), Fish (13%), Pig (13%), Spices (13%), Mustard (3%), Maize (3%), Vegetables (17%), Eri and Muga (3%).
- The average turnover of the surveyed enterprises increased from Rs.8.24 lakhs in FY 2023-24 to Rs.9.58 lakhs in FY 2024-25, reflecting a growth trend.
- 57% reported availing loans. In terms of loan type, 65% of these enterprises had accessed term loans, 29% availed cash credit facilities, while 6% had availed both.
- 73% reported receiving support under the program in the form of light touch-up interventions. 20% indicated that they had been supported through Business Development and Management Services. A smaller proportion (7%) also received long-term intensive incubation support.
- **Outcome-** 67% of respondents reported increased employment within their firms, reflecting the program’s contribution to enterprise growth. Nearly three-fourths (73%) diversified their businesses by introducing new products or services, indicating enhanced entrepreneurial capacity. Improvements were also noted in food quality standards (67%) and enterprise turnover (53%), suggesting progress in both operational and financial performance. Additionally, 43% of enterprises adopted improved technologies, while 23% successfully mobilized finance for business expansion.

A2.2 Assam Agribusiness Growth Laboratory (AAGL)

- **Cohort 1:** 23 enterprises have completed the incubation process.
- **Cohort 2:** 26 enterprises have completed the incubation process.
- **Cohort 3:** 26 enterprises have been selected from 91 applications.

The major activities undertaken included organizing a boot camp, conducting diagnostic panels and mentoring clinics, facilitating access to finance, providing technical assistance, supporting food quality improvement, offering e-commerce mentoring, enhancing branding and social media presence, arranging a Go-to-Market strategy session by Google and organizing events and exposure visits.

Loans amounting to Rs 21 Cr have been disbursed across 15 districts.

ETA Study (N=30)

- The key focus commodities of the enterprises include Rice (23%), Spices (17%), Fruits and Vegetables (13%), Pig (13%), Mustard (10%), Fish (7%), Maize (3%) and Dairy (3%).
- The financial performance of the surveyed enterprises shows a steady upward trend, with the average turnover rising from Rs.66.27 lakh in FY 2023-24 to Rs.94.56 lakh in FY 2024-25.
- 40% reported availing loans. In terms of loan type, 75% of these enterprises had accessed term loans, 17% availed cash credit facilities, while 8% had availed other.
- The types of support received through AAGL included light touch-up support (67%), business development support (77%), credit facilitation (43%), capacity-building support (33%), intensive incubation (13%), product development (23%) and revenue enhancement support (7%).
- **Outcome-** 83% of enterprises indicated that their participation led to increased employment within the firm, while 77% reported business diversification through the introduction of new products or services. Additionally, 73% observed an increase in enterprise turnover and 63% reported improvement in food quality standards and adoption of improved technologies. Furthermore, 50% of the enterprises mentioned successfully mobilizing finance for business expansion.

Component B: Facilitating Agro Cluster Development

B1: Support to establishment of Cluster Level Industry Association

- Established **18** Industry Associations comprising **2845** individual entrepreneurs to represent various agricultural sectors and value chains
- **18** Agro Industrial Development Plans (AIDP) developed and approved
- **8** Common Facility Centers (CFCs) approved comprising **204** firms
  - ✓ Rice: 3
  - ✓ Mustard Oil: 2
  - ✓ Food processing: 2
  - ✓ Silk: 1
- Additional Support
  - ✓ Raw material procurement linkage with APART FPCs and individual farmers
  - ✓ Marketing support- capacity building, social media & conventional channels
  - ✓ Financial linkage with Commercial banks
  - ✓ Convergence with existing schemes of Industry Department

B1.1 Industry Association (N=17)

- On average, around 216 enterprises have been clustered under these IAs.
- The Industry Associations (IAs) are dealing with a diverse range of value chains, with the most prominent ones being Rice (17) and Mustard (12). Other major commodities include Banana (8), Tomato (8) and Ginger (6).

- Most IAs reported maintaining and regularly updating key administrative and financial records.
- The Annual General Body Meeting was conducted during FY 2024-25, and on average, each IA held around 4.29 Executive Body meetings. Additionally, all confirmed that an auditor has been appointed and the audited balance sheet for FY 2023-24 is available.
- The turnover grew by approximately 55% from FY 2022-23 to 2024-25, while profits increased by about 60% over the same period.
- Over the past three years, 9 out of 17 IAs reported that participation in the associations has expanded marketing opportunities, enabling access to newer markets. Most IAs have established market linkages across various channels, with the strongest focus on retailers (16 out of 17 IAs, average 4.25 linkages each) and wholesalers (13 out of 17 IAs, average 3.85 each), indicating robust engagement with traditional market networks. Modern trade outlets (11 IAs, average 3.64) and e-commerce platforms (9 IAs, average 2.33) have moderate participation.
- Challenges faced by IAs while facilitating cluster groups for developing business opportunities- The most common challenge, cited by 13 IAs, was mobilizing active members to be a part of the IA. This was followed by lack of representation or participation from all value chain members (10 IAs) and difficulty in identifying enterprises specific to critical value chains (8 IAs).

B1.2 Common Facility Center (N=7)

- Most CFCs were approved between May and September 2021, with one later approval in May 2023 (Jorhat). Out of the seven units, four have already commenced production, while three are scheduled to begin in November 2025, indicating a generally steady but staggered rollout.
- Mustard and rice emerge as major commodity clusters, supported by high-capacity processing units in Lakhimpur, Biswanath followed by Hojai, Sonitpur and Jorhat.
- CFCs focusing on fruits, vegetables and spices (Karbi Anglong and Morigaon) are progressing but have relatively smaller processing capacities.
- Gender participation among SPV members varies considerably, ranging from 5% to 43%, with Kamrup (Metro) exhibiting the highest female representation. Project costs vary widely- from Rs.129.68 lakh to Rs.789.55 lakhs - reflecting differences in infrastructure scale, technology and commodity types.
- Production shows a varied pattern, largely influenced by the type of commodity and the stage of operationalization. The mustard oil units in Lakhimpur and Biswanath report the most consistent and high-volume output, with daily capacities of 6-10 MT/day.
- Fruit and vegetable processing units in Karbi Anglong and Morigaon’s quarterly figures, reflect the seasonal availability of raw materials. Their diversified product baskets banana chips, turmeric, pickles and spices - provide value addition but remain modest in scale, suggesting potential for expansion once raw material supply chains are strengthened.
- The textile unit in Kamrup (M) focuses on Eri and Muga yarn and fabric with annual capacities rather than daily outputs, reflecting the craft-oriented nature of the sector. Production will begin in November 2025.
- Overall, operational CFCs exhibit moderate to strong production performance but several units - especially rice and textile - are still in the ramp-up phase. Strengthening raw material linkages and ensuring timely commissioning will be critical for achieving full production potential across centers.

B2: Supply chain support

B2.1 Rehabilitation of access roads

- Target : 200 km
- Completed : 213.5 km

B2.2 Warehouse and warehouse receipts development

- Target : 40 godowns
- Completed : 37 godowns

B2.3 Up-gradation and modernization of agricultural wholesale markets

- Target : 99 markets
- Completed : 96 markets

The trade volume, increased by approximately 45.5% after modernization compared to the pre-modernization period.

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Roads (N=20)

The construction of the roads has significantly enhanced connectivity and access for local communities. As a result of this improved infrastructure, access to markets (20) and towns (17) has improved. 9 respondents also identified improved linkages to production clusters and 3 mentioned increased access to warehouses. Further, the road connects to State Highways (9) and National Highways (7), greatly improving regional mobility and reducing travel time. Beyond economic benefits, the road has also improved social access - providing easier connectivity to educational institutions (19) and health facilities (15) - thereby enhancing access to essential services. All noted a visible increase in traffic density on the road following its rehabilitation, suggesting greater usage and improved accessibility for the surrounding communities.

All the respondents from the 20 roads constructed believe that the travel time has reduced due to the rehabilitation of this road and they also felt that the transportation of goods and commodities have become easier. Universally (N=20), it is believed that the cost of transportation of goods and commodities has reduced after the rehabilitation.

Warehouse (N=20)

- 18 out of 20 warehouses are accredited and registered with the Warehousing Development and Regulatory Authority (WDRA), reflecting adherence to regulatory standards and enhanced credibility.
- The warehouses have an average total storage capacity of 4,032.75 MT, with an average monthly storage of 2,088 MT of which 60% are agri-horti commodities.
- The most stored items include paddy, mustard and pulses (black gram, pea and lentil), each reported by 11 respondents. Maize is stored in 10 warehouses, while oilseeds and spices are each stored by 6.
- All 20 warehouses are equipped with fire extinguishers, first aid boxes, toilet complexes and drinking water filters. All warehouses reported that trucks can access their premises and that they are well-connected through dedicated approach roads and internal roads, ensuring efficient movement of goods to and from the facility.

Markets (N=20)

- In terms of trade volume, the markets reported an increase in throughput from an average of 3,461 MT per year before renovation to 4,135 MT per year after renovation.
- Vegetables and pulses are traded in all surveyed markets (20 each), indicating their consistent demand and supply. Fruits, spices and mustard are also major commodities, each reported by 18 respondents. Paddy and maize are traded in 16 and 11 markets respectively, while oilseeds feature in 14.

- Drainage facilities, community toilet blocks, loading and unloading bays for trucks, parking areas and electricity connections are available in the markets.
- Most respondents cited the assurance of receiving a fair market price and the opportunity to fetch good prices for their produce are reasons for thriving in the markets. A significant number also appreciated the competitive pricing environment, which helps maintain profitability and sustains business activity. Additionally, friendly behavior and cooperative interactions among traders and buyers contribute to a positive trading atmosphere. People also acknowledged the supportive role of market authorities in resolving issues and the ease of accessibility of the market as enabling factors.

Component C: Fostering Market-Led Production and Resilience Enhancement

C1: Promoting climate-resilient technologies and its adoption

C1.1 Agriculture crop, Horticulture, Spices and Condiments value chain

Paddy (N=1127; I=627, C=500)

- 81% of farmers adopted recommended Sali season varieties such as Ranjit-Sub1, Bahadur-Sub1, Swarna-Sub1, BINA Dhan 11, BINA Dhan 17 and DRR 44. BINA Dhan is also widely adopted in Boro cultivation (37%), indicating its versatility and efficiency across seasons. Nearly 97% of farmers have shifted to APART-promoted varieties, with women showing particularly high adoption and compliance with the package of practices (PoPs), reflecting efficiency in knowledge transfer and practice adoption.
- Demonstration and training activities have further strengthened efficiency outcomes- 93% of farmers reported yield improvements, 51% reported better quality output through exposure to new varieties and 49% gained from improved farm practices.
- 53% of farmers are associated with FPCs with slightly higher participation among women. Marketing diversification has improved, with 25% selling through FPCs, 22.3% through government procurement systems and 20.6% to processors.
- The average yield stands at 5,990.54 kg/ha for intervention and 4,938.32 kg/ha for control farmers, 21.3% improvement in productivity. Intervention farmers report an average revenue of Rs. 99,864 per ha, against Rs. 74,835 per ha for control farmers, a 33.4% increase. Despite almost similar input costs per ha (around Rs. 36,000), the net earnings per ha of intervention farmers are nearly 70% higher (Rs.64,077 vs Rs.37,617). The gross margin ratio for intervention farmers is 64.16% as compared to 50.2% for control farmers.

Maize (N=132)

- 87% of farmers adopted APART-recommended maize varieties such as NMH-731, PAC-751, ADV-756 and NMH-713, with women showing strong preference for ADV-756. 88% of farmers continue to cultivate recommended varieties and 65% adhere to the full PoPs. Women farmers maintained 100% varietal adoption, underlining the inclusiveness and long-term behavioral impact of the interventions.
- Nearly 96% of farmers reported yield improvements, while 88% gained awareness of new varieties and 82% adopted improved farm practices through demonstrations.
- Only 11.4% of maize farmers are members of Farmer Producer Companies (FPCs) but sale of produce is mainly through traders. Only about one-fourth (23.5%) have direct linkages with processors.
- The average production among intervention farmers is 5,292 kg (average area 0.57 ha) and correspondingly, the average yield stands at 9,216.56 kg/ha. Intervention farmers report an average revenue of Rs.94,711. The average input cost stands at Rs.33,555 and the average earning of maize farmers is approximately Rs.61,156 - Gross Margin

Ratio is 64.6%. There has been 3.3-fold rise in productivity, from 2.88 to 9.21 t/ha, over baseline.

Pulses (N = 387)

- 71% of intervention farmers adopted improved varieties such as *Black gram PU-31, Lentil WBL 77, Green Pea NS 1100, Green Pea KSS 110* and *Field Pea AMAN*. There was high compliance with PoPs across the sample (71-90%), showing efficient uptake of agronomic practices. There has been integration of cultivating with traditional seed varieties with improved techniques as they reported over 90% adoption of modern PoPs, indicating diffusion of best practices across farming systems. Nearly 22% of all pulse farmers are women, who exhibit high compliance with improved practices.
- APART demonstrations have improved yields as reported by 93.8% of farmers, alongside enhanced crop quality and expanded knowledge on modern farming techniques.
- Institutional participation is high, with 64.1% of farmers being FPC members, facilitating collective decision-making, better price realization and access to credit. Though private input networks dominate procurement, cooperatives and FPCs strengthen distribution efficiency.
- Intervention farmers report an average revenue of Rs.43,492 per ha for black gram, Rs.28,610 per ha for Pea and Rs.69,556 per ha for Lentil. The average earning for black gram is Rs.14,123 per ha, Rs. 6,732 per ha for Pea and Rs.52,953 per ha for Lentil, amongst which lentil is the most profitable (76.19% gross margin ratio).

Fruits (N=164) - Banana and Pineapple

- All surveyed farmers (100%) have adopted improved seed varieties with 78% opting for Kew and 22% for Queen. Among them, 79% of Kew and 75% of Queen growers have continued to follow the demonstrated PoPs even after several years, indicating strong technology retention and farmer confidence in the improved practices.
- Fruit farmers reported improved farm performance due to demonstration-based learning and the accessibility of improved inputs, farm mechanization, efficient water and fertilizer management. The introduction of short-duration and disease-resistant varieties reduced crop losses and enhanced yield in periods of erratic rainfall.
- Nearly 44.5% of fruit farmers are now members of Farmer Producer Companies (FPCs), benefiting from collective decision-making (91.8%), access to credit and insurance (41.1%) and higher sale prices (35.6%). They reported that membership in FPCs has helped them negotiate better prices collectively and enhanced profitability. About one-third of female fruit farmers are FPC members and actively involved in production and marketing activities. Enhanced skill-building and cross-learning opportunities have strengthened their confidence and decision-making roles within the household and farmer groups.
- The average production among intervention fruit farmers stands at 4,792 kg for banana and 8,033 kg for pineapple, with corresponding average yields of 21,791.59 kg/ha and 24,565.43 kg/ha, respectively. Intervention farmers report an average revenue of Rs. 6,40,470 per ha for banana and Rs.5,46,288 per ha from pineapple cultivation. Considering input costs of around Rs.1,89,956 per ha for banana and Rs.1,70,283 per ha for pineapple, the average earnings are Rs.4,50,515 per ha and Rs.3,75,944 per ha, respectively. Notably, female pineapple farmers earned an even higher average income, reflecting greater improvement from APART.

Potato (N=906; I= 606, C=303)

- Intervention farmers have efficiently adopted table varieties like Kufri Pukhraj (51.5%), Kufri Surya (38%), Kufri Jyoti (9.6%) and Kufri Khyati (1%), while Chipsona-3 (53%) and Lady Rosetta (41%) dominate in the processing segments. Female farmers have preferred Kufri Surya and Chipsona-3 more. 94.8% Kufri Surya users, 92.4% Kufri Pukhraj users, 89.6% and all Kufri Khyati users have completely adopted the PoPs.
- Among the processed potato variety users, 96.7% Lady Rosetta users, 60% Chipsona-4 users and 52.2% Chipsona-3 users have completely adopted the recommended PoPs. The widespread adoption of Packages of Practices (PoPs) has enhanced efficiency in crop management across both male and female farmers.
- Demonstrations under APART have boosted efficiency as reportedly, 94% of farmers achieved higher yields, 50% improved crop quality, 49.6% learned better farm practices and 47.6% were introduced to new seed varieties. Trainings and farmer field days (FFDs) have contributed to the adoption process.
- 62.2% of Potato farmers are engaged through Farmer Producer Companies, with slightly higher participation among males (64%) than females (57.6%). Only 13.9% of farmers reported marketing their produce through FPCs, though Lady Rosetta and Khyati growers demonstrated greater collective sourcing from FPCs and government agencies. The APART program also led to successful women-led contract farming initiatives like Jaymoti FPC, which can serve as a best practices guideline for other segments.
- The average production among intervention potato farmers is 8,682 kg (Processed variety) and 8,807 kg (Table variety), whereas control farmers produce only 3,933 kg, indicating a 124% higher table variety output under intervention. Correspondingly, the average yield stands at 17,676 kg/ha for processed variety and 17,042 kg/ha for intervention table variety compared to 8,074 kg/ha for control farmers - reflecting an 111% improvement in productivity.
- Intervention farmers report an average revenue of Rs.2,66,606 per ha (Processed) and Rs.2,08,662 (Table), compared to only Rs. 98,175 for control farmers - an increase of nearly 112% in revenue. Although input costs per ha were Rs.95,096 for intervention households (table variety) and Rs. 60,472 per ha for control households, the net earnings per ha stood substantially higher at Rs.1,49,390 (Processed) and Rs.1,13,566 (Table), implying a tripling in earning from control samples (Rs.37,703 per ha).

Other Vegetables (N=736)

- Majority of farmers have adopted improved and hybrid seed varieties promoted under APART for key vegetables like Brinjal (98%), Cabbage (95%), Cauliflower (80%), Pumpkin (75%) and Tomato (92%). Among all the varieties, *Rabada, BC 90/76, Tetris, Madhuri, Arjun* and *Trishul* have been particularly successful. Furthermore, 88-98% of farmers continue to follow the recommended Package of Practices (PoPs), including farmers who cultivate traditional varieties reflecting strong retention of improved cultivation practices.
- About 92.3% of farmers experienced yield enhancement, while 57.2% reported better quality produce, indicating that APART interventions have directly contributed to higher productivity and reduced crop losses.
- Nearly 45% of vegetable farmers are members of Farmer Producer Companies (FPCs). FPC membership has improved their access to collective marketing, quality inputs and credit facilities. Among these, 36% reported better price realization and 28% reported reduced transaction costs due to collective marketing. Women’s participation in FPCs has also increased, with active involvement in grading, sorting and local market coordination, enhancing both household income and decision-making roles.

- The average production among intervention farmers for major vegetables stands at 8,917 kg (average area is 0.48 ha), with an average yield of 18,440 kg/ha. Intervention farmers reported an average revenue of Rs.3,88,884 per ha, contributing substantially to their overall annual household earnings of around Rs.3,29,230 per ha.

Mustard (N=999; I=499, C=500)

- 99% of intervention farmers adopted improved varieties such as DRMR 150-35, NRCHB-101, PM-28 and AAU TS-38, with 35% female participation and 65% rapeseed growers among women. APART demonstrations reached over 1.17 lakh farmers, strengthening gender inclusion and SC/ST representation.
- APART's demonstrations have been particularly effective in **enhancing yield (96%)**, **seed access (59%)** and **improved farm practices (53%)**. Strong adoption of complementary practices like selling by-products (62%), use of sprayers and expeller machines and limited uptake of honeybee cultivation have improved farm-level efficiency and resource utilization.
- About 45% of farmers are FPC members, improving collective marketing though only 13% sell through them. Varieties like PM-28 had better institutional seed linkages (>50% through FPCs).
- Intervention farmers achieved higher productivity (844.4 kg vs. 767.7 kg in control) even after low cultivable area (0.48 vs. 0.69 in control) and net earnings (Rs.27,945 vs. Rs.25,277 in control). Rapeseed recorded greater profitability (Rs.32,602), reflecting 46% higher household income among intervention farmers.

Ginger (N=132)

- Nearly all farmers (99%) have adopted APART recommended ginger varieties for all crop cycles post demonstrations with a 53:46 split between ver-Nadia and Rio-de-Geniero. Adoption of Package of Practices (PoPs) has also been strong with 80% of ver-Nadia and 88.5% of Rio-de-Geniero growers fully adopting the PoP. Female farmers show particularly high adoption and consistency, highlighting their efficiency in applying improved agronomic practices particularly in Karbi Anglong district which has a GI tag for indigenous ginger variety.
- The widespread adoption of improved seed varieties, scientific cultivation practices and institutional support has significantly enhanced productivity, profitability and resilience of ginger farmers across intervention areas.
- About 25.8% of farmers are members of Farmer Producer Companies (FPCs), with most having 3-4 years of membership. Farmers recognize the primary benefit of collective decision-making (94%), with additional advantages including access to credit (14.7%) and price stabilization (11.8%). However, female farmers are entirely absent from FPC membership, highlighting a critical gender gap in access to institutional support.
- The average yield stands at 11,867 kg/ha, underscoring the high productivity achieved under APART interventions. The average revenue stands at Rs. 1,36,710, against an average input cost of Rs. 96,614, resulting in net earnings of Rs. 40,098 per farmer. Women ginger farmers earned more revenue than their male counterparts but due to higher input costs, the earnings were slightly lesser.

C1.2 Milk Value Chain - Formal and Informal Sector (N=1257; I=703, C=554)

- In terms of herd composition, farmers associated with formal milk value chains (VCs) tend to keep more productive, descript breeds, averaging 5.9 cattle per household with 2.4 descript milking cows, reflecting greater investment in improved genetics and management practices. Informal VC farmers, although owning larger herds (7.2 cattle), rely more on non-descript breeds, indicating higher herd size but lower productivity.

Control group farmers maintain smaller, mixed herds (5.2 cattle) with limited specialization.

- Demonstration-based learning has proven highly effective, with 98% of formal and 93% of informal VC farmers finding them useful. Exposure to breeding demonstrations (MAIT, AI) reached 53% in formal and 47% in informal sectors. Fodder cultivation is practiced by 44.5% of formal and 38% of informal farmers, indicating a move toward improved feed self-sufficiency. Participation in animal health camps was higher among Formal VC farmers (62.0%) compared to Informal VC farmers (47.7%).
- Artificial Insemination (AI) adoption is widespread across both Formal and Informal VCs, over 90% of farmers have availed AI services. Formal VC farmers mainly use doorstep AI through MAITs (73%), while Informal VC farmers depend more on local AI centers (45%). Farmers report improved productivity (average 2.1-2.4 calves per year).
- Membership in Milk Producer Institutions (MPI) or Dairy Cooperative Societies (DCS) is higher in Formal VC (52.2%) than Informal VC (40.4%).
- **WAMUL Expansion and Scaling-up:** The increase in processing capacity from 1.5 to 3 lakh liters per day underlines a sustainable growth trajectory.
- 87.8% dairy farmers sell milk to WAMUL, with slightly higher participation among female farmers (90.5%) than males (86.3%). The primary reason for selling to WAMUL is a confirmed and assured market (91%). Nearly 87% farmers received Additional Milk Price (AMP) from WAMUL. Digital facilities are widely used, with 72.3% of farmers benefiting from online billing systems for direct bank transfers of milk payments, with higher usage among male farmers (78.1%) than female farmers (62.3%).
- Intervention households in the milk value chain show stronger market linkages and higher earnings compared to control farmers. Nearly 73% of intervention farmers sell to Dairy Cooperative Societies (DCS), against only 6% in control areas, ensuring better price assurance and reliable market access.
- Average selling price across all channels is marginally higher for intervention farmers, especially for sales to neighbors (Rs. 52.3/kg) and sweet processors (Rs.49.3/kg), compared to control groups and for Control (Rs. 48.1) and WAMUL (Rs.48.4). Volume sold per day is generally higher for control farmers across most informal channels, except for DCS sales, where intervention farmers sell more (10.7 kg/day vs. 6.2 kg/day).
- **The earnings of dairy farmers are as follows:** Rs.17.74 lakhs for WAMUL farmers, 14.81 lakhs for Informal sector farmers and Rs.10.50 lakhs for control dairy farmers.

C1.3 Milk Value Chain - Cross-cutting areas of Formal and Informal Sectors

The results-based framework indicates that some cross-cutting interventions need attention. While training of DCS members far exceeded targets (167%) and Gopal Mitra training was nearly on target (96%), animal health camps (35%) and reproductive health/mastitis management camps (49%) fell short. Immunization coverage was also very low (10%).

C1.4 Fish Value Chain (N=1278; I=878, C=400)

- APART has strengthened integrated aquaculture practices by promoting quality fish seed and feed production, genetically improved strains and better management systems. It has also introduced innovative models like carp-mola polyculture and prawn-based polyculture, while building capacities through Farmer Producer Organizations (FPOs) and market linkages.

- Polyculture has an adoption rate of 98.6%, followed closely by Paddy-cum-Fish (97.3%) and Polyculture with Freshwater Prawn Farming (99.3%). The Paddy-cum-Fish farmers are continuing cultivating high-yield paddy variety (90%), high yield fish seed variety (82%) and cultivating small fish varieties like mola (44%). Use of recommended fish species remains consistently high across systems (97-98%), reflecting strong adherence to scientifically validated culture compositions. However, compliance with recommended seed quantities shows variation - Polyculture (84.5%) lags Paddy-cum-Fish (88.2%) and Prawn-integrated systems (94.4%), suggesting room for improvement in stocking density management.
- **Sourcing fish seeds:** Polyculture farmers rely predominantly on private hatcheries (63.5%) and government hatcheries (40.5%) and their own stock (45.2%); Paddy-cum-Fish farmers procure from private hatcheries (47.9%) and government hatcheries (44.3%); Polyculture with Prawn Farming demonstrates the most organized structure, with strong institutional linkages - FPCs (53.2%), private hatcheries (53.9%) and government hatcheries (47.5%).
- **Procuring Fish feed:** Polyculture Farmers depend on both institutional and local markets, with moderate reliance on private and government hatcheries. Paddy-cum-Fish farmers procure inputs from government and FPC channels, providing quality assurance and extension support. Strong institutional sourcing through FPCs and hatchery networks underscores commercialization and organized input procurement for polyculture prawn farmers.
- Intervention in polyculture farming has led to major improvements in yield (+40.6%), income and profitability (gross margin +72% per ha) as compared to control, confirming the effectiveness and sustainability of project-supported practices under APART.
- All systems emerged as highly efficient, profitable and resource-productive, offering strong financial returns per hectare. Polyculture with Prawns provides the advantage of species diversification and high market value, while Paddy-cum-Fish is more valuable for integrated farming, ecological benefits and suitability for farmers with limited input capacity. Due to the ability to produce two crops, paddy and fish, from a single cultivable area, this technique is both profitable and sustainable.
- **Beel Fisheries-** 100% are members of Beel Development and Management Committees (BDMCs). 83.5% of respondents reported income generation for community members, 55.3% acknowledged employment opportunities and 43.5% noted better household access to fish for consumption. With an average production of 14,127.67 kg and total revenue of Rs.37.42 lakhs, the average unit cost is Rs. 271.47/kg, generating net earnings of Rs. 33.06 lakhs, indicating high profitability and cost efficiency.

C1.5 Sericulture and Handloom Value Chain

Eri Silk

- 87.5% of respondents are women; 51% belong to ST communities. About 75% depend on Eri silk as primary livelihood, engaged for 12 years on average, typically cultivating 0.18 ha of host plants.
- 93% possess rearing appliances; 48% own rearing houses; 46% own or share spinning machines provided through APART or FPCs. Use of rearing houses and mechanized spinning reduced drudgery and improved yarn quality.
- Formation of FIGs and FPCs for the first time in Assam linked spinners and planters. Training and exposure visits (28%) enhanced women’s technical and financial autonomy, strengthening local sericulture networks.

- Eri seed cocoon output rose from 1,170 kg to 1,503 kg, commercial cocoons from 596 kg to 795 kg and yarn from 10.8 kg to 16.4 kg, reflecting strong productivity gains. Average household income stands at Rs. 1.43 lakh, of which Rs. 38,438 comes from Eri silk.

Muga Silk

- The average seed reared per year increased from 3,543 grams to 4,760 grams, while the number of seed cocoons produced per year rose from 4,057 to 7,343 after APART. Similarly, annual dfls (disease-free lay) production increased from 3,720 to 5,880, reflecting significant gains in productivity and rearing efficiency under improved practices and technical support. In the sample, 37 are reelers, all of whom are female. Using BHIR, they produce on an average 2,739.2 grams of yarn per year.
- 56% received rearing houses from APART. Out of all, 35% went for exposure visits. Out of those reelers who had gone for exposure visits, 48% mentioned gaining knowledge on Technology for Muga activities, 34% on Muga Production, 28% on Marketing of the produced Muga and 20% on Management of the trade /business and others (28%).
- 46% are members of FIGs, 89% said that their FIGs are part of an FPC. 66% are members of FPCs and 53% are marketing through FPCs. Promotion of FIGs and FPCs improved institutionalization in previously informal sector and allowed for dissemination of eco-friendly ways of production.
- Muga silk rearing accounts for almost 50% of the total income of households, bringing an average of Rs.1.5 lakh. This was cited as the primary livelihood for 68% of the respondents.

Handloom (N=133)

- Average fabric output increased from 8 to 9 meters per year on traditional looms, valued at Rs.250/m, yielding Rs.2,250 annually. 100% of weavers produce mekhela-chador, 95% weave gamusas and smaller shares make sarees and stoles, sustaining Assam’s traditional textile heritage while modestly improving productivity post-APART. In design practices, 97% follow traditional motifs, though 82% now use CATD software, showing digital adoption.
- Training participation is strong with 62% trained in weaving, 60% in awareness programs, 13% in market linkages, 12% in new accessories and 10% in design, with limited exposure visits (1%).
- 87% of weavers sell through private traders, 16% through FPCs, 5% via Reshom Haat and 3% at fairs/exhibitions, averaging 1.8 exhibitions annually. Only 33% are FPC members (mostly over 4 years), yet membership offers tangible benefits as 85% reported better collective decision-making, 45% improved price stability, 28% access to credit/insurance and 19% market access.
- About 50% of respondents reported income increases after APART, with 68% experiencing rises below 25% and 12% exceeding 50%. The average household income is Rs.1,12,289, with weaving contributing Rs.35,782 annually. Nearly 95% of weavers spend their income on household needs, 81% reinvest in weaving, 75% spend on children’s health and education and 40% save.

C2: Product aggregation and Sale through Producer Associations and setting up market intelligence

C2.1 Product aggregation and sale through Producer Associations

There are **125 FPCs** (Agri & Horti: 88, Fish: 26, Silk: 11) registered under APART with 60,573 shareholders (33% women). These are being formed and supported by different agencies.

- **37 CSCs functional** (Agri-horti: 10, Fishery: 22, Silk: 5)
- Equipped with need-based infrastructure and machinery/ equipment
- Facilitated for aggregation, post-harvest handling, value addition etc.
- Fully women operated 4 FPCs/CSCs *(2 on Silk Sector and 2 on Agri/Horti.)*

Farmer Producer Company (FPC) (N=100)

- FPCs had an average of 502 farmer-members.
- 33% of the FPCs reported conducting their Annual General Meeting (AGM) for FY 2025-26, while the remaining FPCs stated that their AGM is scheduled to be held later, during the September-October period.
- The surveyed FPCs demonstrated strong compliance with core statutory requirements. All FPCs possessed a PAN card and 99% had GST registration. Furthermore, 100% of FPCs were more than one year old and had completed audited reports, indicating adherence to financial disclosure norms. Record maintenance practices were also robust, with nearly universal documentation of passbooks (100%), board meeting minutes (97%), FIG meeting minutes (97%) and cash books (97%).
- Among the FPCs engaged in food-related activities (88% of the sample), almost all (98%) had secured FSSAI certification, ensuring compliance with food safety standards. Additionally, 90 percent of FPCs had obtained MSME license numbers, reflecting their growing integration into formal enterprise systems.
- 95% of FPCs reported establishing Social Audit Committees. Among these, 96% had conducted an audit.
- A majority of the FPCs were crop based, with rice accounting for 35%. This was followed by fishery-based enterprises (26%). Other significant commodities included mustard (13%) and maize (7%).
- Overall, the annual turnover grew by 17.8% within two years and profit also increased by 15.3% last year, showcasing a clear upward trend.
- 63% of the FPCs have successfully accessed newer markets, including digital and online marketing platforms, thereby expanding their avenues for sales and improving market outreach. In parallel, 48% of the FPCs reported improved access to loans and credit facilities.
- On average, 35 members per FPC participated in Krisarthak/FEC training programs.
- 75% of FPCs organized KCC awareness camps and among these, an average of 100 members attended per camp.
- Across the surveyed FPCs, an average of 55 members per company held Kisan Credit Cards.
- 48% of the FPCs reported participating in workshops, fairs or exhibitions. Notably, 11 silk-based FPCs showcased their products in events such as Saras Mela, Rongali Mela and regional exhibitions, where silk items were sold.
- The benefits reported by farmers from joining FPCs are diverse, but better price realization emerged as the most prominent advantage, cited by nearly 69% of respondents. Other key benefits included access to organized markets throughout the year (19%) and to a lesser extent, the elimination of trader and middlemen dependence (11%).
- 100% reported the establishment of a Grievance Committee and 85% of FPCs reported the presence of an Internal Complaints Committee (ICC) in compliance with POSH guidelines.

Common Service Centers (CSC) (N=20)

- On average, each CSC/FPC had around 445 member farmers.

- The assessment found that the FPCs undertake a range of activities through their respective CSCs. Among these, market linkage emerged as the most common activity, reported by 16 FPCs, followed by aggregation (16) and value addition through primary processing (10). Activities such as input-output marketing were undertaken by 8 FPCs, while a smaller number were involved in facilitating credit linkage (5), training (4) and insurance services (3).
- The analysis of focus commodities reveals that the activities of the FPCs and their respective CSCs are primarily centered around fish, which serves as the key commodity for 12 FPCs. This is followed by rice, identified as the focus commodity for 4 FPCs.
- Overall, the services provided by CSCs demonstrate a strong focus on enhancing market linkages, facilitating access to quality inputs and supporting value addition through processing, all aimed at improving farmer incomes and long-term sustainability. Collectively, these outcomes suggest that CSC interventions have not only strengthened farmer capacity and promoted the adoption of modern technologies but also enhanced market access and generated tangible economic benefits for the farming community.
- The 7 Agri-horti CSCs collectively reported an annual sale of 350 MT of focus commodities such as rice, mustard and banana, generating a revenue of approximately Rs.86.9 lakhs. In addition, the CSCs sold 245 MT of processed/ semi-processed products, by-products, other commodities, etc. generating an additional revenue of Rs.97.5 lakhs. Together, these accounted for a cumulative sale of 595 metric tons and a total revenue of about Rs.1.84 Cr during FY 2024-25.
- The 12 Fish CSCs collectively reported sales of 555 tons of fish during the year 2024-25, generating a total revenue of approximately Rs 5.28 Cr. In addition to fish, these CSCs also engage in trading other commodities such as paddy, maize, mustard, potato, cabbage, cauliflower, black gram, turmeric with a combined sales volume of about 238 tons and revenue of Rs.80.9 lakhs.
- The surveyed Silk CSC sold various products and Eri raw silk, generating an income of Rs 16 lakhs.

Custom Hiring Center (CHC)

APART has facilitated 46 CHCs. APART had provided a range of 8-10 machines to the CHCs namely, Rotavator, Electric Power Tiller/Weeder (MP), Drum Seeder, Transplanter, Electric Battery-Operated weeder, Reaper, Multi-Crop combine harvester with straw management system, Pulverize and Rice Mill.

Access to Custom Hiring Centers (CHCs) remains limited for most farmers despite their potential to enhance mechanization and reduce production costs. The primary difficulty lies in distance and location- many CHCs are not situated close to farming communities, making it hard for farmers to reach them, particularly during peak seasons. Vegetable farmers (24%) and paddy farmers (21%) said that there is a CHC available nearby. Even where CHCs exist, machine availability is often inadequate or mismatched with crop-specific needs.

Additionally, high local rental charges, transportation costs and limited awareness or coordination mechanisms further restrict usage. As a result, small and marginal farmers, who could benefit most from shared machinery access, continue to face barriers in adopting mechanized practices efficiently and cost-effectively.

C2.2 Setting-up Market Intelligence Cell

Agricultural Market Intelligence Unit (AMIU) was established at Assam Agricultural University, Jorhat in January 2021. AMIU collects market information from 91 markets of Assam for 89 commodities with the help of Field Data Enumerators (FDEs) deputed in 17 APART districts of Assam. The valuable market data set derived daily price information for the farmers and traders has helped them in taking informed decision on sale and procurement of various agricultural commodities. Satisfied with data quality, the AGMARKET even synchronized the AMIU market data into their portal and are available daily.

Market information is being disseminated through multiple channels, including the official website, mobile app for farmers and SMS alerts. It is also shared via integration with the AGMARKNET Portal of the Government of India, as well as through WhatsApp groups, social media platforms, market blackboards, ticker boards and Doordarshan broadcasts to ensure wide and timely outreach.

The end-line study also has attempted to collect information on MSP from the farmers across different commodities and is presented in report.

C3: Facilitating access to and responsible use of financial services

C3.1 Information and Counselling on Financial Services

Krisarthak rolled out in Jan 23; beneficiaries covered: 2,00,479 out of which 47% are female. In total, six cycles of implementation phases were executed from the month of May 2023 to October 2024. Value chains covered include - Agri/Horti, Fishery, Handloom, Sericulture and Dairy.

Across six cycles, a total of 1,18,219 farmers registered through the Bittiya Sakhi Chatbot and Kobo App, while 80,039 registered on the chatbot alone. Completion of chatbot learning modules was strong, with 91.85% (73,516 farmers) finishing all modules. Engagement with collectives was significant, with 248 FPCs and 5,432 dairy farmers from 64 Dairy Cooperative Societies registered. Notably, counselling under the Farmers Financial Health Survey (FFHS) expanded rapidly, reaching 9581 farmers by Oct 2024.

C3.2 Assam Challenge Fund

Number of farmers benefitting from financial products: The aggregate achievement stands at only 27% of the overall target (62,143 against 2,27,569), indicating significant shortfall.

ETA Study (N=46)

Thematic support- An overwhelming majority of respondents (98%) reported receiving support related to insurance services. A smaller share of respondents (4% each) benefited from credit support for production and investment purposes and from savings and digitization of banking services. Only 2% of respondents indicated receiving support in terms of access to pension schemes.

Vimo Sewa, Dehaat and ECSO- A total of 20 respondents was interviewed, all of whom had received insurance-related services. Among them, 75% availed Crop Insurance (General), while 50% were covered under Wage-Loss Insurance (Hospi-Cash Insurance). Additionally, 25% reported receiving QR-based Parametric Crop Insurance (Seed germination of mustard) and a smaller share (5%) received QR-based Parametric Fish Insurance.

Samunnati, RangDe, ESAF and Integra- A total of 26 respondents was interviewed, all of whom had availed working capital loans. 96% mentioned satisfactory documentation support from the sub-project while accessing the loan.

Advantages Gained After Participating in Xamahar- Respondents reported several benefits from their participation in the Xamahar initiative. Half of the respondents (50%) mentioned that they received credit support which helped them improve their businesses, while 48% each highlighted that they got exposed to better markets and that risks were averted through insurance coverage. Additionally, 33% of respondents noted that they were able to expand their businesses and 15% reported earning better profits. A smaller proportion indicated having more marketable surplus (9%) and established linkages with financial institutions (2%).

Component D: Project Management, Monitoring, Learning

Grievance Redressal Mechanism (GRM): Awareness of APART's GRM is generally moderate among all sectors. Despite low grievance-lodging rates across most segments, all respondents who filed complaints reported that their issues were addressed, indicating an effective system.

Conclusion

The Assam Agribusiness and Rural Transformation Project (APART) achieved a substantial transformation across Assam's agricultural and allied sectors over its eight-year duration (October 2018 - September 2025). The project successfully delivered on its Project Development Objective (PDO): **to add value and improve resilience of selected agriculture value chains, focusing on smallholder farmers & agro entrepreneurs and to advance Assam's COVID-19 response**.

Key Strategic Achievements and Impacts

1. **Enabling Smallholder Resilience and Productivity**: The project's central success lies in translating interventions into tangible economic gains and building climate resilience at the farm level.
    - **Farmer Outreach and Technology Adoption:** APART has reached out to **6,32,086 farmers** at least with one service or asset across the lifespan of the project. But it had covered more than 8 lakh farmers (of which 30.5% were females) through various interventions like climate-resilient technology demonstrations, training and exposure visits, organizing farmers and enterprises into FPCs, IAs, DCSs, BDMCs, providing agri tools, saplings (sericulture), rearing houses, looms (handloom) among others. The project demonstrated 27 climate-resilient technologies (108% achieved).
    - **Paddy and Staple Crop Gains:** The introduction of Stress-Tolerant Rice Varieties (STRVs) gained strong acceptance, stabilizing production in flood-prone areas. Intervention farmers achieved a statistically significant **21% improvement in yield** and 70% higher net earnings compared to control groups.
    - **Horticulture and Value Addition:** APART introduced **processed potato varieties** to Assam, leading to contract farming agreements with private industry partners like PepsiCo, which is establishing a large processing plant in Nalbari. Processed potato varieties yielded the gross margin ratio (56%).
    - **Fisheries Transformation:** The project introduced scientific practices like mola-carp integrated farming and polyculture with freshwater prawns. Polyculture interventions resulted in a **43% yield improvement** and a **72% increase in net earnings**. APART also successfully organized Beel fish farmers into **Beel Development Management Committees (BDMC)** for the first time.
    - **Sericulture and Handloom:** The project successfully organized the traditionally "unorganized, home-based silk farmers" into Farmer Interest Groups (FIGs) and Farmer Producer Companies (FPCs).
2. **Strengthening Institutional and Enterprise Ecosystems:** APART created robust institutional mechanisms to foster collective action and private sector investment.
    - **Farmer Producer Companies (FPCs):** APART facilitated the formation of **125 FPCs**, achieving its target for FPO formation and membership. Among the 100 FPCs surveyed, a steady growth of 17.8% in average annual turnover has been noticed, reaching Rs.17.2 lakhs in financial year 2024-25.
    - **Common Facility Center (CFCs):** Eight CFCs are operational. CFCs act as a catalyst for cluster growth, increasing productivity, reducing costs, enhancing quality, improving market access and strengthening institutions. They provide an integrated

ecosystem where small producers can thrive and move from subsistence-level production to a commercially viable, competitive value-chain position.

- **Enterprise Promotion:** The Enterprise Development and Promotion Facility (EDPF) exceeded its targets, supporting **1,803 enterprises**. Interventions through schemes like Kshyamata and the Assam Agribusiness Growth Lab (AAGL) led to diversification and an increase in employment for participating enterprises.
- **Investment Mobilization:** The project played a vital role in attracting private capital, facilitating investment leads that resulted in **Rs 4,399 Cr from 65 investors**, with Rs. 2,541 Crores directed toward agri-based sectors.
- **Dairy Sector Formalization:** WAMUL (West Assam Milk Producers Cooperative Union Limited) emerged as a major player, expanding its milk processing capacity from 60 TLPD to **150 TLPD** and reaching 1,600 village-based Dairy Cooperative Societies (DCS). This cooperative model resulted in WAMUL-associated households achieving the **highest revenue and net returns**. The long-term vision aims to process 10 lakh liters of milk per day through the newly formed NEDFL.

3. **Enhancing Market Access and Connectivity (Component B & C):** The modernization of physical and digital infrastructure significantly enhanced market efficiency.

- **Rural Infrastructure:** The rehabilitation of **213.5 km of rural access roads** improved all-weather connectivity, reduced travel time and lowered transportation costs for farmers. **96 wholesale agricultural markets** were modernized, providing essential facilities like drainage systems and internal roadways.
- **Market Intelligence:** The establishment of the **Agricultural Market Intelligence Unit (AMIU)** at AAU successfully collected real-time price data from 91 markets for 89 commodities, which was then synchronized with the AGMARKNET portal to aid informed decision-making by farmers and traders.
- **Financial Inclusion:** The financial education initiative, **Krisarthak** (Financial Education and Counselling - FEC), provided training to over 2,00,479 beneficiaries. The **Xamahar** Challenge Fund deployed financial products, primarily insurance, benefiting 62,143 farmers.

4. **Gender and Social Equity**

- Gender inclusion was a notable achievement, particularly in women's participation, economic efficiency and leadership in grassroots institutions.
- **Female Participation:** The project reached 2,44,573 female beneficiaries (116.5% of the target). Women dominated the Sericulture and Handloom value chains, representing 100% of handloom respondents.
- **Economic Empowerment:** Female farmers demonstrated higher productivity in certain crops (e.g., ginger, processed potato) and often exhibited stronger savings capacity and financial prudence in intervention households compared to control groups.
- **Leadership:** Successful, women-only FPCs like Jaymoti FPC emerged as models of strong governance and high profitability.

5. **Management and Governance:** The overall fund utilization reached a high of **98.4%**. The centralized, web-based digital platform, the **Project Management Information System (PMIS)**, played a pivotal role in providing real-time, comprehensive monitoring and enhancing accountability. Furthermore, the project met its target for addressing registered grievances related to project benefits (100% achieved).

In conclusion, APART successfully initiated a transformation across Assam's agricultural and allied sectors by enhancing farmer productivity through climate-resilient technologies, fostering institutional strength through FPCs and IAs and building crucial market infrastructure and financial inclusion mechanisms. These achievements provide a robust foundation for inclusive, market-oriented and sustainable agribusiness growth in the state.

1. Chapter 1: Introduction

1.1 Background

1.1.1 APART- Overview

World Bank assisted Assam Agribusiness and Rural Transformation Project (APART) being implemented by the Assam Rural Infrastructure and Agricultural Services Society (ARIASS), lays special focus on value addition in the production and post-harvest segments of selected agricultural commodity value-chains; facilitate agribusiness investments through inclusive business models, that provide opportunities to small farmers as well as stimulate the establishment of new small and medium agribusiness enterprises; and support resilience of agriculture production systems to better manage the increasing production and risks associated with climate change in the targeted districts.

Project Development Objective (PDO): To add value and improve resilience of selected agriculture value chains, focusing on smallholder farmers & agro entrepreneurs and to advance Assam's COVID-19 response.

The **Key Project Indicators (KPI)** for the PDO level results are: (a) Farmers reached with agricultural assets or services (number), of which female (percentage). (CRI); **Value add measured by**: (b) Increase in quality as measured by price premium of commodities sold by beneficiaries in the selected value chains; (c) Share of selected commodities sold through new marketing channels; **Resilience measured by**: (d) Farmers adopting improved agricultural technology (gender disaggregated). (CRI).

1.1.2 Project Details

- APART is operational in **24 districts of Assam**- (1) Nagaon, (2) Sonitpur, (3) Barpeta, (4) Karbi Anglong, (5) Kamrup, (6) Kamrup-M, (7) Dhubri, (8) Golaghat, (9) Kokrajhar, (10) Lakhimpur, (11) Darrang, (12) Cachar, (13) Sivasagar, (14) Jorhat, (15) Goalpara, (16) Morigaon, (17) Nalbari, (18) Hailakandi, (19) South Salmara Mankachar, (20) Majuli, (21) West Karbi Anglong, (22) Hojai, (23) Charaideo and (24) Biswanath.
- Covering the **6 Agro-climatic zones** (ACZ) - North Bank Plain Zone (NBPZ), Upper Brahmaputra Valley Zone (UBVZ), Central Brahmaputra Valley Zone (CBVZ), Lower Brahmaputra Valley Zone (LBVZ), Barak Valley Zone (BVZ) and Hills Zone (HZ).
- Project has **4 broad components** (i) Enable Agri-Enterprise Development, (ii) Facilitate Agro-Cluster Development, (iii) Market-led Production and Resilience Enhancement and (iv) Project Management, Monitoring and Learning with 12 sub-components.
- Project is working with **6 value-chains** (VCs)- (i) Cereals, (ii) Pulses, (iii) Fruits & Vegetables, (iv) Spices and Condiments, (v) Livestock (Fish and Dairy) and (vi) Specialty VC (Sericulture and Handloom). The other segments of APART includes infrastructure (access roads, markets, warehouse), enterprise, industry associations and producer associations.

1.2 Baseline Study of APART

The Baseline study of APART was conducted in 2018-19 by erstwhile M&E agency. The study covered a sample of 7,750, drawing 5,477 samples from APART Intervention Blocks and 2,273 as Controls from non-project blocks across 16 districts.

1.2.1 Challenges in Using the Baseline Data

Several issues were identified during the review and use of the baseline data:

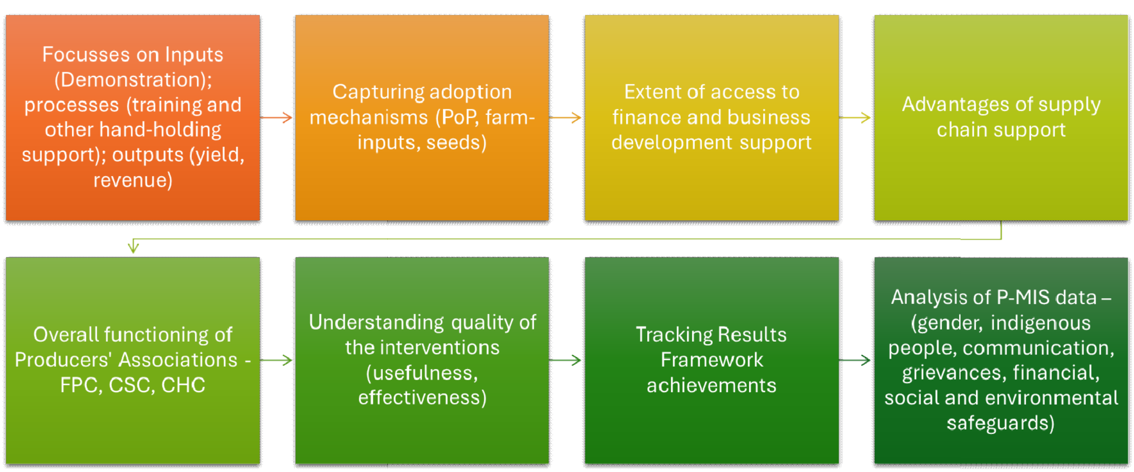
1. **Mismatch between the baseline report and raw data-** The reported total sample size in the baseline report (7,750) does not correspond with the raw dataset (11,482).
2. **Incomplete reporting of commodity-wise distribution-** The baseline report does not provide information on the total sample (N) for each commodity, limiting detailed analysis.
3. **Presence of duplicate entries-** The raw dataset contained duplicate records which required extensive data cleaning.
4. **Reduced sample size after data cleaning-** Following the removal of duplicates and inconsistencies, the usable sample size of the raw dataset was reduced to 8,520.
5. **Mismatch in Findings-** In addition to discrepancies in sample size, inconsistencies were also noted between the baseline report and the raw dataset with respect to productivity data. For instance:
    - *Paddy (Baseline Report)*: Intervention - 2.2 tons/ha; Control - 2.3 tons/ha
    - *Paddy (Cleaned Raw Data):* Intervention - 4.96 tons/ha; Control - 3.45 tons/ha
6. **Varied sample size-** The sample differs considerably by commodity, as reflected in the cleaned dataset:
    - Paddy - 6,163 households (Intervention: 4,277; Control: 1,936)
    - Mustard - 257 households (Intervention: 112; Control: 145)
    - Potato - 129 households (Intervention: 63; Control: 66)

1.3 Progress Monitoring Reports

The M&E agency has completed four rounds of Progress Monitoring Surveys (PMSs). It has covered the 24 districts of APART, twice through the four rounds of Progress Monitoring Surveys, covering all aspects of the project. Additionally, Gross Margin Analyses (GMA) of four focused commodities (Paddy, Poly-culture Fish, Potato and Mustard) were also conducted.

- Total sample covered in 4 PMS - 9469 (Intervention - 8253; Control - 1216)
- Value-chains and other segments covered - 28

Figure 1: *Focus of Progress Monitoring Studies*



1.3.1 Progress Monitoring Survey (PMS) Rounds- Details

Table 1: *Summary of Progress Monitoring Survey (PMS) Rounds*

PMS Round	Dates	Districts	Sample Size			Highlights
			I- VC	I- Others	C	
1	18th May 2022 to 13th June 2022	Sonitpur, Lakhimpur, Jorhat, Sivasagar, Morigaon, Nagaon, Barpeta, Kamrup, Cachar, Hailakandi, Karbi Anglong and West Karbi Anglong **(12)**	1804	197	316	Extent of demonstration and usefulness
2	18th November 2022 to 19th December 2022	Darrang, Biswanath, Golaghat, Majuli, Charaideo, Hojai, Dhubri, Nalbari, Goalpara, Kamrup Metro and Kokrajhar **(11)**	1872	201	300	Focus on adoption and challenges of adoption: FPCs, DCS, SPV, AAGL, Kshyamata
3	01st July 2023 to 2nd August 2023	Sonitpur, Lakhimpur, Jorhat, Sivasagar, Morigaon, Nagaon, Barpeta, Kamrup, Cachar, Hailakandi, Karbi Anglong and West Karbi Anglong **(12)**	1849	263	300	GMA - Paddy (with support from WB); GMA - Poly-culture Fish; Sub-components of Sericulture (Eri & Muga); Potato, Nursery Entrepreneurs, Xamahar, Krisarthak
4	05th November 2024 to 04th December 2024	Darrang, Biswanath, Sonitpur, Golaghat, Majuli, Charaideo, Hojai, Morigaon, Nalbari, Goalpara, Kamrup (M) and Kokrajhar **(12)**	1662	405	300	GMA - Mustard and Potato

1.3.2 Learnings from PMS Rounds

The PMS rounds yielded several insights into the progress, adoption levels and challenges across various sectors supported under the project:

1. **Impact on farmer incomes** - Through APART, targeted practices and improved seed varieties for commodities such as paddy, mustard, processed potatoes and fish have contributed significantly to boosting farmer's incomes.
2. **Farmer adoption trends** - Interventions in agri-horti have led to improved yields. A considerable proportion of farmers have started adopting improved practices and varieties. However, full adoption remains constrained due to the limited local availability and high cost of quality seeds and other farm inputs.
3. **Fisheries sector progress** - Fisheries have demonstrated a persistent increase in both variety and production with high adoption rates among farmers.
4. **Institutional strengthening of WAMUL** - WAMUL has expanded significantly, increasing its processing capacity and bringing many dairy farmers under its fold.
5. **Status of Producer Associations** - Producer Associations remain in their early stages of development and require continuous handholding support to function independently.

6. **Support needs for IAs and agro-enterprises** - Industry Associations (IAs) and agro-enterprises require assistance with market linkages, business development and access to finance to sustain and scale operations.
7. **Challenges in establishing linkages between CFCs and CSCs** - The final linkage between Common Facility Centers (CFCs) and Common Service Centers (CSCs) has not yet been effectively established, primarily due to the prolonged time required for their formation.

1.4 End-Term Assessment of APART

The End Term Assessment (ETA) of the Assam Agribusiness and Rural Transformation Project (APART) aims to comprehensively assess the project's performance in terms of its overall objectives and intended outcomes. It seeks to determine how far the interventions have contributed to enhancing agricultural productivity, strengthening value chains, improving market linkages and increasing rural incomes, while ensuring participation of women and farmers. The assessment also focuses on analyzing institutional capacities, ownership of the associations formed and the potential for scaling and sustaining interventions beyond the project period.

1.4.1 Monitoring Components

i. Project development objectives (component wise) results have been measured through quantitative and qualitative information.
ii. Endline results of focused commodities have been compared with available baseline values.
iii. The end term assessment and analyses have been done using comparable data from non-project areas.

1.4.2 Sample Coverage

A total of **7,822 samples** is being covered under the study:

- **Intervention Group**: 18 districts spanning all 6 agro-climatic zones, comprising 150 blocks and 555 villages. From each village, approximately 10 households are surveyed. This includes **5,255 samples from value chains** and **310 from other segments**.
- **Control Group**: 9 districts spanning all 6 agro-climatic zones, comprising 9 blocks and 121 villages. From each village, approximately 19 households are surveyed, covering a total of **2,257 households from value chains**.
- **Qualitative Component**: Key Informant Interviews (KIIs) with OPIU and PCU Coordinators, along with Focus Group Discussions (FGDs) with Farmer Producer Companies (FPCs), Common Service Centers (CSCs), Common Facility Centers (CFCs) and stakeholders related to roads, markets and warehouses.

2. Chapter 2: End-Term Assessment (ETA) Methodology

Defining the ETA methodology requires careful reflection on the available datasets to assess their relevance and suitability for robust comparison. The following considerations outline the critical factors in selecting an appropriate study design.

a) **Baseline Data:** The baseline study was conducted in 2018-19 when APART interventions were hardly there. However, the report mentions few important indicators like production, productivity and market price of certain value chain commodities (for APART and Non-APART blocks) which can now be compared with the ETA results. This will help us to adopt the Difference-In-Means method[1] for few focused commodities. Since limited variables were used in the Baseline study, statistical significance of the difference in the intervention can only be assessed through the intervention and control data of the endline results. Moreover, segments like producer's associations, industry associations, agro-enterprise and others were not included in the baseline study.

b) **Progress Monitoring Surveys (PMS):** The PMS Round 1 was conducted in May 2022, more than four years after the commencement of the project with 2,317 sample (1,804 from value chains, 197 from other segments and 316 from control area).

The objective of the PMS was to capture the inputs, processes and outputs, thereby, ascertaining the progress of the project. Establishing a baseline with PMS Round 1 data poses the following challenges - (a) given the long duration of the intervention that had elapsed by then, (b) sample size is not robust enough for comparison with endline data.

2.1 Proposed Study Design

The End Term Assessment (ETA) has been conducted using independent samples rather than panel data. Moreover, control data was gathered for five focused commodities - Paddy, Mustard, Potato, Fish and Milk - as discussed and agreed with the ARIAS Society.

Given the complexity and diversity of APART's interventions, a nuanced methodology is required to capture the important dimensions of impact/ change. The achievements of a project as large and multi-faceted as APART cannot be captured using a single design approach. Hence, a multi study-design framework, aligned with the nature and availability of data, has been adopted for the End-Term assessment study:

a) **Comparison in productivity and revenue for the five focused commodities** (Paddy, Mustard, Potato (table variety), Fisheries (Polyculture) and Milk (Informal) was compared between baseline and endline (Intervention and Control) using the **Difference-in-Means approach**. Also, t-test (assuming unequal variances) has been conducted to statistically compare baseline and endline outputs.

b) **Greater comparison between intervention and control** was established using **Multivariate regression-based analysis** has also been adopted for the 5 focused commodities Paddy, Mustard, Potato (table variety), Fisheries (Polyculture) and Milk (Informal) to compare outcomes between intervention and control areas at the endline by controlling for observable household and contextual characteristics that may influence outcome.

c) **Operational efficiency** of crop cultivation has been calculated using **Gross Margin Analysis** and **Gross Margin Ratio** for all crops, milk and fisheries.

[1] Difference-In-Means method is a statistical technique that measures the absolute difference between the average values of two distinct groups to determine if the difference is statistically significant.

d) **Comparison with Baseline and End-Term Assessment (ETA) findings -** Control information was not collected for commodities like maize, black gram, lentil, pea, ginger, banana, pineapple, cabbage, cauliflower, tomato, pumpkin, brinjal, milk (formal), paddy-cum-fish, polyculture with freshwater prawns, beel fishery, sericulture and handloom. **Mann-Whitney U-test** and **non-parametric test[2],** have been conducted to ascertain statistical changes between baseline and end-term assessment.

e) For **new segments** including Formal Milk, Fish (Paddy-cum-fish and polyculture with prawn), potato (processed variety), enterprises, industry associations, farmer producer company (FPCs) and infrastructure, only ETA results with qualitative inputs were used as there is no baseline or control information.

The study also includes the analyses of Project Development Objective (PDO) indicators:

1. **Increase in price premium of commodities sold by beneficiaries (%)** estimated by comparing volume-weighted average prices at baseline and endline to assess percentage changes over time.
2. **Share of selected commodities sold through new marketing channels (%)** was calculated based on the proportion of total produce marketed through project-supported channels. For paddy and maize, new marketing channels included project-supported procurement centers, Farmer Producer Companies (FPCs) and direct sales to processors and millers. In the case of potato, contract farming arrangements facilitated under the project enabled farmers to sell directly to processors and FPCs, alongside improved access to traders. For milk, the quantity of milk sold to Dairy Cooperative Societies (DCSs) established under the project was considered, while for fisheries, the quantity of fish sold to markets was included.
3. **Farmers adopting improved agricultural technology (%)** was calculated as the percentage of surveyed farmers who reported adopting either improved seed varieties or recommended packages of practices promoted by the project and any of the climate resilient technologies.

2.1.1 Sampling Design

2.1.1.1 Determination of Sample Size for Difference-in-Means Study

The following formula is used for the sample size determination:

$$\boldsymbol{n = \left(Z_{\alpha/2} + Z_{\beta}\beta\right)^2 * \frac{(p_1(1-p_1) + p_2(1-p_2))}{(p_1 - p_2)^2}}$$

where $Z_{\alpha/2}$ is the critical value of the Normal distribution at α/2 (e.g., for a confidence level of 95%, α is 0.05 and the critical value is 1.96), Z_β is the critical value of the Normal distribution at β (e.g., for a power of 80%, β is 0.2 and the critical value is 0.84) and p1=0.5 and p2=0.6 are the expected sample proportions of the two groups, the baseline and the end-line. We have considered a design effect of 1.3 and arrived at 500. A sample of 500 or more is considered for the commodities.

2.1.1.2 Determination of Sample Size for the Cross-sectional Study

For the non-focused commodities for which control data have not available (as discussed above), the sample size was determined using the following formula:

$$\boldsymbol{n = p(1-p) * (Z/E)^2}$$

[2] Non-parametric test is a type of statistical test that does not assume any specific distribution for the population data, making it a "distribution-free" method. These tests are useful for analysing data that comes from small sample sizes.

Where Z is the value from the standard normal distribution reflecting the desired confidence level (e.g., Z=1.96 for a 95% confidence level), and E=0.10 is the desired margin of error. p is the proportion of successes in the population. The value of p that maximizes p(1-p) is p=0.5. Consequently, if no information is available to approximate p, then p=0.5 generates the most conservative or the largest sample size.

N=97.

With a design effect of 1.3, the sample size is 125. Hence, we consider a sample of 125 for the other value chain crops.

Table 2: *Endline Study - Sample Covered (Intervention and Control)*

	Intervention	Control
Paddy	627	500
Maize	132	-
Black Gram	133	-
Lentils	127	-
Pea	127	-
Banana	146	-
Pineapple	18	-
Brinjal	131	-
Cabbage	155	-
Cauliflower	187	-
Pumpkin	132	-
Tomato	131	-
Ginger	132	-
Mustard	499	500
Potato		
Potato (Processed)	300	-
Potato (Table variety)	303	303
Milk		
Milk (Formal) DCS	353	-
Milk (Informal) DCS	350	554
Fisheries		
Fisheries (Polyculture)	500	400
Fisheries (Paddy cum Fish)	148	-
Beel Fishing	85	-
Polyculture with freshwater prawns	145	-
Sericulture		
Silk (Muga)	133	-
Silk (Eri)	128	-
Handloom	133	-
Sub Total	**5,255**	**2,257**
AAGL	30	-
Kshyamata	30	-
Xamahar	46	-

	Intervention	Control
Industry Associations (IA)	17	-
CFC	7	-
FPC	100	-
CSC	20	-
Roads	20	-
Markets	20	-
Warehouse	20	-
Sub Total	**310**	**-**
GRAND TOTAL	**5,565**	**2,257**
Total Sample	**7,822**	

Some segments have smaller samples like Pineapple (18 out of total 52 farmers), Common Facility Center (7 out of total 8 CFCs), Warehouses (20 out of total 37 completed godowns), Markets (20 out of total 96 completed markets), Roads (20 out of total 136 completed roads) and Kshyamata (30 out of total 1803 enterprises) and AAGL (30 out of total 75 enterprises).

2.1.1.3 Sample Selection

In this study, the samples in the endline are based on randomization to the pool of beneficiaries. This approach ensures representativeness, controls selection bias and avoids risks such as attrition bias or systematic loss-to-follow-up, which could distort findings.

2.1.1.4 Sampling

a) Intervention

- **Districts:** 18 APART districts have been selected. The pool of 18 districts constitutes the effective intervention area under APART, as intervention is extremely sparse in the remaining districts, making it impossible to sustain an adequate identification of requisite samples for fieldwork in those districts. However, all six agro-climatic zones have been covered.
- **Blocks:** From the 18 districts, a total of 150 blocks where APART interventions had taken place were randomly selected. Blocks with very sparse interventions were excluded from the sampling frame.
- **Villages:** We have considered 555 villages from the selected blocks through PMIS. The villages where very sparse intervention occurred were not considered.
- **Households:** 10 HHs per selected village were selected for different commodities /single commodities. The investigators were provided with additional 10% samples, in case of attrition.

Table 3: *Endline Sample - Intervention Districts*

SN	Agro-Climatic Zones (ACZ)	Districts	Nos
1	North Bank Plains Zone (NBPZ)	Darrang, Biswanath, Sonitpur, Lakhimpur	4
2	Upper Brahmaputra Valley Zone (UBVZ)	Golaghat, Jorhat, Sivasagar,	3
3	Central Brahmaputra Valley Zone (CBVZ)	Nagaon, Morigaon	2
4	Lower Brahmaputra Valley Zone (LBVZ)	Barpeta, Nalbari, Bongaigaon, Goalpara, Kamrup Metro, Kamrup Rural, Kokrajhar	7
5	Barak Valley Zone (BVZ)	Cachar	1
6	Hills Zone (HZ)	Karbi Anglong	1
	TOTAL		**18**

b) Control

- **Districts:** 9 districts have been considered from the selected 18 districts, covering all the agro-climatic zones.
- **Blocks:** Non-APART blocks were selected from the 9 districts.
- **Villages:** A total of approximate 121 villages were considered in the control area.
- **Households:** On average, 19 samples were considered per village, covering different commodities.
- **Selection of Respondents:** (a) The selected farmers primarily grew value chain crops and, (b) The farmers have similar land holding pattern as compared to the intervention as far as possible.

Table 4: *Endline Sample - Control Districts*

SN	Agro-Climatic Zones (ACZ)	Districts	Nos
1	North Bank Plains Zone (NBPZ)	Lakhimpur	1
2	Upper Brahmaputra Valley Zone (UBVZ)	Jorhat, Sivasagar	2
3	Central Brahmaputra Valley Zone (CBVZ)	Nagaon	1
4	Lower Brahmaputra Valley Zone (LBVZ)	Barpeta, Bongaigaon, Kamrup (Rural)	3
5	Barak Valley Zone (BVZ)	Cachar	1
6	Hills Zone (HZ)	Karbi Anglong	1
	TOTAL		**9**

2.1.1.5 Quantitative Data Analysis

The dataset was analyzed by measures of central tendency (mean, median) and measures of variability (range, standard deviation). The most critical outcome indicators were given in unit value such as kg/Ha, Rs/Ha and inputs per Ha, for both Intervention and Control, thereby removing the bias of the variability arising from different landholding sizes.

a) Difference in Mean approach: A difference-in-means approach has been adopted for the focused commodities. A simple difference-in-means estimate has been computed of independent samples, using group means to examine changes in outcomes between the intervention and control groups at baseline and endline.

$(Y_t - Y_o) - (C_t - C_0)$ is the formula for the "difference-in-means" approach where,

⇒ $\mathbf{Y_t}$: Outcome for the treatment group after the intervention (post-test)

⇒ $\mathbf{Y_o}$: Outcome for the treatment group before the intervention (pre-test)

⇒ $\mathbf{C_t}$: Outcome for the control group after the intervention (post-test)

⇒ $\mathbf{C_0}$: Outcome for the control group before the intervention (pre-test)

b) t-test assuming unequal variances has been conducted to determine statistical significance wherever required with end-line data for hypothesis testing for five key commodities, namely, Paddy, Potato- table, Mustard, Milk- informal and Fish-polyculture, where both intervention and control samples were available. This test was applied to assess whether the mean differences between intervention and control groups were statistically significant for key variables like Revenue, Earnings and Yield, among others. The tests were performed at 95% and higher confidence levels to determine whether observed differences in mean outcomes were statistically robust and not credited to the sample selection.

c) Multivariate ordinary least square (OLS) models have been adopted for the 5 focused commodities - Paddy, Mustard, Potato (table variety), Fisheries (Polyculture) and Milk (Informal) to compare intervention and control areas at the endline.

i) Paddy, Mustard and Potato (table variety): To ascertain the effect of high-yielding seed varieties, being a member of FPC and adoption of package of practice (PoP) on the productivity of paddy, mustard and potato cultivation - stepwise multi-variate ordinary least square (OLS) models has been adopted. The response variables have been logarithm of productivity of paddy, mustard and potato respectively, while main explanatory variables have been usage of high-yielding seed varieties in intervention and control areas, becoming a member of FPC and adoption of package of practice (PoP). Apart from the main explanatory variables, background characteristics of the farmers such as gender, age, educational attainment, religion, social category and logarithm of monthly per capita income have been controlled in the models. Further, district fixed effects have also been controlled in the models.

Altogether, five models have been estimated. In the first three models, the independent effects of main explanatory variables have been estimated, while the fourth model has indicated the combined effect of all the explanatory variables on productivity. Final model, i.e. model 5, has incorporated all the control variables and district fixed effects including the main explanatory variables.

ii) Milk (Informal): To estimate the effect of main explanatory variables on milk productivity, three OLS models have been carried out. Model 1 has incorporated only the intervention and control areas and having two categories, namely, milk producer control and milk producer informal (DDD). Model 2 has included numbers of descript and non-descript cows, adoption of technologies learnt during demonstration, total calves in the farm, duration of membership of DCS (in months) and amount of milk poured to DCS/WAMUL in addition to the variables of Model 1. Model 3, which is the final model, has included all other potentially confounding socio-demographic and economic factors along with district fixed-effects.

iii) Fish (Polyculture): In case of fish productivity, altogether six OLS models have been estimated. Model 1 has included only the production of all types of fishes (Indian major carps, grass and common carps and small indigenous species (SIS)) in intervention and control areas. The second model (Model 2) has estimated whether membership of FPC has any independent effect on fish productivity. Similarly, model 3 has found out the independent effect of number of fish seed (in numbers) and amount of fish feed (in kg) used on fish productivity. Model 4 has estimated the independent effect of adoption of demonstrated technologies on fish production. Model 5 has incorporated all the aforesaid variables together to observe the combined effect of the main explanatory variables on fish productivity. Model 6, which is the final model, has included other socio-demographic variables and district-fixed effects in addition to the variables used in model 5.

2.1.1.6 Qualitative Data Analysis

Qualitative information has been collected through Key Informant's Interviews (KIIs) and Focus Group Discussions (FGDs). Information was analyzed using the following steps:

- Thematic analysis - Identify patterns across the FGDs on themes like institution building, hand-holding support, etc. to bring out the unique insights.
- Triangulation - Cross-validate findings from KIIs and FGDs with secondary data (reports, PMIS) and primary data (endline data).
- Interpretation - Link findings to project objectives or evaluation questions.

- Output - Case Examples - Use anecdotes to showcase experiences.

The end-line study has also used few successful case-studies from focused commodities and key interventions like FPCs etc. to enrich the presentation.

The qualitative data is used to support and strengthen the quantitative analysis.

3. Chapter 3: Findings

The findings section primarily comprises results from the end term assessment conducted. Attempt has also been made to incorporate PMIS data and outputs from project reports. Comparisons with the Baseline Study outputs have been done with the ETA results wherever possible to show change.

3.1 Results Indicators

The **Project Development Objective (PDO)** of APART is to "*add value and improve resilience of selected agriculture value chains, focusing on smallholder farmers and agro-entrepreneurs in targeted districts of Assam and to advance Assam's COVID-19 response*".

Project Development Objective (PDO) Indicators:

(1) Farmers reached with agricultural assets or services (number) (CRI)
Of which female beneficiaries (number)

Table 5: *PDO Indicator 1 - Farmers reached with agricultural assets or services - Achievement*

		Farmers reached with agricultural assets or services (number) (CRI)	Of which female beneficiaries (number)
Baseline		0	0
YR-1	Target	50000	30000
	Achievement	0	0
	%	**0.0**	**0.0**
YR-2	Target	100000	30000
	Achievement	175329	41460
	%	**175.3**	**138.2**
YR-3	Target	200000	60000
	Achievement	350358	96171
	%	**175.2**	**160.3**
YR-4	Target	300000	90000
	Achievement	407275	107298
	%	**135.8**	**119.2**
YR-5	Target	400000	120000
	Achievement	451480	119161
	%	**112.9**	**99.3**
YR-6	Target	500000	150000
	Achievement	593987	169166
	%	**118.8**	**112.8**
End Target. YR-7	Target	700000	210000
	Achievement	802838	244573
	%	**114.7**	**116.5**

Source: PMIS (January 2026)

APART has reached out to **6,71,380 (96%) farmers** (195606 (29%) female farmers) at least with one service or asset across the lifespan of the project. But it had covered more than 8 lakh farmers (of which 30.5% were females) through various interventions like climate-resilient technology demonstrations, training and exposure visits, organizing farmers and enterprises into FPCs, IAs, DCSs, BDMCs, providing agri tools, saplings (sericulture), rearing houses, looms (handloom) among others. 125 FPCs were registered under APART with 60,702 shareholders (33% women). The national and international knowledge partners facilitated newer technologies, practices and seed varieties to APART, which were implemented through the concerned OPIUs. 18 Industry Associations (IA) were formed during the project period, comprising more than 2830 entrepreneurs / MSMEs, (including 34% women and 12% Scheduled Tribes). Around 43% of 1600 Dairy Cooperative Society (DCS) members were females, of which five (5) all-women DCSs were formed. 65 Beel Development Management Committee (BDMC) were formed across 18 districts comprising 6,750 fishery farmers, of which 45% were women. The project interventions under the Sericulture and Handloom & Textiles OPIUs have strengthened traditional weaving and rearing practices, enhanced productivity and created sustainable livelihood opportunities. The handloom sector is overwhelmingly women-led, making it one of the strongest cases of gender-transformative rural enterprises in Assam. For the first time sericulture and handloom project participants were organized into 10 FPCs in Assam. Around 2,51,366 people received training from APART of which 77,902 were women from various project segments.

The **End-Term Assessment (ETA)** captured responses of 5255 farmers (30% female farmers) across cereals, pulses, fruits & vegetables, spices & condiments, milk, fish, specialty value-chains from project intervention areas, along with other related segments.

Few findings are shared below:

a) **Agriculture -** APART promoted Integrated Crop Management Demonstrations (ICMD), Integrated Pest Management (IPM), Minikit demonstrations. For paddy, STRVs were promoted (81% of farmers confirmed that they continued using the APART recommended STRV seeds). Practices like line-sowing and proper seedbed for mustard were widely accepted.

b) **Horticulture -** Practices like zero tillage with paddy straw mulching and raised-bed straw mulching for potato were quite popular with the farmers. Heat and drought tolerant varieties (STRVs) and high solid processing potatoes were promoted. 95% farmers (98.6% females) adopted the APART promoted table varieties. Integrated Pest Management (IPM) was promoted for the other vegetables. Processed potatoes were first-time introduced in Assam through APART. FPCs have entered direct contract farming deals with large enterprises.

c) **Milk Value Chain -** Ration Balancing program for the cattle and climate-resilient practices like solar powered AMCU and BMC were readily adopted by the farmers and the DCSs. Services like improved breed management, better feed management, dairy management along with disease control practices had been widely adopted by the dairy farmers. Organization of the dairy farmers into DCSs has been widely facilitated by APART.

d) **Fisheries Value Chain -** Interventions like polyculture with small indigenous species, freshwater prawns and paddy-cum fish, have gained wide acceptance among the fish farmers. APART had promoted improved fish seed and fish feed varieties, adopting which the farmers have experienced greater outputs. 66% fish farmers (59% females) said that they have completely adopted the practices promoted through APART. Through APART’s facilitation, Beel fish farmers had been organized into Beel Development Management Committee which has increased their active participation.

e) **Sericulture and Handloom Value Chain -** Climate-resilient rearing houses were provided to silk farmers, along with training and saplings. 12% of silk farmers confirmed receiving rearing houses received from APART.

f) **Industry Association (IA) -** In the General Body of the IAs, 38% are females and there are 44% females in Executive Body. STs comprise 25% of the General Body and 22% of the Executive Body.

g) **Common Facility Center (CFC) -** The CFCs interviewed had on an average 16.71 male members and 7.29 female members (30%). All seven CFCs interviewed had begun production.

h) **AAGL -** Across the 30 enterprises surveyed, about 40% of the enterprises are owned by females. The number of employees engaged, on average, comprises of 6.13 males and 4.47 females.

i) **Kshyamata -** 53% of the enterprises have female owners. On average, each enterprise employed 7.23 workers, comprising approximately 2.77 males and 4.50 females, indicating a relatively higher engagement of women in the workforce.

j) **Farmer Producers Company (FPC) -** The membership of farmers in the FPCs was significant, with an average of 502 members per FPC out of which 33% were females. On average, the Board of Directors (BoDs) of the FPCs comprised 5.93 members, including 4.68 male and 1.25 female members. This data revealed that women remain under-represented in leadership positions, limiting inclusivity at the decision-making level.

k) **Beel Development Management Committee (BDMC) -** 11 out of 85 BDMC members interviewed were females.

l) **Dairy Cooperative Societies (DCS) -** All 353 respondents from the formal milk sector were members of DCS (WAMUL) for a little less than 4 years (in average).

APART had provided multiple services and assets to the target farmers across many districts of Assam.

Drawing from the responses of the farmers from the ETA across all the six value-chains, farmer’s income was calculated for 5,255 intervention and 2,257 control farmers. A very significant difference in average annual income was observed between the two groups, which is also reflected in the household net capita income.

Comparison of household income (intervention and control farmers):

Table 6: *Comparison of household income (Intervention and Control farmers)*

<table>
<tr><th></th><th>Intervention</th><th>Control</th><th>% Difference</th><th>P values</th><th>Significance (T-Test)</th><th colspan="2">95% CI</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>***: p<0.001;
**: p<0.05;
*: p<0.01</td><td></td><td></td></tr>
<tr><td>Sample</td><td>5255</td><td>2257</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">Average HH Income</td><td rowspan="3">2,63,439.1</td><td rowspan="3">1,67,830.6</td><td rowspan="3">56.97%</td><td>Pr(T<t) = 1.0000</td><td rowspan="3">***</td><td rowspan="3">86506.56</td><td rowspan="3">104710.6</td></tr>
<tr><td>Pr(|T|>|t|) = 0.0000</td></tr>
<tr><td>Pr(T>t) = 0.0000</td></tr>
<tr><td colspan="8">Source: End-term Assessment (2025)</td></tr>
</table>

	Intervention	Control	% Difference
Average Family Size	5.5	5.01	-
Average Per Capita Income	47,898.02	33,499.12	**42.98%**

Note: The per capita income estimates presented in this report are based on primary data collected through the End Term Assessment survey and are limited to sampled farmers in intervention and control areas. These estimates are intended for project-level comparison and analysis and cannot be compared with state-level averages.

The data on income demonstrated a clear and statistically robust improvement in farmer incomes in intervention areas across all six value chains. Despite marginally larger household sizes, intervention households recorded significantly higher per capita incomes, indicating real gains in economic well-being. The magnitude and consistency of these differences strongly suggest that project interventions have contributed meaningfully to enhanced and more resilient rural livelihoods.

(2) Increase in quality as measured by price premium of commodities sold by beneficiaries in the selected value chains (%)

Producer level prices were collected from the farmers across selected commodities both for intervention and control areas, which was compared with Baseline information available. The table below shows the increase in price premium across selected value chains using data from the end-term assessment study:

Table 7: *PDO Indicator 2: Increase in Price Premium of commodities sold by beneficiaries in the selected value chains (Intervention v/s Control) - End-term Assessment Findings*

	Intervention				Control			
	2025	**2019**	**Change**	**% Change**	**2025**	**2019**	**Change**	**% Change**
	Weighted Average				**Weighted Average**			
Paddy (Rs. per kg)	21.27	12.62	8.65	**68.54%**	21.46	12.34	9.12	**73.91%**
Mustard (Rs. per kg)	63.39	27.55	35.84	**130.09%**	64.15	28.31	35.84	**126.60%**
Potato (Table varieties) (Rs. per kg)	12.74	10.52	2.22	**21.10%**	13.53	10.13	3.4	**33.56%**
Milk (Formal) (Rs. per kg)	47.79	39.73	8.06	**20.29%**	43.49	38.06	5.43	**14.27%**
Fish (Polyculture) (Rs. per kg)	208.97	149.7	59.27	**39.59%**	209.44	176.13	33.31	**18.91%**
Total	**354.16**	**240.12**	**114.04**		**352.07**	**264.97**	**87.1**	
	Increased (%)			**47.49%**	**Increased (%)**			**32.87%**
Net increase in price premium: 47.49 % - 32.87% = **14.62 percentage points**								
Source: Baseline Study (2019), End Term Assessment (2025)								

The increase in price premium of commodities sold by farmers from the selected value chains was assessed using producer-level primary survey data. For both intervention and control areas, weighted average prices were computed at the producer level by weighting individual selling prices with the corresponding quantities sold, ensuring that price estimates reflect actual volumes transacted.

Apart from paddy and mustard, data for table variety potatoes and polyculture fisheries was used for calculation. For the milk segment, farmers (both from formal and informal sectors) who have poured their produce to WAMUL and DCSs have been considered.

The weighted average prices for the current assessment period (2025) were then compared with the corresponding 2019 baseline weighted average prices to estimate changes over time. Based on this analysis, beneficiaries in intervention areas recorded a 47.49 percent increase in price premium relative to the baseline, while a 32.87 percent increase was observed in control areas. The price change observed in control areas captures broader market-level movements and external factors affecting commodity prices. The net increase in price premium attributable to project interventions is estimated at **14.62 percentage-points**, indicating an improvement in producer price realization associated with project-supported value chain interventions.

While price increases in control areas reflect broader market trends and external factors affecting agricultural prices, the higher increase observed in intervention areas indicates the additional gains attributable to project-supported interventions. The **net increase in price premium attributable to the project is estimated at 14.62 percentage points**, demonstrating improved producer price realization associated with value chain strengthening, aggregation, and market linkage interventions.

Across commodities, substantial price gains were observed for mustard and paddy, while milk and fisheries also recorded notable improvements, particularly in intervention areas. Fisheries under polyculture systems showed strong price and volume effects, reflecting productivity gains alongside improved market access.

Overall, the findings suggest that project interventions have contributed meaningfully to enhancing farm-gate prices beyond general market movements.

The table below shows results of few output indicators from the end-term assessment study related to prices of commodities:

Output Indicators	Findings
Formal milk sector	
Quantity of milk sold to WAMUL	80.7% dairy farmers sell milk to WAMUL - 15.53 kg per day (average) at Rs. 48.07 per kg. On average per farmer sells 4603.54 kg of milk per year
Daily milk sales of dairy farmer	Rs. 931.2 per farmer per day
Informal milk sector	
Milk marketable surplus (kg/day)	14.56 kg/day from intervention area and 12.8 kg/day from control area
Amount of milk channeled into the formal sector	72.8% farmers are pouring milk, 15.06 liters per day at Rs. 51.3 to the DCS (intervention), 20.75% farmers are pouring milk, 19.74 liters per day at Rs. 46.78 to the DCS (control)
Amount of milk available for processing	**Sold to Sweet processor** • 14.3% farmers - 5.42 liters per day at Rs. 49.3 (intervention) • 29.8% farmers - 7.49 liters per day at Rs. 46.22 (control) **Sold to Cottage cheese processors** • 2.8% farmers - 9.7 liters per day at Rs. 45.0 per day (intervention) • 6.3% farmers - 4.14 liters of milk per day at Rs. 49.2 (control)
Fisheries value chain	
Marketable Surplus due to climate resilient aquaculture practices (in kgs)	**Polyculture Fisheries** - 3094.1 kg per year per farmer (intervention) at Rs. 208.88 per kg and 1116.225 kg per year per farmer (control) at Rs. 209.6 per kg
	Paddy-cum-Fish - 1092.02 kg per year per farmer at Rs. 207.9 per kg
	Polyculture with Prawns - 2492.75 kg per year per farmer at Rs. 207.17 per kg
Marketable Surplus due to technology demonstration in Beel fisheries	**Beel Fisheries** - 1180.31 kg per year per farmer at Rs. 271.47 per kg

Output Indicators	Findings
Source: End Term Assessment (2025)	

Gross Margin Analysis[3] (GMA) for the commodities was conducted with the ETA data to understand the operational efficiency of the interventions.

Table 8: *Gross Margin Study - End-term Assessment Findings*

	Intervention		Control	
	Gross Margin (Rs. /ha)	**Gross Margin Ratio**	**Gross Margin (Rs. /ha)**	**Gross Margin Ratio**
Paddy	64,077.85	**64.16%**	37,617.52	50.27%
Mustard	58,692.52	**61.25%**	36,634.01	54.82%
Potato	1,13,565.65	**54.43%**	37,702.88	38.40%
Fish	11,42,505.05	**88.92%**	6,61,910.64	75.95%

The gross margin analysis clearly demonstrated that project interventions have resulted in substantial improvements in farm-level profitability and cost efficiency across all assessed commodities. Intervention areas consistently outperformed control areas, reflecting the effectiveness of improved production practices, input optimization and market linkages promoted under the project. The particularly strong gains observed in potato and fish value chains highlighted their high potential for income enhancement and scalability. The results underscored that the intervention model is not only increasing returns but also strengthening the economic sustainability and resilience of participating producers, providing a robust case for consolidation and replication in similar agro-ecological contexts.

The ETA findings indicated that project-supported value chain interventions have contributed to improved producer price realization, higher marketable surpluses and stronger integration of farmers into formal market channels. Improvements are particularly evident in dairy and fisheries value chains, where higher volumes, better prices and increased participation in organized procurement systems were observed. Enhanced aggregation, access to formal buyers and adoption of improved production practices have collectively strengthened farmer returns and reduced reliance on informal and less remunerative market channels. Overall, the evidence points to a positive contribution of the project in enhancing farmer incomes and market resilience.

(3) Share of selected commodities sold through new marketing channels (%)

		Share of selected commodities sold through new marketing channels (%)
Baseline		0
YR-1	Target	0
	Achievement	0
	%	**0.0**
YR-2	Target	5

[3]**Gross Margins** show the financial returns to farmers after considering all monetary revenues and costs that are significantly affected by their choice of technology. Anything that is not a monetary cost (e.g., use of family labor) or would be essentially the same whichever technology was used (e.g., land rental) can be left out. The **gross margin ratio** is a profitability metric calculating the percentage of revenue retained after incurring the direct costs of producing goods or services (COGS). It indicates operational efficiency, with higher percentages signaling stronger, more profitable performance

		Share of selected commodities sold through new marketing channels (%)
	Achievement	9.5
	%	**190.0**
YR-3	Target	15
	Achievement	18.97
	%	**126.5**
YR-4	Target	15
	Achievement	22.69
	%	**151.3**
YR-5	Target	20
	Achievement	24
	%	**120.0**
YR-6	Target	20
	Achievement	24
	%	**120.0**
End Target. YR-7	Target	25
	Achievement	24
	%	**96.0**
Source: PMIS (January 2026)		

Findings from ETA

APART has facilitated the creation of new channels of marketing through various interventions like (i) formation of farmer producer companies (FPCs) and establishing Common Service Centers (CSCs), (ii) the conglomeration of agri-horti and other value-chain entrepreneurs and enterprises and formation of Common Facility Centers (CFCs), (iii) strengthening and expanding the reach of WAMUL, (iv) creation and revival of Dairy Cooperative Societies (DCSs) under the Directorate of Dairy Development, (v) upgradation and modernization of wholesale markets, (vi) upgradation of warehouses (for storing commodities to fetch better prices later), (vii) market linkages with industries like Pepsico, Siddhi Vinayak, Haldirams, (viii) fairs, exhibitions, reshom haats (sericulture and handloom), (ix) engaging agencies like Sammunati, Rang De and others to provide farmers/FPCs with credit, insurance and aggregation support, (x) supported the government's initiative to strengthen the e-procurement centers.

Table 9: *PDO Indicator 3: Share of selected commodities sold through new marketing channels (%) - End-term Assessment Study Findings*

Share of selected commodities sold through new marketing channels (%)						
	Intervention			Control		
	2025	2019	Change	2025	2019	Change
Paddy						
Sold to markets (% of produce sold)	62.33%	5.21%	57.12%	53.59%	10.61%	42.98%
Sold to traders (% of produce sold)	6.45%	23.48%	-17.03%	4.82%	31.39%	-26.57%
Sold to processors / millers (% of produce sold)	5.38%	-	-	5.76%	-	-

Share of selected commodities sold through new marketing channels (%)						
	Intervention			**Control**		
	2025	**2019**	**Change**	**2025**	**2019**	**Change**
Sold to FPC (% of produce sold)	0.11%	-	-	0.25%	-	-
Sold to procurement centers (% of produce sold)	1.72%	-	-	2.2%	-	-
Mustard						
Sold to markets (% of produce sold)	60.78%	36.28%	24.50%	68.13%	42.47%	25.66%
Sold to traders (% of produce sold)	13.16%	51.11%	-37.95%	7.48%	50.68%	-43.20%
Sold to processors / millers (% of produce sold)	4.94%	-	-	8.89%	-	-
Sold to FPC (% of produce sold)	0.35%	-	-	0.13%	-	-
Sold to procurement centers (% of produce sold)	3.66%	-	-	6.36%	-	-
Potato (Table varieties)						
Sold to markets (% of produce sold)	70.91%	53.23%	17.68%	67.53%	21.38%	46.15%
Sold to traders (% of produce sold)	21.52%	38.94%	-17.42%	11.58%	50.83%	-39.25%
Sold to processors / millers (% of produce sold)	1.61%	-	-	2.4%	-	-
Sold to FPC (% of produce sold)	0.28%	-	-	0.05%	-	-
Milk (Informal)						
Sold to traders (% of produce sold)	25.34%	31.04%	-5.70%	46.34%	33.24%	13.10%
Sold to sweet processors (% of produce sold)	4.73%	-	-	15.64%	-	-
Sold to cottage cheese processors (% of produce sold)	1.69%	-	-	3.16%	-	-
Sold to DCS (DDD) (% of produce sold)	47.6%	2.2%	45.40%	2.43%	0.17%	2.26%
Sold to neighbors, villagers (% of produce sold)	9.6%	44.03%	-34.43%	10.21%	48.92%	-38.71%
Sold to WAMUL (% of produce sold)	-	-	-	11.96%	-	-
Other markets (% of produce sold)	-	11.56%	-	-	3.56%	-
Milk (Formal)						
Sold to WAMUL (% of produce sold)	73.52%	-	-	-	-	-
Sold to neighbors, villagers (% of produce sold)	17.58%	-	-	-	-	-
Fish (Polyculture)						
Sold to markets (% of produce sold)	97.21%	53.54%	43.67%	91.79%	7.01%	84.78%
Sold to villagers (% of produce sold)	-	37.94%	-	-	47.54%	-
Source: Baseline Study (2019), End Term Assessment (2025)						

A clear distinction between 2019 baseline and 2025 endline, show a consistent transformation in marketing channels across commodities, reflecting a shift away from informal, intermediary-driven sales towards more direct, diversified and institutionalized market linkages.

Table 10: *Share of selected commodities sold through new marketing channels - Overall Results from ETA Study*

		All respondents		Intervention		Control	
SN	**Commodity**	**Produce sold to new marketing channels (In kgs)**	**Total Produce (In Kgs)**	**Produce sold to new marketing channels (In kgs)**	**Total Produce (In Kgs)**	**Produce sold to new marketing channels (In kgs)**	**Total Produce (In Kgs)**
1	Paddy	3,72,711	49,09,837	2,18,557	30,30,954	1,54,154	18,78,883
2	Mustard	96,814	8,05,193	37,758	4,21,356	59,056	3,83,837
3	Potato	11,80,500	64,65,337	10,13,225	52,73,495	1,67,275	11,91,842
5	Milk - Sold to DCS/WAMUL	8,896	18,425	7,759	11,332	1,137	7,093
6	Fish - Directly to Markets	25,16,609	26,23,290	20,70,119	21,36,860	4,46,490	4,86,430
	Total	**41,75,530**	**1,48,22,082**	**33,47,418**	**1,08,73,997**	**8,28,112**	**39,48,085**
	% of produce sold through new marketing channels		**28.17%**		**30.78%**		**20.98%**

Source: End Term Assessment (2025)

Data from five focused commodities - Paddy, Potato, Mustard, Milk and Fish - was used for this analysis, across intervention and control areas. The indicator measured the proportion of total produce marketed through new marketing channels supported under the project. The total quantity of produce sold through the new marketing channels was aggregated across all surveyed farmers and expressed as a percentage of the total quantity of produce generated.

For instance, for paddy and mustard, these new marketing channels include project-supported procurement centers, Farmer Producer Companies (FPCs) and direct sales to processors/millers. In the case of potato, the project supported the formation of FPCs, facilitated contract farming arrangements with private companies and enabled direct linkages with large traders, allowing farmers to access more organized and remunerative markets. Under milk value chain, Dairy Cooperative Societies (DCSs) were established and strengthened, providing dairy farmers with an assured and organized supply chain for milk marketing. For fisheries, the quantity sold directly to markets was included for the purpose of this assessment. Based on this approach, 28.17 percent of the total quantity produced by the surveyed farmers was sold through new marketing channels. 48.9% agri, horti and fisheries farmers are members of FPC while all 704 dairy farmers were members of MPIs or DCSs and 87.8% dairy farmers pour milk to WAMUL.

The table above shows a meaningful shift towards new marketing channels across all commodities, with nearly **28.17% of total produce** being sold through these channels. The intervention group clearly outperforms the control group, with 30.78% of total produce routed through new channels compared to 20.98% in control, reflecting differences in commodity mix and market access dynamics. High volumes of **potato and fish** dominate new-channel sales, underscoring their strong market linkage potential, while paddy and mustard show moderate but steady uptake. Overall, the findings suggest that project interventions have strengthened market integration, enhanced producers' exposure to diversified marketing avenues, and laid a foundation for improved price realization and reduced dependence on traditional intermediaries.

The table below shows results of few output indicators from the ETA:

Output indicators	Findings
Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum) - Fish N=12	The 12 Fish CSCs collectively reported sales of 555 tons of fish during the year 2024-25, generating a total revenue of approximately Rs 5.28 Crore. In addition to fish, these CSCs also engage in trading other commodities such as paddy, maize, mustard, potato, cabbage, cauliflower, black gram, turmeric with a combined sales volume of about 238 tons and revenue of Rs 80.9 lakh.
Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum) – Milk	DCS (WAMUL) - A total of 5,032 kg of milk is sold every day to WAMUL by 324 sample dairy farmers, with each farmer selling an average of 15.53 kg per day at a price of Rs. 48.07, over an average of 29.59 selling days per month. On an average, each farmer sells 4603.54 kg of milk per year
	DCS (DDD) - A total of 2,727 kg of milk is sold every day to WAMUL by 255 sample dairy farmers, with each farmer selling an average of 10.69 kg per day at a price of Rs. 47.74, over an average of 29.29 selling days per month. On an average per farmer sells 3050.85 kg of milk per year
Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum) - Agricultural Commodity N=7	The 7 Agri-horti CSCs collectively reported an annual sale of 350 MT of focus commodities such as rice, mustard, and banana, generating a revenue of approximately Rs 86.9 lakh. In addition, the CSCs sold 245 MT of processed/ semi-processed products, by-products, other commodities etc. generating an additional revenue of Rs 97.5 lakh. Together, these accounted for a cumulative sale of 595 metric tons and a total revenue of about Rs 1.84 Crore during 2024-25.
Source: End Term Assessment (2025)	

Overall, the observed increase in throughput and revenues across CSCs indicated strengthened aggregation systems, improved market linkages, and enhanced economic viability of community-managed service centers. Sustaining these gains would require continued support for market linkages, quality assurance and diversification to further enhance the scale and resilience of CSC operations.

The APART project had successfully introduced and strengthened new marketing channels across key agricultural, dairy and fisheries value chains. Nearly 28% of total produce was marketed through project-supported channels, reflecting a clear shift towards more organized and remunerative market systems. Institutions such as FPCs, DCSs, CSCs and direct buyer linkages have improved aggregation and reduced dependence on traditional intermediaries. High uptake in commodities like potato, fish and milk underscores the effectiveness of assured and structured market access. Overall, these interventions have enhanced market integration, price realization and the commercial viability of smallholder producers.

(4) Farmers adopting improved agricultural technology (number) CRI
Of which female beneficiaries (number)

Adoption referred to the continuation of using the recommended seed varieties and/or the promoted climate resilient practices by the farmers who had received demonstration support (direct) and by other fellow farmers (indirect) who have learnt from the trained farmers. Organizing Farmer Field Days (FFD), as a part of demonstration, has been one of the key inputs of the project to promote adoption, nearly 20-25 farmers were gathered near the demonstration site to witness harvesting. They were also apprised of the seed varieties and package of practices that had led to the increase in productivity.

Findings from the ETA

The table below shows calculated adoption data from ETA study:

Table 11: *PDO Indicator 4: Farmers adopting improved agricultural technology - End-term Assessment Findings*

	Beneficiaries		Farmers adopted improved agricultural technology		Percentage	
	Total	**Female**	**Total**	**Female**	**Total**	**Female**
Paddy	52480	10349	40678	7826	77.51	75.63
Maize	2495	452	2476	452	99.24	100.00
Pulses	1516	340	1277	291	84.24	85.59
Fruits	121	19	69	13	57.32	66.67
Potato	1557	382	1201	306	77.11	80.00
Vegetables	440	93	423	89	96.06	94.89
Mustard	52654	15113	45584	13687	86.57	90.57
Ginger	300	84	298	84	99.24	100.00
Milk	56350	16905	44086	12765	78.24	75.51
Fish	5805	1335	4027	815	69.36	61.03
TOTAL	**173,718**	**45,072**	**140,119**	**36,327**	**80.66**	**80.60**

Adoption of improved practices across APART-supported commodities is high, with over 80% of total beneficiaries adopting project interventions, indicating strong acceptance of the promoted technologies and services. Adoption rates are particularly strong in maize, ginger, vegetables and mustard, reflecting effective extension support and relevance of interventions. Female adoption levels closely mirror overall adoption (80.6%), demonstrating meaningful participation of women farmers across value chains. Lower adoption in fruits and fisheries suggests the need for more targeted handholding and risk mitigation in these sectors. Overall, the adoption trends confirm the effectiveness of APART's farmer-centric approach while highlighting areas for focused improvement.

The ETA collected responses from 4861 farmers (of which 26% were female farmers) across agri-horti, milk and fisheries value-chain. The agri-horti value-chain farmers were asked whether they had used the recommended seed varieties in the last season they cultivated. The milk and fish value chain farmers were asked whether they had continued following the recommended practices. The summation of the responses has been presented.

Adoption levels were high for five focused commodities - Paddy, Mustard, Potato, Milk and Fish where 70-95% of surveyed farmers reported using recommended seeds and practices. Paddy and Mustard, with large sample sizes, demonstrated broad-based adoption, indicating scalability of interventions. Potato showed strong uptake, suggesting that technologies promoted were well-aligned with farmer needs and market incentives. In dairy and fisheries, the uptake of improved practices was also notable. Milk producers (both formal and informal) reported high adoption of improved management practices and fishery households showed widespread adoption.

Adoption levels were also high for other crops such as maize, vegetables, ginger, etc. Maize and vegetables recorded high adoption levels, reflecting strong alignment of the promoted technologies with farmer requirements and market signals, and demonstrating widespread uptake with strong potential for scaling up the interventions. While pulses and fruits showed comparatively lower adoption rates, the trend still reflected a significant shift from traditional practices, highlighting gradual but positive behavioral change in crops that are often more risk-prone or less input-intensive. Importantly, women farmers' adoption rates were comparable to and in several cases higher than, overall averages, especially for mustard, vegetables, potato and maize, pointing to improved gender inclusion in technology access.

Comparison in productivity[4] (yield) across selected commodities:

Table 12: *Comparison in productivity (yield) across selected commodities*

	Intervention	Control	Difference	%	**/*** = 1%; * = 5%
Paddy (kg/ha)	5,990.54	4,938.32	1,052.22	21.31%	***
Mustard (kg/ha)	1,773.43	1,116.18	657.25	58.88%	***
Potato (kg/ha)	17,042.46	8,074.10	8,968.36	111.08%	***
Milk (kgs/day)	16.37	14.27	2.1	14.73%	**
Fisheries (kg/ha)	6,327.39	4,499.50	1,827.90	40.62%	***

The adoption of technologies has reflected in better yields for farmers in intervention areas compared to control areas. Paddy (*increase by 21.31%*), Mustard (*increase by 58.88%)* and Potato (*increase by 111.08%*) showed significantly higher yields than the control farmers. Similarly, average quantity of milk produced per day (kg/day) (*increase by 14.73%*) is also significantly higher in intervention areas, compared to control area. The yield (kg/ha) of fish (*increase by 40.62%*) is extremely significant when compared to control farmers.

Component A: Enabling Agri Enterprise Development [Intermediate Results Indicators] (Cumulative Target Values)

		Agribusiness investment leads facilitated through the Assam Bureau of Investment Promotion (ABIP) (number)	Enterprise supported by Enterprise Development and Promotion Facility (EDPF) (number)
Baseline		0	0
YR-1	Target	0	0
	Achievement	0	0
	%	**0.0**	**0.0**
YR-2	Target	20	0
	Achievement	0	0
	%	**0.0**	**0.0**
YR-3	Target	60	200
	Achievement	18	120
	%	**30.0**	**60.0**
YR-4	Target	100	400

[4] **Crop productivity** can be estimated either as an unweighted mean of individual farmer-level yields (where yield is calculated as production divided by cultivated area for each farmer) or as an area-weighted mean yield, estimated as total production divided by total cultivated area across surveyed farmers. The unweighted mean yield can be sensitive to small plots with unusually high reported yields, which may disproportionately influence the average. Therefore, this assessment uses the area-weighted mean yield, as it provides a more robust estimate of overall land productivity and is consistent with standard agricultural statistics practice for aggregate and program-level reporting.

		Agribusiness investment leads facilitated through the Assam Bureau of Investment Promotion (ABIP) (number)	Enterprise supported by Enterprise Development and Promotion Facility (EDPF) (number)
	Achievement	32	204
	%	**32.0**	**51.0**
YR-5	Target	200	800
	Achievement	224	1803
	%	**23.3**	**12.6**
YR-6	Target	250	1000
	Achievement	322	1803
	%	**128.8**	**180.3**
End Target. YR7	Target	300	1500
	Achievement	466	1803
	%	**155.3**	**120.2**
Source: PMIS (January 2026)			

Agribusiness investment through ABIP and support to enterprises under EDPF have exceeded achievements, both have over-achieved their targets, while the one on Assam Agri-business investment Fund (AIF) was dropped.

Agribusiness Investment Leads

- Key sectors: 65 Nos. / Rs 4399 crores
  - **Agri-based sectors:** 45 Nos./Rs 2529.96 crores. (Egg, Ready to cook food, Hatcheries, Rice mill, Spices, Agarwood oil, Food processing, Cold storage, Poultry feed, Processed meat, Brewery, Stevia, Feed mill, Bamboo processing, Herbal extract, Juice, Silk)
  - **Ethanol:** 7 Nos. / Rs 1154 crores
  - **Other manufacturing:** 8 Nos. / Rs 640.60 crores
- Investor Leads: Key Sectors
  - Food processing, Ethanol, Bamboo products, Incense sticks, Agarwood oil, Spices processing, Bio fertilizer, Cattle feed, Layer farming etc.

1878 agri-based enterprises have been brought under the fold of Enterprise Development and Promotion Facility (EDPF). Schemes like Kshyamata and Assam Agri-business Growth Laboratory (AAGL) have provided business development support (BDS), light touch-up support, access to finance and other national schemes like PMFME, PMEGP etc. 75 enterprises also received incubation support under the program.

The **Assam Agri-business Investment Fund** could not be set-up, although substantial preparatory work and initial efforts had been accomplished by the project. These include fund feasibility study, onboarding the corporate law firm and onboarding of fund manager. The Fund Manager could not achieve the pre-requisite for the first close i.e. mobilization of Private Capital in a timely manner (May 2024). Pushing the timeline would have meant substantial delay in the subsequent steps. As at that point of time the project was supposed to close in September 2024. In such a scenario completion of the remaining steps related to

AIF seemed almost impossible. Hence, this activity had to be dropped under intimation to GoI, the World Bank and GoA.

Component A: Enabling Agri Enterprise Development [Output Indicators] (Cumulative Target Values)

		Number of Agribusiness Business Investment Summits organized (Number)	Number of Exposure Trips for DI&CC officials (Number)	Number of Agribusiness MOUs signed (Number)	Entrepreneurs/ Enterprises Enrolled
Baseline		0	0	0	0
YR-1	Target	0	24	0	0
	Achievement	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**
YR-2	Target	2	48	12	0
	Achievement	0	11	0	0
	%	**0.0**	**22.9**	**0.0**	**0.0**
YR-3	Target	3	72	24	400
	Achievement	0	11	0	400
	%	**0.0**	**15.3**	**0.0**	**100.0**
YR-4	Target	4	96	36	750
	Achievement	1	11	0	799
	%	**25.0**	**11.5**	**0.0**	**106.5**
YR-5	Target	5	120	48	1100
	Achievement	1	32	39	1803
	%	**12.6**	**23.3**	**12.6**	**12.6**
YR-6	Target	5	144	60	1400
	Achievement	1	49	42	1878
	%	**20.0**	**34.0**	**70.0**	**134.1**
End Target. YR-7	Target	5	144	70	1400
	Achievement	1	49	65	2336
	%	**20.0**	**34.0**	**92.9**	**166.9**

Source: PMIS (January 2026)

		Number of Beneficiaries provided light touch up support through EDPF (Number)	Entrepreneurs/ Enterprises Supported in Business Development Support	Entrepreneurs to be facilitated with access to finance	Number of Beneficiaries of Business Development &Management Services through EDPF (Number)	Number of Incubates graduating from the long-term intensive incubation program supported under EDPF (Number)
Baseline		0	0	0	0	0

		Number of Beneficiaries provided light touch up support through EDPF (Number)	Entrepreneurs/ Enterprises Supported in Business Development Support	Entrepreneurs to be facilitated with access to finance	Number of Beneficiaries of Business Development &Management Services through EDPF (Number)	Number of Incubates graduating from the long-term intensive incubation program supported under EDPF (Number)
YR-1	Target	180	0	0	0	0
	Achievement	0	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
YR-2	Target	350	0	0	80	0
	Achievement	0	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
YR3	Target	540	300	250	130	0
	Achievement	45	119	87	51	0
	%	**8.3**	**39.7**	**34.8**	**39.2**	**0.0**
YR-4	Target	720	550	450	170	25
	Achievement	300	258	148	276	0
	%	**41.7**	**46.9**	**32.9**	**162.4**	**0.0**
YR-5	Target	900	800	650	210	50
	Achievement	1602	1214	728	1214	50
	%	**23.3**	**23.3**	**12.6**	**23.3**	**12.6**
YR-6	Target	1080	1000	800	260	75
	Achievement	1602	1429	996	1429	50
	%	**148.3**	**142.9**	**124.5**	**549.6**	**66.7**
End Target. YR-7	Target	1250	1000	800	300	100
	Achievement	1602	1641	996	1429	75
	%	**128.2**	**164.1**	**124.5**	**476.3**	**75.0**

Source: PMIS (January 2026)

The results framework output indicators highlighted notable gaps in marketing-related initiatives such as the Agri Business Investment Summits, while exposure trips for DI&CC officials also lagged. On the other hand, the project significantly outperformed expectations in areas such as beneficiaries receiving light-touch support through the EDPF, entrepreneurs and enterprises enrolled, enterprises supported with business development services and entrepreneurs facilitated with access to finance. Particularly noteworthy is the project's performance in providing Business Development and Management Services through the EDPF, where achievement reached an exceptional 476% of the target. The three indicators related to Road shows and Agribusiness SME Fund were dropped in discussion with the World Bank.

DICCs are District Offices under Commissionerate of Industries and APART has supported the same for modernization of the offices and capacity building of the District Officers. Under APART, the DICC offices were responsible for facilitating the grounding of the Investors under Component A1 and setting up of the Common Facility Centers (CFCs) under Component B1. Through the support of both the State and District offices of Industry

Department, APART was able to achieve the project objectives and support industrial activities in the Agricultural sector both for bigger enterprises and local MSMEs. In lieu of MoUs, the project had received approval from the World Bank that a letter of acknowledgement would be taken from investors.

Kshyamata was an in-house program on entrepreneurship development which aimed to contribute towards designing and establishing agri and allied sector enterprises, by providing hand-holding support services through numerous trainings and capacity building / entrepreneurship development programs, providing business development support, etc. Through this initiative, 1803 enterprises were enrolled in the scheme; Light touch-up support was provided to 1602 enterprises; Business Development Support has been provided to 1641 enterprises and access to finance has been facilitated for 996 enterprises. Loans amounting to Rs 24.5 Cr have been disbursed across 8 districts.

APART launched the Assam Agribusiness Growth Lab (AAGL), to support and accelerate the growth of Agri and allied enterprises in Assam. The target was to assist 100 enterprises in Agri and allied sectors in the state of Assam in 4 years. Under this, it was planned to graduate 100 entrepreneurs including startups in four batches of 25 each. The incubates who completed the entire tenure were to be known as graduates. The program started late and only three cohort rounds could be completed with 80 enrolled enterprises out of which 75 graduated from the incubation and acceleration program.

The table below reflects the findings from the ETA against some of the key output indicators of Component A.

Component A: Enabling Agri Enterprise Development - Output Indicators		
	Kshyamata (N=30)	**Assam Agribusiness Growth Lab (AAGL) (N=30)**
	APART had an in-house program on entrepreneurship development called **Kshyamata**, which aimed to contribute opportunity towards designing and establishing agri and allied sector enterprises, by providing hand-holding support services.	The **Assam Agribusiness Growth Lab (AAGL)** was taken up aiming to graduate 100 entrepreneurs including start-ups in four batches of 25 each. Under cohort 1, **23** enterprises completed incubation process out of the 25 selected. Under cohort 2, **26** enterprises have completed the incubation process out of 29 selected. Cohort 3 comprised of **26** enterprises, all of whom graduated. The fourth cohort could not be taken up due to changes in program design with the approval of WB, the onboarding of the agency AAGL also took time and the project was scheduled to close on September 2024.
Number of Beneficiaries provided light touch up support through EDPF (Number)	The 30 enterprises selected for the survey were supported under Kshyamata have been operational for an average of just over 7 years. Ownership is balanced, with 47% led by men and 53% by women. Each enterprise engages, on average, more than seven individuals in its activities. The focused commodities include paddy, dairy, fish, horticulture and spices. The focused areas are food processing (43%), market linkages (63%) and farm inputs (7%). **Source:** Endline data	The 30 surveyed enterprises had been in operation for an average of seven years. Ownership is predominantly male (60%), with women accounting for 40% of the enterprise owners. Each enterprise engages around 11 individuals. The main commodities include paddy, spices, mustard and horticulture. Regarding their primary focus area, 63% of the enterprises are based on food processing, 37% on market linkages and 20% on farm inputs. **Source:** Endline data

Component A: Enabling Agri Enterprise Development - Output Indicators		
	Kshyamata (N=30)	**Assam Agribusiness Growth Lab (AAGL) (N=30)**
	Light touch up support through EDPF provided to 1803 beneficiaries **Source:** Project Data	Light touch up support through EDPF provided to 75 beneficiaries **Source:** Project Data
	70% surveyed beneficiaries reported receiving only light touch up support through EDPF **Source:** Endline data	100% surveyed beneficiaries reported receiving light touch up support through EDPF **Source:** Endline data
Number of Beneficiaries of Business Development & Management Services through EDPF (Number)	Business Development & Management Services support provided to 1429 beneficiaries **Source:** Project data	Business Development & Management Services support provided to 75 beneficiaries **Source:** Project data
	93% surveyed beneficiaries reported receiving Business Development & Management Services support through EDPF **Source:** Endline data	100% surveyed beneficiaries reported receiving Business Development & Management Services support through EDPF **Source:** Endline data
	Majority of enterprises have leveraged program support to strengthen their operations: 73% have diversified their business by introducing new products or services, 67% have improved food quality standards, and 67% reported an increase in employment. Additionally, 53% noted growth in enterprise turnover, 43% adopted improved technologies, and 23% were able to mobilize finance for their enterprise. **Source:** Endline data	A significant proportion of enterprises reported positive outcomes following program support: 83% indicated an increase in employment, 77% have diversified their business by introducing new products, 63% have improved food quality standards, 73% reported growth in enterprise turnover, and 63% have adopted improved technologies. However, only 50% of enterprises reported successfully mobilizing finance for their operations. **Source:** Endline data
Number of Incubates graduating from the long-term intensive incubation program supported under EDPF (Number)	-	Long-term intensive incubation program support provided to 75 enterprises under EDPF **Source:** Project data
	-	13% surveyed enterprises reported receiving support from long-term intensive incubation program under EDPF. 3 Cohorts were completed **Source:** Endline data
Source: End Term Assessment (2025), Project Documents		

Component B: Facilitating Agro Cluster Development [Intermediate Results Indicators] (Cumulative Target Values)

		Joint actions undertaken by firms in a cluster (number)	Agro-industrial development plans developed (number)	Firms mobilized into Industry Associations (number)	Negotiable warehouse receipts issued to project beneficiaries (number)	Increase in Trading volume through improved markets (%)	Rural roads upgraded with climate resilient technologies (KM)
Baseline		0	0	0	0	0	0
YR-1	Target	0	0	0	0	5	0
	Achievement	0	0	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
YR-2	Target	28	7	1000	0	5	50
	Achievement	6	0	279	0	0	12
	%	**21.4**	**0.0**	**27.9**	**0.0**	**0.0**	**24.0**
YR-3	Target	96	17	1700	0	10	100
	Achievement	12	0	347	0	0	40
	%	**12.5**	**0.0**	**20.4**	**0.0**	**0.0**	**40.0**
YR-4	Target	164	17	1700	0	15	150
	Achievement	314	18	1917	0	0	47
	%	**191.5**	**105.9**	**112.8**	**0.0**	**0.0**	**31.3**
YR-5	Target	232	17	1700	1000	15	200
	Achievement	330	18	2468	232	0	175.46
	%	**12.6**	**12.6**	**12.6**	**12.6**	**12.6**	**12.6**
YR-6	Target	300	17	1700	5000	20	200
	Achievement	639	18	2742	310	0	175.46
	%	**213.0**	**105.9**	**161.3**	**6.2**	**0.0**	**87.7**
End Target. YR-7	Target	500	17	1700	10000	20	200
	Achievement	695	18	2845	644	47.81	221.48
	%	**139.0**	**105.9**	**167.4**	**6.4**	**239.1**	**110.7**

Source: PMIS (January 2026)

The component has made significant progress in key areas, with achievement of targets for Agro-Industrial Cluster Development Plans and mobilization of firms into industry associations (142%). While good progress has also been made in warehouses upgraded (93%) and markets upgraded (90%), the establishment of e-trading facility and open auction platforms are yet to commence and remains a critical gap.

The targeted number of warehouse receipts was reduced after optimistic planning at the time of project appraisal as the intervention was entirely new to the state. As the warehouse upgradation program took time, the project took up a successful pilot on WRF in Tezpur, Sonitpur District (2023-24).

213.5 km of climate resilient roads have been constructed under the project, benefitting around 87,751 households across 21 districts.

The following table shows the findings from the ETA against some of these indicators:

Number of firms mobilized into Industry Associations (IAs) (Number) N=17
On average, 216 enterprises have been clustered under each Industry Association (IA). Small enterprises with similar commodities were selected. Women's participation remains notable, with an average of 82 members in the general body and 5 in the executive body. All IAs are associated with major agri-horti commodities, with sectoral distribution showing 4 IAs also engaged in fisheries, 2 in dairy and 2 in sericulture and handloom. The financial performance of the IAs demonstrates growth, with annual turnover rising from Rs.20.65 lakh in 2022-23 to Rs.27.35 lakh in 2023-24 and further to Rs.32.06 lakh in 2024-25. About 35% of respondents reported that participation in Industry Associations (IAs) has facilitated better access to loans and credits. Additionally, 53% of the IAs have established market linkages through e-commerce platforms, while 65% have developed connections through modern trade. Furthermore, linkages have been established with retailers (94%), wholesalers (76%) and traders (53%) indicating a diversified and expanding market outreach. IA members confirmed having participated in various capacity-building and trainings over the past year. Among them, 71% reported attending entrepreneurship trainings, 47% participated in exposure visits and 35% were involved in ICT programs, contributing to enhanced business and managerial capabilities among their members.
Rural roads upgraded with climate resilient technologies (Km) N=20
The findings indicate that rehabilitated roads have provided multiple benefits to the respondents. On an average, the length of the surveyed roads upgraded is 1.4 km. All respondents (100%) reported improvement in road quality while 85% noted faster access to town. Increased access to markets was reported by all. All respondents (100%) observed an increase in traffic density following road rehabilitation and 50% felt that access by lorries and trucks had increased. Universally (100%), respondents agreed that road rehabilitation has reduced travel time, made transportation of goods and commodities easier, lowered transportation costs and enhanced market access.

Component B: Facilitating Agro Cluster Development [Output Indicators] (Cumulative Target Values)

		Number of Agro-Industrial Cluster Development Plans (AIDPs) Developed (Number)	Number of firms mobilized into Industry Associations (IAs) (Number)	Number of Warehouses Upgraded (Number)	Warehouse Receipt Financing (Amount in INR lakhs)	Number of Markets Upgraded (Number)	Number of E-Trading Facility / Spot Exchange Platforms Operational (Number)	Number of Open Auction Platforms Operational (Number)	Number of motivational seminars conducted to attract buyers/sellers to the markets (Number)
Baseline		0	0	0	0	0	0	0	0
YR-1	Target	0	0	0	0	0	0	0	16
	Achievement	0	0	0	0	0	0	0	16

		Number of Agro-Industrial Cluster Development Plans (AIDPs) Developed (Number)	Number of firms mobilized into Industry Associations (IAs) (Number)	Number of Warehouses Upgraded (Number)	Warehouse Receipt Financing (Amount in INR lakhs)	Number of Markets Upgraded (Number)	Number of E-Trading Facility / Spot Exchange Platforms Operational (Number)	Number of Open Auction Platforms Operational (Number)	Number of motivational seminars conducted to attract buyers/sellers to the markets (Number)
	%	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
YR-2	Target	7	1000	16	0	15	0	0	48
	Achievement	0	120	0	0	0	0	0	22
	%	**0.0**	**12.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**45.8**
YR-3	Target	17	2000	33	5	50	1	9	80
	Achievement	0	1362	0	0	0	0	0	28
	%	**0.0**	**68.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**35.0**
YR-4	Target	17	2000	40	10	70	2	19	112
	Achievement	18	2038	0	0	0	0	0	40
	%	**105.9**	**101.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**35.7**
YR-5	Target	17	2000	40	15	75	4	30	144
	Achievement	18	2468	6	75	17	0	0	58
	%	**12.6**	**12.6**	**12.6**	**12.6**	**12.6**	**12.6**	**12.6**	**12.6**
YR-6	Target	17	2000	40	20	75	4	30	144
	Achievement	18	2742	11	80	17	0	0	76
	%	**105.9**	**137.1**	**27.5**	**400.0**	**22.7**	**0.0**	**0.0**	**52.8**
End Target. YR-7	Target	17	2000	40	25	100	4	30	144
	Achievement	18	2845	37	170	96	0	0	109
	%	**105.9**	**142.3**	**92.5**	**680.0**	**96.0**	**0.0**	**0.0**	**75.7**

Source: PMIS (January 2026)

37 godowns and 96 markets have been upgraded/modernized under the project.

Two output indicators against eight could not be achieved, related to trading and e-auctions.

A feasibility study for setting-up electronic auctions and spot exchange platforms in Assam was carried out through a competitively hired agency. In the early phase of the study, it became evident that setting-up such platforms was not feasible at that point of time. The same was discussed with World Bank and accordingly the initiative to set-up such platforms were aborted.

The target for Warehouse Receipt Financing in monetary terms corresponding to number of receipts remained low by an oversight.

The table below shows the findings from the ETA against some of the output indicators of Component B:

Number of Warehouses Upgraded (Number) N=20
The average total storage capacity of the renovated warehouses is 4,033 MT. At present, they store about 2,088 MT per month. Around 55% of the warehouses store more than one type of agri-horti value chain commodity. All warehouses reported that trucks can access their premises and that they are well-connected through dedicated approach roads and internal roads, ensuring efficient movement of goods to and from the facility. Construction of Drainage system also has proved to be beneficial and has improved occupancy rate.
Number of Markets Upgraded (Number) N=20
On average, each market has around 61 traders and 44 vendors, along with 5 registered Grower's Societies. About 30 sellers and 14 traders, on average, are formally registered with the market. The markets handle an average annual volume of 4,135 MT of commodities. All markets trade in a wide range of agri-horti value chain commodities, with pulses and vegetables sold universally, followed by mustard, fruits and spices. Around 50% of the markets have wholesale sheds, while all markets have retailer sheds.
Source: End Term Assessment (2025)

Component C: Fostering Market Led Production and Resilience Enhancement [Intermediate Results Indicators] (Cumulative Target Values)

		Climate resilient technologies demonstrated in the project areas (Number)	Farmer Producer Organizations (FPOs) supported by the Project-FPOs (No.)	Farmer Producer Organizations (FPOs) supported by the Project-Members (No.)	Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum)-Fish	Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum)-Milk	Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum)-Agricultural Commodity	Producers provided financial education / counseling	Producers with increased access to financial services (number), of which at least 30% are female
Baseline		0	0	0	0	27	0	0	0
YR1-	Target	7	0	0	0	30	0	2500	0
	Achievement	7	0	0	0	30	0	0	0

		Climate resilient technologies demonstrated in the project areas (Number)	Farmer Producer Organizations (FPOs) supported by the Project-FPOs (No.)	Farmer Producer Organizations (FPOs) supported by the Project-Members (No.)	Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum)-Fish	Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum)-Milk	Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum)-Agricultural Commodity	Producers provided financial education / counseling	Producers with increased access to financial services (number), of which at least 30% are female
	%	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
YR-2	Target	15	0	0	0	45	0	10000	0
	Achievement	11	0	0	0	36	0	0	0
	%	**73.3**	**0.0**	**0.0**	**0.0**	**80.0**	**0.0**	**0.0**	**0.0**
YR-3	Target	25	30	12000	2000	90	40000	30000	0
	Achievement	18	0	15580	0	38	0	15839	1276
	%	**72.0**	**0.0**	**129.8**	**0.0**	**42.2**	**0.0**	**52.8**	**0.0**
YR-4	Target	25	50	20000	3500	175	45000	70000	0
	Achievement	18	44	24506	0	73	201	20001	3845
	%	**72.0**	**88.0**	**122.5**	**0.0**	**41.7**	**0.4**	**28.6**	**0.0**
YR-5	Target	25	125	50000	5500	315	53000	150000	50000
	Achievement	18	124	59357	5400	74	1731.9	27321	23325
	%	**12.6**	**12.6**	**12.6**	**12.6**	**12.6**	**12.6**	**12.6**	**12.6**
YR-6	Target	25	125	60000	6000	505	60000	200000	100000
	Achievement	26	126	60094	8429	186	8686.47	130009	38447
	%	**104.0**	**100.8**	**100.2**	**140.5**	**36.8**	**14.5**	**65.0**	**38.4**
End Target. YR-7	Target	25	125	60000	10000	100000	30000	250000	125000
	Achievement	27	125	60094	10272.45	56575	27016.42	200479	117259
	%	**108.0**	**100.0**	**100.2**	**102.7**	**56.6**	**90.1**	**80.2**	**93.8**

	Climate resilient technologies demonstrated in the project areas (Number)	Farmer Producer Organizations (FPOs) supported by the Project-FPOs (No.)	Farmer Producer Organizations (FPOs) supported by the Project-Members (No.)	Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum)-Fish	Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum)-Milk	Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum)-Agricultural Commodity	Producers provided financial education / counseling	Producers with increased access to financial services (number), of which at least 30% are female
Source: PMIS (January 2026)								

The project achieved targets in 4 indicators. Along with climate-resilient technology demonstrations, the two indicators related to FPCs have been achieved. Out of the three indicators related to CSC, the one on Fish surpassed expectations and on agriculture commodity is above 90%, while milk throughput of the CSCs (56.6%) lagged targets.

The fifth indicator on milk remained unachieved. As per the PAD, the target set was 760 MT per annum which was previously achieved. However, since the target was on the lower side, the same was set by World Bank for 1,00,000 MT, which could not be achieved.

APART-led climate-resilient demonstrations

Agriculture

- The Paddy PMIS dataset covered 72,033 demonstrations over 2018 to 2023, with a cumulative demonstration area of 21,044 ha, across 26 districts engaging 19.7% women farmers and 80.3% men.
- The Maize PMIS dataset covered 4,844 demonstrations implemented between 2018 and 2023, across 16 districts, covered a total of 1,868 ha of farmer fields (average 0.39 ha per demonstration), with 18% of demonstrations involved women farmers.
- The Pulses PMIS dataset showed 6,402 demonstrations from 2018-23 across 13 districts with a cumulative area of 2087.9 ha engaging 22.7% female farmers.

Horticulture

- The Horticulture PMIS dataset comprising fruits (banana and pineapple) and vegetables (brinjal, cabbage, cauliflower, potato, pumpkin and tomato) covered 9,671 demonstrations over 2018 to 2023, with a cumulative demonstration area of 2,726.64 ha, across 18 districts engaging 22.7% women.

Spices and Condiments

- The Mustard PMIS dataset from 2018 to 2023 covered 80,025 demonstrations across 17 districts with a cumulative area of 23,475.9 ha, engaging 28.7% female farmers.
- The Ginger PMIS dataset from 2018-23 covered 400 demonstrations across 4 districts with a cumulative area of 88.48 ha, engaging 28% female farmers.

Fisheries VC

- APART has reached out to 11,918 fish farmers (including Beel members), among which 23.2% are female farmers through various interventions.

Milk VC

- 21 DCSs have been formed by the Directorate of Dairy Development
- WAMUL operated through 24 districts, covering 3400 villages and forming 1600 DCSs with 50,000+ active pourers. Expanded milk processing capacity from 60 to 150 TLPD, with facilities for value-added products such as ice cream, flavored milk and traditional sweets.

Sericulture and Handloom

- Sericulture - Plantation support, training and rearing houses were provided to 4591 Eri farmers and Muga farmers, among which 2632 are females.
- Handloom – Through APART, the Directorate of Handloom & Textiles have worked with 7000 weavers of which 99% are women, 33.7% belonged to indigenous groups. 12 Farmer Producer Companies (FPCs) have been successfully registered to strengthen farmer collectives and streamline production and marketing, and 4 Common Service

Centers (CSCs) have been established to support the operations and provide shared facilities to the stakeholders involved.

Farmer Producer Company (FPC) - APART has promoted 125 FPCs across three significant value chains, namely Agri-Horti, Fishery and Silk, which are owned and managed by farmers. Through this FPC intervention, APART has also given importance to developing the capacity and skills of FPC members in post-harvest management, governance, value addition and marketing of the produce for better price realization of FPC products. The business development support extended from APART is multi-pronged for the overall growth and sustainability of the FPCs.

Common Service Centers (CSCs) - 37 (Agri-horti - 10, Fishery - 22 and Silk - 5) CSCs are functional.

Krisarthak (Financial Education Counseling) - The objective of Krisarthak was to develop and implement an ICT-based FEC program for target beneficiaries to contribute to enhancing their financial inclusion, defined as their access to and prudential use of appropriate financial services. 129,470 farmers were reached out, 51,506 (40%) were women. 58,268 farmers were registered through Bittiya Sakhi chatbot and Kobo App (for base phone users) in 21 districts. 25,420 (43.6%) male farmers, 32,848 (56.4%) female farmers were registered - 52,240 (89.65%) smartphone users and 6028 (10.34%) base phone users. Five value-chains (Agri/Horti, Fishery, Handloom, Sericulture and Dairy) were covered. APART supported FPCs and DCS were also reached out.

Xamahar Assam Challenge Fund mobilized ten financial institutions to innovate and scale value-chain financing models, which benefited 1,17,259 producers across priority districts. Through APART Rs. 35.18 crores were granted to the sub-projects.

The table below shows ETA findings against the Component C intermediate indicators:

<table>
<tr><th>Output Indicator</th><th>Findings</th></tr>
<tr><td>Climate resilient technologies demonstrated in the project areas (Number)</td><td>The ETA reached out to 4861 farmers (of which 26% were female farmers) across agri-horti, milk and fisheries value-chain, who have received climate resilient technology demonstrations from 2018-2024.</td></tr>
<tr><td>Farmer Producer Organizations (FPOs) supported by the Project-FPOs (No.) N=100</td><td rowspan="2">On average, the FPCs are having more than 502 members, including 335 male and 167 female shareholders, of which 91 belong to indigenous groups. The focused commodities of FPCs include rice (35%), fish (26%), mustard (13%), and eri and muga silk (9%), while the remaining 18% comprises other agri-horti commodities.
The annual turnover of the FPCs has shown a steady increase, from INR 14.5 lakh in 2022-23 to INR 15.9 lakh in 2023-24 and INR 17.2 lakh in 2024-25. Furthermore, 63% of FPCs have gained access to new markets or marketing channels, including online platforms, while 48% have secured access to loans and credit facilities. When asked about the benefits perceived by farmers from joining FPCs, 69% of FPCs reported that farmers experience better price realization for their produce, while 19% mentioned that farmer's interests are safeguarded through year-round access to organized markets.</td></tr>
<tr><td>Farmer Producer Organizations (FPOs) supported by the Project-Members (No.) N=100</td></tr>
<tr><td>Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum) - Fish N=12</td><td>The 12 Fish CSCs collectively reported sales of 555 tons of fish during the year 2024-25, generating a total revenue of approximately Rs 5.28 Crore.
In addition to fish, these CSCs also engage in trading other commodities such as paddy, maize, mustard, potato, cabbage, cauliflower, black gram, turmeric with a combined sales volume of about 238 tons and revenue of Rs 80.9 lakh.</td></tr>
<tr><td>Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum) - Milk</td><td>DCS (WAMUL) - A total of 5,032 kg of milk is sold every day to WAMUL by 324 dairy farmers, with each farmer selling an average of 15.53 kg per day at a price of Rs. 48.07, over an average of 29.59 selling days per month.
On an average per farmer sells 4603.54 kgs of milk per year</td></tr>
</table>

Output Indicator	Findings
	DCS (DDD) - A total of 2,727 kg of milk is sold every day to WAMUL by 255 dairy farmers, with each farmer selling an average of 10.69 kg per day at a price of Rs. 47.74, over an average of 29.29 selling days per month. On an average per farmer sells 3050.85 kg of milk per year
Increase Volume throughput of the Common Service Centers (CSCs) (tons per annum) - Agricultural Commodity N=7	The 7 Agri-horti CSCs collectively reported an annual sale of 350 MT of focus commodities such as rice, mustard, and banana, generating a revenue of approximately Rs 86.9 lakh. In addition, the CSCs sold 245 MT of processed/ semi-processed products, by-products, other commodities etc. generating an additional revenue of Rs 97.5 lakh. Together, these accounted for a cumulative sale of 595 metric tons and a total revenue of about Rs 1.84 Crore during 2024-25.
Producers provided financial education / counseling. N=100	On average, 35 members per FPC participated in Krisarthak/FEC training programs. 75% of FPCs organized KCC awareness camps, and among these, an average of 100 members attended the camps.
Producers with increased access to financial services (number), of which at least 30% are female.	When asked about the types of thematic support received through the Challenge Fund, 98% of respondents mentioned insurance-related support. Among them, 75% reported receiving regular crop insurance, while 50% availed Wage-loss (Hospi-cash) Insurance. Additionally, among respondents who received loans, 100% indicated that these were working capital loans. 50% reported that Xamahar enabled them to access credit for improving their businesses. One-third (33%) indicated that they were able to expand their business operations, while 48% acknowledged that risks were effectively mitigated through the insurance support provided under the program. 80% of respondents from Vimo Sewa, Dehaat and ECSO reported improved awareness of insurance procedures and documentation. Likewise, 85% of respondents from Samunnati, RangDe, ESAF and Integra indicated that they have gained the skills for the required documentation for availing credit loans. Most claims were made under the Parametric Insurance scheme. While the initiative was taken positively, it was closed prematurely for unspecified reasons. It is recommended that the scheme be revived or considered in future project designs.
Source: End Term Assessment (2025)	

Component C: Fostering Market Led Production and Resilience Enhancement [Output Indicators] (Cumulative Target Values)

Horticulture, crop, spices and condiments value chains:

		Number of Demonstrations on Climate Resilient Technologies conducted by Agriculture and Horticulture Departments (Number)	Number of Demonstrations on Climate Resilient Technologies conducted by Assam Agricultural University (Number)	Number of Trainings of Nursery Growers Conducted (Number)
Baseline		0	0	0
YR-1	Target	1814	210	20
	Achievement	0	0	0
	%	**0.0**	**0.0**	**0.0**
YR-2	Target	5054	450	40
	Achievement	4211	419	2

		Number of Demonstrations on Climate Resilient Technologies conducted by Agriculture and Horticulture Departments (Number)	Number of Demonstrations on Climate Resilient Technologies conducted by Assam Agricultural University (Number)	Number of Trainings of Nursery Growers Conducted (Number)
	%	**83.3**	**93.1**	**5.0**
YR-3	Target	9164	690	60
	Achievement	6386	724	28
	%	**69.7**	**104.9**	**46.7**
YR-4	Target	13274	832	100
	Achievement	7849	724	58
	%	**59.1**	**87.0**	**58.0**
YR-5	Target	17034	832	140
	Achievement	18358	781	166
	%	**12.6**	**12.6**	**12.6**
YR-6	Target	20234	832	140
	Achievement	22650	791	166
	%	**111.9**	**95.1**	**118.6**
End Target. YR-7	Target	22000	832	140
	Achievement	22650	791	166
	%	**103.0**	**95.1**	**118.6**
Source: PMIS (January 2026)				

The performance of **Agri-Horti Value Chains** has been strong, with demonstrations on climate-resilient technologies by departments exceeding targets (103%) and training of nursery growers at 119%, while AAU demonstrations reached 95% of the target.

The table below reflects adoption data for agri-horti commodities and spices from the ETA:

Output Indicator	Findings
Horticulture, crop, spices and condiments value chains: Number of Demonstrations on Climate Resilient Technologies conducted by Agriculture and Horticulture Departments (Number)	**Paddy -** 75% of 2018 demonstration farmers, 81.5% of 2019 farmers, 79% of 2020 farmers, 74% of 2021 farmers and 98% of 2022 farmers have continued cultivating STRVs last season (2025), much after they had received demonstration. 74.5% farmers have adopted seed varieties recommended by APART during demonstrations and 71.9% have continued following the said package of practices.
	Maize - 84.8% farmers have adopted seed varieties recommended by APART during demonstrations and have continued following the said package of practices.
	Pulses - 60.2% farmers have adopted seed varieties recommended by APART during demonstrations and 56.3% have continued following the said package of practices.
	Fruits - 48.8% farmers have adopted seed varieties recommended by APART during demonstrations and 47.6% have continued following the said package of practices.

Output Indicator	Findings
	Potato - 70% farmers of 2018 demonstration farmers, 95% of 2019 farmers, 77% of 2020 farmers, 79% of 2021 farmers, 97% of 2022 farmers and 71% of 2023 farmers have continued cultivating the APART recommended potato varieties in the last season, much after they had received demonstrations. 95% farmers have adopted seed varieties recommended by APART during demonstrations and 94% have continued following the said package of practices. **Processed Potatoes -** 72% farmers have adopted seed varieties recommended by APART during demonstrations and 71.3% have continued following the said package of practices.
	Vegetables - 72.3% farmers have adopted seed varieties recommended by APART during demonstrations and 71.3% have continued following the said package of practices.
	Mustard - 99% farmers who have received demonstration support in the year 2020, continued to use the APART recommended seed varieties in the last season, similarly 69% of 2021 farmers and 92% of 2022 farmers have used recommended seed varieties last season, much after they had received demonstrations. 81.6% farmers have adopted seed varieties recommended by APART during demonstrations and 78.8% have continued following the said package of practices.
	Ginger - 84.1% farmers have adopted seed varieties recommended by APART during demonstrations and 83.3% have continued following the said package of practices.
Source: End-term Assessment (2025)	

Component C: Fostering Market Led Production and Resilience Enhancement [Output Indicators] (Cumulative Target Values)

Milk value chain: Formal Sector

		Number of AI Services to be Administered per Year (Number)	Number of Calves to be Born per Year (Number)	Number of Dairy Farmers to be reached through MPIs/DCS (Number)	Quantity of Milk to be Procured from MPIs/DCS (?000 kg per Day)	Creation of Chilling Capacity (BMCs) (?000 liters per Day)	Creation of Liquid Milk Processing Capacity (?000 liters per Day)	Milk Sales (?000 kg Per Day)
Baseline		0	0	0	0	0	0	0
YR-1	Target	56550	15834	1275	25	4	0	66
	Achievement	39520	21370	255	1.34	0	0	50.68
	%	**69.9**	**135.0**	**20.0**	**5.4**	**0.0**	**0.0**	**76.8**
YR-2	Target	156420	43798	5180	36	18	40	80
	Achievement	105374	44723	1027	2.42	0	0	54.09
	%	**67.4**	**102.1**	**19.8**	**6.7**	**0.0**	**0.0**	**67.6**
YR-3	Target	303330	84934	10650	54	64	130	112
	Achievement	253712	80992	12835	29.62	33	0	55
	%	**83.6**	**95.4**	**120.5**	**54.9**	**51.6**	**0.0**	**49.1**
YR-4	Target	482790	135181	18480	82	141	130	135

		Number of AI Services to be Administered per Year (Number)	Number of Calves to be Born per Year (Number)	Number of Dairy Farmers to be reached through MPIs/DCS (Number)	Quantity of Milk to be Procured from MPIs/DCS (?000 kg per Day)	Creation of Chilling Capacity (BMCs) (?000 liters per Day)	Creation of Liquid Milk Processing Capacity (?000 liters per Day)	Milk Sales (?000 kg Per Day)
	Achievement	377347	124092	13522	38	47	60	65
	%	**78.2**	**91.8**	**73.2**	**46.3**	**33.3**	**46.2**	**48.1**
YR-5	Target	679374	190225	27895	120	209	180	158
	Achievement	758452	288249	28513	48	88	60	83
	%	**111.64**	**151.53**	**102.22**	**40.00**	**42.11**	**33.33**	**52.53**
YR-6	Target	894546	250471	36400	159	287	180	187
	Achievement	818839	308919	28513	52	103	150	103
	%	**91.5**	**123.3**	**78.3**	**32.7**	**35.9**	**83.3**	**55.1**
End Target. YR-7	Target	1132530	317110	44955	202	307	180	217
	Achievement	1084665	423438	49681	161.52	220	150	137.24
	%	**95.8**	**133.5**	**110.5**	**79.96**	**71.7**	**83.3**	**63.2**

Source: PMIS (January 2026)

The progress of Milk Value Chain (Formal sector) is mixed. AI services reached 96% of the target cumulatively, while calves born at HH level exceeded expectations at 134%. The number of dairy farmers covered was also higher than planned (111%). However, indicators on milk procurement (80%), chilling capacity (72%), processing capacity (83%) and milk sales (63%) fell short of their respective targets.

WAMUL emerged as a new leader in the milk sector in Assam with significant growth and transformation through APART. WAMUL underwent a major infrastructure and operational transformation that significantly improved productivity, efficiency and transparency across its dairy value chain, under APART.

- WAMUL established a network of 400 trained Mobile AI Technicians (MAITs) delivering over 11 lakh AI services, leading to the birth of 5 lakh genetically improved calves, 50% of which are female.
- Over 2 lakh genetically improved female calves born, ensuring higher future milk productivity.
- WAMUL expanded operations to 24 districts, covering 3400 villages and forming 1600 DCSs with 50,000+ active pourers.
- Increased daily milk procurement to 1.6 lakh kg, sourced directly from farmers.
- WAMUL has set up 70 Bulk Milk Cooling (BMC) units (2.2 lakh LPD total capacity) and deployed 18 insulated road milk tankers (RMTs) with a capacity of 1,56,000 liters to maintain a seamless cold chain.
- WAMUL expanded milk processing capacity from 60 to 150 TLPD, with facilities for value-added products such as ice cream, flavored milk and traditional sweets.

The table below reflects data from the End-term assessment:

Output Indicator	Findings
Percentage of farmers who have availed AI services	85.8% dairy farmers reported to have availed AI services
Total number of calves born per year	On an average 624 number of calves were born per year
Average number of Dairy Farmers who are members of MPI / DCS	All 353 dairy farmers (100%) were members of MPIs/DCS
Quantity of milk sold to WAMUL	80.7% dairy farmers sell milk to WAMUL - 15.53 kg per day (average) at Rs. 48.07. On average per farmer sells 4603.54 kg of milk per year
Daily milk sales of dairy farmer	Rs. 931.2 per farmer per day
Source: End-term Assessment (2025)	

Component C: Fostering Market Led Production and Resilience Enhancement [Output Indicators] (Cumulative Target Values)

Milk value chain: Informal Sector

		Dairy Informal Milk Marketable Surplus (kg per Day)	Informal Milk channeled into the Formal Sector (kg per day)	Informal Milk available for processing (kg per day)	Value Realized from the Informal Milk Channeled to the Formal Milk Sector (Rs?000 per day)
Baseline		0	0	0	0
YR-1	Target	0	0	0	0
	Achievement	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**
YR-2	Target	0	0	0	0
	Achievement	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**
YR-3	Target	21600	10800	1080	117
	Achievement	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**
YR-4	Target	51840	25920	3888	303
	Achievement	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**
YR-5	Target	82080	41040	8208	514
	Achievement	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**
YR-6	Target	103680	51840	12960	689
	Achievement	25763	12580	25763	528
	%	**24.8**	**24.3**	**198.8**	**76.6**
End Target.	Target	207360	103680	31104	1450

		Dairy Informal Milk Marketable Surplus (kg per Day)	Informal Milk channeled into the Formal Sector (kg per day)	Informal Milk available for processing (kg per day)	Value Realized from the Informal Milk Channeled to the Formal Milk Sector (Rs?000 per day)
YR-7	Achievement	82520.34	40287.3	42233.04	1893.5
	%	**39.8**	**38.9**	**135.8**	**130.6**
Source: PMIS (January 2026)					

In the informal sector, while the marketable surplus is only 40%, encouragingly, value realized from informal milk channeled to the formal sector surpassed targets (131%).

The Directorate of Dairy Development (OPIU) facilitated the transformation of the informal dairy sector into the formal one through improvement in resilience in production, quality, safety and standards of milk adding value to the produce with particular focus on informal market actors and dairy entrepreneurs in targeted districts. Few key activities included:

- Design, Development and Printing of training manuals for Informal Milk Market Actors, protocols for Training of Trainers (ToT), capacity building of government officials on Laboratory Technology were conducted with support from International Livestock Research Institute (ILRI).
- Training of milk market actors (Milk Producers, Milk Traders, Sweet Makers and Cottage Processors) in targeted project districts on improved package of practices for quality and hygiene was conducted. Immediately after each training, a Hygienic Milk Monitoring Committee (HMMC) was constituted among the trained actors to monitor the adoption of improved practices taught during the training.
- Formation of Dairy Cooperatives Societies (DCS) among the interested trained Milk Producers through mobilizing the informal dairy value chain through strengthening of the existing DCS, formation of new DCS wherever feasible and register them under the Assam Cooperatives Registration Act. They were supported with capacity up-gradation, input services, market access and other linkages in the Milk value chain.
- Linkages and Support to market actors to run their business efficiently by providing input support and recognition for adoption of improved practices.
- Development of Milk Collection Centers at each DCS for better aggregation of milk produced by each member of the Dairy Cooperative Society (DCS).

The table below reflects data from the ETA for the informal sector Milk VC:

Output Indicator	Findings
Milk marketable surplus (kg/day)	14.56 kg/day from intervention area and 12.8 kg/day from control area
Amount of milk channeled into the formal sector	72.8% farmers are pouring milk, 15.06 liters per day at Rs. 51.3 per kg to the DCS (intervention), 20.75% farmers are pouring milk, 19.74 liters per day at Rs. 46.78 per kg to the DCS (control)
Amount of milk available for processing	**Sweet processor** - 14.3% farmers - 5.42 liters per day at Rs. 49.3 (intervention) - 29.8% farmers - 7.49 liters per day at Rs. 46.22 (control) **Cottage cheese processors** - 2.8% farmers - 9.7 liters per day at Rs. 45.0 per day (intervention) - 6.3% farmers - 4.14 liters of milk per day at Rs. 49.2 (control)

Output Indicator	Findings
Source: End-term Assessment (2025)	

Component C: Fostering Market Led Production and Resilience Enhancement [Output Indicators] (Cumulative Target Values)

Fisheries value chain:

		Area Under Climate Resilient Aquaculture Practices (Hectares)	Water Area in Hectares to be covered under Technology Demonstration in Beel fisheries (Hectares)	Increase in Marketable Surplus due to climate resilient aquaculture practices (Tons)	Increase in Marketable Surplus due to technology demonstration in Beel fisheries combining small indigenous fishes (Tons)
Baseline		0	0	0	0
YR-1	Target	0	0	0	0
	Achievement	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**
YR-2	Target	250	125	1225	250
	Achievement	240.9	138.25	0	0
	%	**96.4**	**110.6**	**0.0**	**0.0**
YR-3	Target	650	425	3125	850
	Achievement	793.28	423	5343.49	774.2
	%	**122.0**	**99.5**	**171.0**	**91.1**
YR-4	Target	1150	925	5225	1850
	Achievement	1366.81	703	5353.01	1282.71
	%	**118.9**	**76.0**	**102.4**	**69.3**
YR-5	Target	1450	1625	6625	3250
	Achievement	2090.19	1160.91	5587.55	1850
	%	**144.2**	**71.4**	**84.3**	**56.9**
YR-6	Target	1700	2225	7850	4450
	Achievement	2607.04	1160.91	5587.55	1850
	%	**153.4**	**52.2**	**71.2**	**41.6**
End Target. YR-7	Target	1700	2225	7850	4450
	Achievement	2652.34	1239.34	5587.55	1850
	%	**156.0**	**55.7**	**71.2**	**41.6**
Source: PMIS (January 2026)					

The water area brought under the **Fisheries Value Chain** for climate-resilient aquaculture practices has substantially exceeded the target (156%), although the resulting marketable surplus has remained lower at 71% of the target.

The Fisheries interventions under APART focused on sustainable fisheries development in Assam. It aimed to increase fish production and productivity through climate-resilient aquaculture and better management practices, while enhancing food security and the livelihoods of smallholder farmers and fishers. The project was implemented by the Department of Fisheries, Assam with technical support from organizations like WorldFish[5] .

The APART aquaculture demonstrations (polyculture, paddy-cum-fish, polyculture with freshwater prawns) showed a consistent scale-up over six years, covering 7,789 beneficiaries and 2,652.34 ha of water area against a target of 2,504 ha, indicating strong field uptake and participation. The Beel Fishery component of the APART project supported 68 beels across five years, bringing 1,105.74 hectares of natural water bodies under improved scientific management.

The table below reflects data from the ETA:

Output Indicator	Findings
Marketable Surplus due to climate resilient aquaculture practices (in kgs)	**Polyculture Fisheries** - 3094.1 kg per year per farmer (intervention) and 1116.225 kg per year per farmer (control)
	Paddy-cum-Fish - 1092.02 kg per year per farmer
	Polyculture with Prawns - 2492.75 kg per year per farmer
Marketable Surplus due to technology demonstration in Beel fisheries combining small indigenous fishes (in kgs)	**Beel Fisheries** - 1180.31 kg per year per farmer
Source: End-term Assessment (2025)	

Component C: Fostering Market Led Production and Resilience Enhancement [Output Indicators] (Cumulative Target Values)

Sericulture and Handloom Value Chain

		Increase in Eri Raw Silk production (Tons)	Increase in Muga Raw Silk production (Tons)	Increase in Eri fabric production (in metres)	Increase in Muga fabric production (in metres)
Baseline		29	5	598000	198000
YR-1	Target	29	5	626000	201300
	Achievement	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**
YR-2	Target	29	5	656000	211860
	Achievement	29	5.175	0	0
	%	**100**	**103.5**	**0.0**	**0.0**
YR-3	Target	29	5	690000	222420
	Achievement	29	5.175	0	0
	%	**100.0**	**103.5**	**0.0**	**0.0**
YR-4	Target	31	6	736000	237820
	Achievement	43.95	6.14	600651	199217
	%	**141.8**	**102.3**	**81.6**	**83.8**
YR-5	Target	34	7	788000	254980
	Achievement	68.616	7.299	663041	288910

[5] https://worldfishcenter.org/project/assam-agribusiness-rural-transformation-apart

		Increase in Eri Raw Silk production (Tons)	Increase in Muga Raw Silk production (Tons)	Increase in Eri fabric production (in metres)	Increase in Muga fabric production (in metres)
	%	**201.8**	**104.3**	**84.1**	**113.3**
YR-6	Target	37	7	844000	272910
	Achievement	70.68	7.903	782388	314912
	%	**191.0**	**112.9**	**92.7**	**115.4**
End Target. YR-7	Target	37	7	902000	291610
	Achievement	73.38	8.163	923218	349552
	%	**198.3**	**116.6**	**102.4**	**119.9**
Source: PMIS (January 2026)					

APART has supported the eri and muga silk farmers through plantation support, providing training and exposure visits, providing rearing houses, spinning and reeling machines and market linkages like fairs and reshom haat. Since, sericulture activities are inherently home-based, it was an unorganized sector. APART through the Department of Sericulture facilitated the formation of Farmer Interest Groups (FIGs) and FPCs for the first time in Assam. Reelers and spinners were incorporated in the FIGs, 1 machine for 3 muga silk reelers and 1 machine for 2 eri silk spinners were provided. Rearing capacity for eri silk was expanded. Plantation activities both in government land and private (farmers') land were promoted. The rearing cost for muga thereby reduced. Eri male farmers systematically cultivated and managed their plantations, thereby reducing the workload of women rearers (eri). The quality of reeling and spinning improved with the available machines. Skill development training was provided to nearly all farmers.

APART has reached to 4591 eri and muga silk farmers of which 2362 are females.

Component C: Fostering Market Led Production and Resilience Enhancement [Output Indicators] (Cumulative Target Values)

Cross cutting areas of Formal and Informal Milk Sectors:

		Number of animals covered under the projects immunization program (Number)	Number of animal health camps (Number)	Number of reproductive health and Mastitis management camps (Number)	Number of Gopal Mitras trained and established (Number)	Training of DCS members on Dairy management (Number)
Baseline		0	0	0	0	0
YR-1	Target	207896	736	232	0	0
	Achievement	0	0	0	0	0
	%	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
YR-2	Target	617528	2348	412	17	20
	Achievement	423267	0	0	0	0
	%	**68.5**	**0.0**	**0.0**	**0.0**	**0.0**
YR-3	Target	1168615	4512	608	32	83
	Achievement	904560	2285	186	44	0
	%	**77.4**	**50.6**	**30.6**	**137.5**	**0.0**

		Number of animals covered under the projects immunization program (Number)	Number of animal health camps (Number)	Number of reproductive health and Mastitis management camps (Number)	Number of Gopal Mitras trained and established (Number)	Training of DCS members on Dairy management (Number)
YR-4	Target	1798502	7096	689	37	130
	Achievement	1314460	3785	373	44	100
	%	**73.1**	**53.3**	**54.1**	**118.9**	**76.9**
YR-5	Target	2444734	9784	736	42	177
	Achievement	247480	5285	373	44	0
	%	**10.1**	**54.0**	**50.7**	**104.8**	**0.0**
YR-6	Target	3105421	12565	769	46	210
	Achievement	247480	5285	373	44	350
	%	**8.0**	**42.1**	**48.5**	**95.7**	**166.7**
End Target. YR-7	Target	3727758	15111	769	46	210
	Achievement	386068	5285	373	44	350
	%	**10.4**	**35.0**	**48.5**	**95.7**	**166.7**
Source: PMIS (January 2026)						

Note: The Foot and Mouth Disease (FMD) immunization under APART was put on hold as it was then covered by GoI scheme. Major inputs were put into training activities.

Findings from End-term Assessment study related to few indicators:

- **Health Camps:** 55.3% farmers have attended health camps on reproductive health and Mastitis management and immunization.
- **Training of DCS:** 42.2% farmers have received training on dairy management through DCS.

Component D: Project Management, Monitoring and Learning [Intermediate Results Indicator | Output Indicator] (Cumulative Target Values)

		Grievances registered related to delivery of project benefits that are actually addressed (Percentage) (CRI)
Baseline		0
YR-1	Target	70
	Achievement	100
	%	**0.0**
YR-2	Target	80
	Achievement	100
	%	**125.0**
YR-3	Target	80
	Achievement	100
	%	**125.0**
YR-4	Target	100
	Achievement	100

		Grievances registered related to delivery of project benefits that are actually addressed (Percentage) (CRI)
	%	**100.0**
YR-5	Target	100
	Achievement	100
	%	**100.0**
YR-6	Target	100
	Achievement	100
	%	**100.0**
End Target. YR-7	Target	100
	Achievement	100
	%	**100.0**
Source: PMIS (January 2026)		

All grievances lodged in the project have been addressed timely.

In the processing of all grievances, APART follows international best practices including the adoption of basic procedures such as acknowledging all grievances and assigning a central tracking number/ID for all grievances alongside basic service standards for the response. APART has also established an operating procedure for the handling of unresolved grievances through a process of escalation - where unresolved grievances are transmitted to the next higher level - to OPIUs and then PCU. The PCU aggregates all grievances into a consolidated single database to monitor the performance of PIUs with service standards and generate aggregated statistics on performance to be disclosed on the project's web platform for the public.

A comprehensive set of trainings on the GRM has been undertaken covering the PCU and PIUs at the State and District level. The training was designed as cascading from the PCU that trains State Level PIU officials as part of the Social Safeguards Training. The PCU and State Officials joined the training sessions for the District Level PIUs conducted by DLCC. Service providers and ATMAs also received training on the GRM.

The tollfree helpline number is functional.

The table below is data collected from ETA from farmers interviewed:

Segments	Percentage of respondents who are aware of APART's GRM process	Percentage of respondents who have ever lodged a formal complaint	Whether the lodged grievance was addressed (Y/N)
Agri-Hoti	67	19	Yes
Milk	77	21	Yes
Fisheries	57	15	Yes
Sericulture and Handloom	70	22	Yes
Kshyamata and AAGL	52	15	Yes
Xamahar	13	0	-
Industry Associations and CFC	39	3	Yes
FPC and CSC	35	4	Yes

Segments	Percentage of respondents who are aware of APART's GRM process	Percentage of respondents who have ever lodged a formal complaint	Whether the lodged grievance was addressed (Y/N)
Roads	80	10	Yes
Markets	55	10	Yes
Warehouse	55	15	Yes
Source: End Term Assessment (2025)			

The assessment of APART's Grievance Redress Mechanism (GRM) indicates that while the system is responsive and effective for those who use it, awareness and uptake vary significantly across beneficiary segments. Awareness is highest among respondents in the Roads (80%), Milk (77%), Sericulture & Handloom (70%) and Agri-Horti (67%) sectors, whereas segments such as Industry Associations & CFC (39%), FPCs & CSCs (35%) and particularly Xamahar (13%) exhibit very low awareness levels.

The proportion of respondents who have ever lodged a formal grievance remains low overall, with only a few segments, Sericulture & Handloom (22%), Milk (21%), Agri-Horti (19%) and Warehouses (15%), showing relatively higher engagement. Notably, all respondents who lodged grievances confirmed that their issues were addressed, reflecting a functional and responsive GRM system.

The findings suggest a need for strengthened communication and outreach efforts, especially in low-performing segments, to ensure equitable access and improved utilization of the GRM across all APART-supported groups.

3.2 Component A: Enabling Agri Enterprise Development

The objective of this component is to enable the establishment, operations and growth of Agri enterprises by creating a congenial investment climate and linking them with much-needed access to finance and technology. This entails a reduction in business and transaction time and cost.

3.2.1 A1: Enhancing State Capacity to Attract Private Investment

The objective of this sub-component is to strengthen the newly established Assam Bureau of Investment Promotion (ABIP), Investment Facilitation Cell, Invest Assam to anchor the private sector investment promotion and facilitation at the state level and strengthen the District Industries and Commerce Centers (DICC).

3.2.1.1 Support to Private Investment at State Level

Activities undertaken for Investment Promotion and Outreach:

Under Component A1, support has been provided to Investors for end-to-end facilitation including Investor outreach, Land identification, Site selection, Policy incentives, Coordination with EoDB team for approvals etc. Key activities for achieving the mentioned objectives are

- A Sector & sub-sector scan study was undertaken to Identify key sector, sub-sector and USP of the State for showcasing to Investors.
- Physical interface: Setup at Commissionerate Industries for Investor facilitation
- Strengthening of DICCs: Infrastructure development and manpower support provided
- Support to Ease of Doing Business (EoDB): Manpower support for implementation of key State and Central reforms
- Investor summits: Support to Investment Summits conducted by the StateG2B Meetings: 155 G2B meeting conducted for Investor Facilitation
- Training, capacity building & exposure visits of Departmental Officers

Key outcomes:

65 Investors facilitated with Investment of Rs 4,399 Cr.

Key sectors:

- **Agri-based sectors:** 45 Nos./Rs 2529.96 crores. (Egg, Ready to cook food, Hatcheries, Rice mill, Spices, Agarwood oil, Food processing, Cold storage, Poultry feed, Processed meat, Brewery, Stevia, Feed mill, Bamboo processing, Herbal extract, Juice, Silk)
- **Ethanol:** 7 Nos. / Rs 1154 crores
- **Other manufacturing:** 8 Nos. / Rs 640.60 crores

Key achievement:

- Lead generation: 466
- G2B meetings held: 155
- Investment summit: Support to APART & State Investment Summits
- Manpower support to EoDB by APART: 6

Support provided to Investors for end-to-end facilitation (Investor outreach, Land identification, Site selection, Policy incentives, Coordination with EoDB for approvals).

Notable result is Rs 4,399 Cr. of Agribusiness Investment facilitated and grounded under APART. Further the project has also supported Ease of Doing Business and implementation of Government of India mandated Business Reforms Action Plan.

3.2.1.2 Strengthening of DICCs

The DICCs form the backbone of investment promotion and facilitation in the state of Assam. The project supports the strengthening of DICCs with respect to their key areas in the promotion of Micro and Small Enterprises (MSMEs) in the selected sector and districts. DICCs are expected to play the role of coordination for agri-enterprise cluster development wherever required. Hence the role is multifunctional in nature.

Given the renewed mandate of DICCs, they are being strengthened by (i) Upgrading the physical Infrastructure of the selected 14 DICCs and (ii) Training and capacity building of DICC staff of the 24 project districts.

Till date, 14 District Industries & Commerce Centers have been upgraded, 1 DICC renovated out of Department funds and 1 DICC at the Commissionerate of Industries & Commerce. 49 exposure visits organized for DICC officials.

DICCs are District Officers under Commissionerate of Industries and APART has supported the same for modernization of the offices and capacity building of the District Officers. With relation to APART, the DICC offices are responsible for facilitating the grounding of the Investors under Component A1 and setting up of the Common Facility Centers under Component B1. Through the support of both the State and District offices of Industry Department, APART was able to achieve the project objectives and support Industrial Activities in the Agricultural sector both for bigger enterprises and local MSMEs.

3.2.2 A2: Setting-up Enterprise Development and Promotion Facility (EDPF)

This subcomponent aims to promote an enabling agriculture enterprise ecosystem in the state. Towards this, the project establishes an Enterprise Development and Promotion Facility (EDPF) to foster and accelerate the growth of the agro-processing sector, thereby promoting the commercialization of agricultural production and increasing value addition and agricultural incomes, both at district and state levels.

3.2.2.1 Kshyamata

This in-house program on entrepreneurship development aimed to contribute towards designing and establishing agri and allied sector enterprises, by providing hand-holding support services through numerous trainings & capacity building/entrepreneurship development programs, providing business development support, etc.

Through this initiative, 1803 enterprises were enrolled in the scheme; Light touch-up support was provided to 611 enterprises; Business Development Support has been provided to 1641 enterprises and access to finance has been facilitated for 916 enterprises. Loans amounting to Rs 24.5 Cr have been disbursed across 8 districts. 991 entrepreneurs facilitated with Rs. 11.61 Cr bank loans & convergence with schemes such as PMFME, AIF etc.

Kshyamata Program supported 1300 agri enterprises and facilitated credit linkage for the entrepreneurs through convergence with various government schemes. The program built the capacity of the Government officials on supporting agri enterprises and provided entrepreneurs with business coaching, support in preparation of business plans, access to finance (credit) & leverage support from existing schemes, and mentoring in establishing new agri businesses, expansion, modernization and diversification of existing agribusinesses. Kshyamata Program guided enterprises on accessing finance, relationship building with financial institutions, etc. and ways for convergence with other ongoing schemes such as (i) Prime Ministers Employment Generation Program (PMEGP) (ii) PM MUDRA Yojana (iii) Scheme for Fund for Regeneration of Rural Industry (SFURTI). The Agri-enterprises reported improved business sustainability and growth, with over 70% showing operational scalability and enhanced market linkages.

Through light touch-up support, the program facilitated business and operational advisory, market linkage and marketing support, compliance and documentation, quality and process improvements, capacity building, technology and digital enablement and minor equipment or input support (where applicable).

Business Development Support includes UDYAM registration, FSSAI registration, GST registration, preparation of DPR for loan application. Access to finance includes facilitating loan application and availing subsidy under PMFME, PMEGP, MUDRA, KCC, etc. Other than the regular district level trainings and workshops, various exposure visits cum entrepreneurship development programs (EDPs) were organized on commodities/value chain within the project. Notable programs include Processing and Value Addition of Millets in Bangalore, Greenhouse Management in Pune and Mushroom Spawn Production in Guwahati, among others.

Most of the enterprises selected for Kshyamata were from the existing lot, few new enterprises were also included.

Endline results:

Background a sample of 30 enterprise-level interviews were conducted across four districts - Jorhat, Kamrup (Rural), Kokrajhar and Sonitpur for the Kshyamata program. The surveyed enterprises have been operational for an average of 7.23 years. Among the enterprises, 53% (16 out of 30) had female owners, while the remaining 47% were male owners. On average, each enterprise employs 7.23 workers, comprising approximately 2.77 males and 4.50 females, indicating a relatively higher engagement of women in the workforce.

The key **focus commodities** of the enterprises include Rice (23%), Dairy (30%), Fruits (27%), Fish (13%), Pig (13%), Spices (13%), Mustard (3%), Maize (3%), Vegetables (17%), Eri and Muga (3%). The major focus areas of the enterprise are Food Processing (43%), Market Linkages (63%), Farm Inputs (7%), Product Equipment and Services (3%) and Warehousing and Logistics (3%).[6]

Turnover and Revenue Targets- The average turnover of the surveyed enterprises increased from Rs.8.24 lakhs in FY 2023-24 to Rs.9.58 lakhs in FY 2024-25, also profit increased from Rs.2.28 lakhs in FY 2023-24 to Rs.2.83 lakhs in FY 2024-25, reflecting a modest growth trend. Although all the growth cannot be directly linked to APART but considering that this was the first time that these small enterprises received handholding support, it can be said that APART had largely facilitated the growth. Only 20% (6 out of 30) of the enterprises reported setting specific revenue generation targets for the current year. Among these, the average revenue target for FY 2025-26 was estimated at Rs.25.75 lakhs. This relatively high average is influenced by two enterprises with substantially larger operations-reporting turnovers of Rs.62 lakhs and Rs.48 lakhs in the previous year and setting ambitious targets of Rs.80 lakhs and Rs.50 lakhs respectively- thereby skewing the overall average upward.

Additionally, 77% of the respondents mentioned having prepared a business plan for FY 2025-26, reflecting an increasing emphasis on structured business planning among participating enterprises.

Availability and Access to Credit- Among the surveyed enterprises, the primary sources of formal credit were Government banks (87%), followed by private sector banks (53%) and microfinance institutions (3%). Out of the 30 enterprises, 57% reported availing loans. Among these 17 enterprises (out of 30 surveyed enterprises), the average loan amount was

[6] Market linkages include backward, forward and horizontal connections that help enterprises sell products consistently, reach better paying and diversified markets, reduce dependence on intermediaries and respond to market demand and quality requirements.

Rs. 5.92 lakhs in FY 2023-24 and Rs. 3.78 lakhs in FY 2024-25. In terms of loan type, 65% of these enterprises had accessed term loans, 29% availed cash credit facilities, while 6% had availed both.

All respondents demonstrated awareness of various government credit schemes. The most known schemes included the Prime Minister Employment Generation Program (PMEGP) (83%), MUDRA (73%), Atmanirbhar Bharat Scheme (70%), Pradhan Mantri Formalization of Micro Food Processing Enterprises (PMFME) (53%), Microfinance (57%) and the Agri Infrastructure Fund (AIF) (33%).

In terms of actual utilization, enterprises reported having accessed loans primarily through the PMFME Scheme (60%), followed by Assam Food and Civil Supplies Corporation Ltd. (AFCSCL) (17%), North East Industrial Development Scheme (NEIDS) (13%), PMEGP (10%) and other schemes (20%).

Support Specific to Kshyamata - Among the 30 respondents, a majority (73%) reported receiving support under the program in the form of **light touch-up interventions**. About one-fifth (20%) of the respondents indicated that they had been supported through **Business Development and Management Services**.

Enterprises accessed a range of services under the program, including **capacity building of enterprises (67%), Business Development Services (77%) and facilitating access to finance (17%)**. The trainings were conducted by District functionaries while exposure visits were planned and executed at the headquarter level.

Specific forms of credit facilitation support included the preparation of a “bankable” business plan and documentation support for availing credit (77%), identification of suitable financial schemes and documentary support to avail a loan (57%), liaison with financial institutions for partnerships or funding support (17%) and convergence with existing Government of India/ Assam policies and schemes (10%).

In addition, 43% of the enterprises reported being introduced to new technologies for agribusiness under Kshyamata. Of these 13 enterprises, 62% had adopted the new technologies. Among those who did not adopt, the key reasons cited were - perception that the technology would not significantly improve business performance (70%), challenges in adopting new technology (25%), comfortable with traditional methods (5%) and not sufficiently trained to adopt the latest technology (5%). 37% also received facilitation support on technology/know-how transfer to develop the agri-business enterprises.

Business Development Services- Enterprises were asked about the types of business advisory services received under the Kshyamata program. **The respondents reported receiving support in Technical (54%), Managerial (35%), Marketing (46%), Financial (46%) and Legal (54%) aspects of enterprise development**. In terms of adoption, it was observed that uptake was higher for marketing and managerial inputs, followed by financial and technical services, while legal advisory services had the lowest adoption rate.

In addition, 27% of Kshyamata-supported enterprises reported receiving assistance in developing Detailed Project Reports (DPRs), while 37% admitted receiving business coaching to run the business successfully. Also 23% of the respondents acknowledged receiving constant handholding support to put the business plan into action.

However, only 10% of enterprises indicated that they had received monitoring support from Kshyamata during business plan implementation. Among these, the areas covered under monitoring included technical methods (67%), legal compliances (67%), marketing actions (33%) and managerial functions (33%).

Outcome - Participation in the Kshyamata program has resulted in several tangible benefits for the enterprises. Two-thirds (67%) of respondents reported increased employment within their firms, reflecting the program's contribution to enterprise growth. Nearly three-fourths (73%) diversified their businesses by introducing new products or services, indicating enhanced entrepreneurial capacity. Improvements were also noted in food quality standards (67%) and enterprise turnover (53%), suggesting progress in both operational and financial performance. Additionally, 43% of enterprises adopted improved technologies, while 23% successfully mobilized finance for business expansion.

Overall, these outcomes demonstrate that Kshyamata interventions have supported enterprises in strengthening their business operations, enhancing productivity and moving towards greater market competitiveness.

3.2.2.2 Assam Agribusiness Growth Laboratory (AAGL)

APART has launched the Assam Agribusiness Growth Lab (AAGL), to support and accelerate the growth of Agri and allied enterprises in Assam. The program would assist 100 enterprises in Agri and allied sectors in the state of Assam in 4 years. Under this, it is planned to graduate 100 entrepreneurs including startups in four batches of 25 each. The incubates who complete the entire tenure are known as graduates.

Entrepreneurs would be provided with expert mentoring, business services and technical assistance through various in-build and connected services. Hand-holding support would be provided to access the right channels for business funding. AAGL became fully operational after June 2021 and it focuses on enterprises working in the areas like farm inputs, Agri production equipment and services, food processing, agri-based warehousing and logistics, farm-to-fork, farm-to-market connect services and others.

- **Cohort 1:** 23 enterprises have completed the incubation process out of 25 selected.
- **Cohort 2:** 26 enterprises have completed the incubation process out of 29 selected.
- **Cohort 3:** 26 enterprises have been selected from 91 applications.

The major activities carried out are listed below:

1. **Boot camp:** A two-day boot camp for Cohort 3.0 was organized at the end of August 2023. This business orientation exercise featured the representation of the 26 agri-startups by their founders.
2. **Diagnostic Panel:** To identify the strengths and weaknesses of the startups, 26 diagnostic panels were conducted. Technical experts in respective areas constituted the panel.
3. **Mentoring Clinics:** 15 mentoring clinics were organized wherein one to one personalized guidance by mentors on specific topic was provided.
4. **Access to finance**: AAGL helped the start-ups in raising fund through assistance such as business modelling and pitch enhancement. One start-up under cohort 3 has raised 50 lakhs from NEDFi Venture Fund. Another 3 enterprises have been shortlisted for government grants.
5. **Technical Assistance:** AAGL identified various technologies from esteemed institutions such as CSIR, NRDC, NIFTEM and AAU, enabling the cohort members to adopt these technologies in their business operations.
6. **Food quality improvement:** Samples were collected and sent to the testing agency (Bureau Veritas) for nutritional parameters testing and other specialized testing from 14 food startups.
7. **E-commerce mentoring:** 8 Mentoring sessions held on e-commerce platforms to develop and implement comprehensive Digital Marketing Strategies.
8. **Branding and Social Media Presence:** Branding AAGL and partner organization in social media and events through feature story and news.

9. **Go-to-market strategy by Google:** A virtual session on GTM strategies by Search Engine Expert of Google for Startups was arranged.
10. **Events and Exposure visit:** In the last India International Trade Fair, two enterprises from Cohort 3 have participated with the support of AAGL.
11. **Loans** amounting to Rs 21 Cr have been disbursed across 15 districts.

Endline results:

Background- A total of 30 enterprise interviews was conducted for AAGL across the districts of Golaghat, Jorhat, Kamrup (M), Kamrup (R), Karbi Anglong, Morigaon, Nalbari, Sivasagar and Sonitpur. The average age of the enterprise is 7.10 years. About 60% of the enterprises are owned by men. The number of employees, on average, engaged is 10.60 persons, comprising 6.13 males and 4.47 females.

The key **focus commodities** of the enterprises include Rice (23%), Spices (17%), Fruits and Vegetables (13%), Pig (13%), Mustard (10%), Fish (7%), Maize (3%) and Dairy (3%). The major focus areas of enterprise operations are Food Processing (63%), Market Linkages (37%), Farm Inputs (20%), Product Equipment and Services (13%) and Warehousing and Logistics (10%).[7]

Turnover and Revenue Targets- The financial performance of the surveyed enterprises shows a steady upward trend, with the average turnover rising from Rs.66.27 lakhs in FY 2023-24 to Rs.94.56 lakhs in FY 2024-25. However, only 70% (21 out of 30) of the enterprises reported setting explicit revenue targets for the forthcoming year. The average projected turnover for FY 2025-26 stands at Rs.165.05 lakhs. However, this figure is significantly influenced by two larger enterprises that recorded turnovers of Rs.7.1 crore and Rs.13.7 crore in the previous year and have set ambitious goals of Rs.12 crore and Rs.14 crore respectively, thereby elevating the overall average.

APART has largely facilitated the growth of the enterprises and have supported them in developing business plans and loan documents.

A strong trend toward strategic planning was also observed, with 93% of the enterprises indicating that they had prepared business plans for FY 2025-26. This reflects an increasing emphasis towards formalized business planning among the surveyed enterprises.

Availability and Access to Credit- Among the surveyed enterprises, the primary sources of formal credit were Government banks (90%), followed by private sector banks (40%) and others (7%). Out of the 30 enterprises, 40% reported availing loans. Among these enterprises, the average loan amount was Rs 19,05,556 in FY 2023-24 and Rs 27,00,000 in FY 2024-25.

In terms of loan type, 75% of these enterprises had accessed term loans, 17% availed cash credit facilities, while 8% had availed other.

Survey findings indicate that while awareness of government credit and enterprise support schemes is high, actual utilization remains limited. Nearly all respondents were aware of the Prime Minister Employment Generation Program (PMEGP) (97%) and MUDRA (93%) schemes; however, only 30% had availed assistance under PMEGP. Awareness of the Pradhan Mantri Formalization of Micro Food Processing Enterprises (PMFME) scheme stood at 70%, with 80% of these respondents reporting accessing its benefits. Awareness of Atmanirbhar Bharat (73%), Microfinance (77%) and AIF (43%) were also notable, though availing under AIF was low at 7%. A small proportion (3-7%) had accessed other schemes such as AFCSCL and AHIDF.

[7] Market linkages include backward, forward and horizontal connections that help enterprises sell products consistently, reach better paying and diversified markets, reduce dependence on intermediaries and respond to market demand and quality requirements.

Overall, the findings suggest strong awareness but limited conversion into actual access, highlighting the need for greater facilitation and linkage support to improve scheme uptake among enterprises.

Support Specific to AAGL - The types of support received through AAGL included light touch-up support (100%), business development support (77%), credit facilitation (43%), capacity-building support (33%), intensive incubation (13%), product development (23%) and revenue enhancement support (7%).

In terms of **program offerings**, a large majority participated in entrepreneurial workshops (93%), followed by business sessions (77%), technical assistance (67%), market linkage facilitation (40%), compliance assistance (23%), access to finance (20%) and diagnostic studies (3%). These findings highlight the comprehensive range of capacity-building and business support interventions extended under AAGL, with varying intensity across cohorts.

Outcome - Most respondents reported positive outcomes from their participation in the AAGL program. 83% of enterprises indicated that their participation led to increased employment within the firm, while 77% reported business diversification through the introduction of new products or services. Additionally, 73% observed an increase in enterprise turnover and 63% reported improvement in food quality standards and adoption of improved technologies. Furthermore, 50% of the enterprises mentioned successfully mobilizing finance for business expansion.

These findings suggest that the AAGL program has contributed significantly to strengthening enterprise growth, enhancing productivity and fostering innovation among participating firms.

3.3 Component B: Facilitating Agro Cluster Development

The objective of this component is to establish a modern supply chain from farm to market that will enable farmers and other value chain participants to access new markets. The component will use a geographically targeted approach by focusing interventions on clusters of agri-enterprises to enable an increase both in the number of such enterprises and in their scale of operations.

3.3.1 B1: Support establishment of Cluster Level Industry Association

The objective of this sub-component is to enhance the competitiveness of agri-enterprises in specific geographic locations. This subcomponent will seek to impact enterprises across different geographic clusters by mobilizing them into Industry Associations (IAs) at the cluster level, strengthening the capacity of such IAs to develop Agro-Industrial Development Plans (AIDPs), laying out an action plan for addressing cluster-level obstacles to enterprise growth over the project period and enhancing access of agri-enterprises to needed technical and Business Development Services (BDSs).

Key outcomes:

- Established **18** Industry Associations comprising **2,845** individual entrepreneurs to represent various agricultural sectors and value chains
- **18** Agro Industrial Development Plans (AIDP) developed and approved
- **8** Common Facility Centers (CFCs) approved comprising **204** firms
    - Rice: 3
    - Mustard Oil: 2
    - Food processing: 2
    - Silk: 1
- Additional Support
    - Raw material procurement linkage with APART FPCs and individual farmers
    - Marketing support- capacity building, social media & conventional channels
    - Financial linkage with Commercial banks
    - Convergence with existing schemes of Industry Department

3.3.1.1 Industry Association

The Assam Agribusiness and Rural Transformation Project (APART) envisage strengthening the state’s agribusiness ecosystem through cluster-based enterprise development, value-chain enhancement and institutional linkages. In alignment with this goal, the formation of Industry Associations (IAs) across key commodities represents a strategic intervention to promote collective action, improve market efficiency and build the institutional foundation for enterprise-led rural transformation.

Eighteen IAs have been constituted across 18 districts comprising 2,845 enterprises. Out of the 18 IAs, 17 IAs were assessed for this review. Each IA clusters an average of 216 enterprises, demonstrating broad- based participation and local economic relevance.

Relevance

The formation of IAs is closely aligned with APART’s objectives of promoting enterprise clusters, strengthening value chains and fostering agribusiness competitiveness. The associations represent diverse commodities, with rice (17 IAs) and mustard (12 IAs) being most prominent, alongside banana, tomato, ginger and fish clusters, reflecting responsiveness to Assam’s agro-climatic strengths and market opportunities:

- **Context alignment:** The IAs cater to local production systems, ensuring interventions are commodity-specific and geographically appropriate.
- **Cluster development:** They organize small and medium agribusinesses into collective structures that improve scale, coordination and bargaining power.
- **Value-chain strengthening:** Through input aggregation, marketing and collective branding, IAs enhance vertical and horizontal linkages across the value chain.
- **Institutional role:** They provide a platform for interface between enterprises, financial institutions and government programs.
- **Entrepreneurship promotion:** The IAs nurture local entrepreneurship through exposure, business development services and technology dissemination.

Thus, the IAs are highly relevant institutional vehicles for promoting enterprise-based growth and rural economic diversification in Assam.

Efficiency

The IAs demonstrate moderate efficiency in governance and operational management, marked by inclusivity and compliance but constrained by limited staffing and professional support.

Membership and Inclusivity: Each IA has an average of 216 members, comprising 134 males and 82 females, with over 53% belonging to indigenous communities. Women constitute about 44% of Executive Body members, reflecting strong gender representation in leadership. This inclusivity underscores the association's social relevance and participatory governance model.

Institutional Operations: The Executive Body (average 11 members) is functional, with all IAs conducting Annual General Body Meetings (FY 2024-25) and an average of 4.29 Executive Body meetings annually. All have audited balance sheets for FY 2023-24, indicating compliance and financial discipline.

Human Resources: However, operational staffing remains inadequate - only 10 IAs employ accountants/office assistants and 9 have Business Development Managers (BDMs). This shortage limits systematic recordkeeping, marketing coordination and expansion of services.

Compliance: While key records such as Cash Books, Passbooks and Asset Registers are consistently maintained (17 IAs), weaker documentation persists for Meeting Minutes (14), Member Profiles (13) and Monitoring Reports (2). Gaps in documentation, MIS and impact reporting constrain institutional learning and performance tracking.

Governance structures are functional and inclusive, but the absence of sufficient professional staff and digital management systems hampers full operational efficiency.

Effectiveness

The IAs have become increasingly effective in driving business outcomes, expanding market access and facilitating member services.

Business Growth: Between FY 2022-23 and FY 2024-25, the enterprises of the IAs turnover grew by 55% (from 20.65 lakhs to 32.06 lakhs), while profits rose by 60% (from 10.06 lakhs to 16.12 lakhs), evidencing improved enterprise coordination, cost-efficiency and business negotiation capacities.

Market Expansion:

- Retail linkages: 16 IAs (avg. 4.25 linkages each)
- Wholesalers: 13 IAs (avg. 3.85)
- Modern trade: 11 IAs (avg. 3.64)
- E-commerce: 9 IAs (avg. 2.33)

- Traders: 9 IAs (avg. 3.11)

These data illustrate that while traditional market channels remain dominant, IAs are gradually entering modern and digital markets, indicating structural evolution in marketing practices.

Access to Finance: Six IAs facilitated loans or credit through nationalized banks (4 IAs), state schemes (4 IAs) and Kisan Credit Cards (2 IAs), enhancing member's access to financial capital and formal systems.

Capacity Building:

- Entrepreneurship (Business Edge): 12 IAs
- Exposure visits: 8 IAs
- ICT training: 6 IAs
- Capacity building initiatives have strengthened managerial, marketing and digital competencies, directly contributing to enterprise competitiveness.

The IAs are achieving steady business growth, market diversification and skill enhancement-reflecting their effectiveness as grassroots business enablers.

Sustainability

Sustainability is emerging as a key consideration in the institutional and financial trajectories of the IAs.

Institutional Sustainability: Most IAs have formalized structures and regularized governance processes, laying a strong foundation for long-term viability. However, their dependence on project facilitation for administrative and technical support indicates the need for progressive transition to self-management through member contributions and service-based revenue.

Financial Sustainability: With growing turnover and profits, many IAs are beginning to generate internal resources. Revenue-generation strategies include skill development (13 IAs), consultancy services (11 IAs) and joint marketing (10 IAs). Yet, profitability remains uneven and many depend on external funding for expansion.

Market and Service Sustainability: The gradual diversification into e-commerce and branding along with collective marketing, provides potential for stable income streams.

Institutionalization of business services: Such as fee-based consultancy, quality certification or aggregation hubs - will be vital for continuity beyond the project period.

The IAs are functionally sustainable but need structured business plans, capitalization and market-based service portfolios to achieve financial self-reliance.

Impact

The IAs have generated measurable impacts across multiple dimensions of Assam's agribusiness ecosystem:

- **Economic Impact:**
  - 55% growth in turnover and 60% growth in profits signal improved market integration and enterprise viability.
  - Members report increased access to markets, better price realization and reduced input costs through collective action.
- **Institutional Impact:**
  - Functional governance and financial compliance have strengthened local-level business institutions.

- Linkages with banks, government departments and modern trade networks have expanded the institutional ecosystem.

- **Knowledge and Skill Impact:**
  - Entrepreneurship, ICT and exposure trainings have enhanced managerial capability and business awareness among members.
  - Adoption of digital and modern market practices has begun transforming traditional business behavior.
- **Gender and Social Impact:**
  - Over 40% women representation in executive bodies and targeted initiatives for women entrepreneurs demonstrate inclusive institutional change.
  - Active participation of indigenous groups fosters social equity and empowerment.

The IAs have contributed significantly to economic empowerment, institutional strengthening and social inclusion, aligning with APART's broader development objectives.

Equity

Equity and inclusion form integral pillars of IA functioning. The associations have consciously integrated gender, social and economic equity considerations into their membership and programming.

- **Gender Equity:**
  - Women constitute 38-44% of total members and nearly half of leadership positions.
  - 14 IAs have organized awareness programs for women entrepreneurs, while 10 conducted exclusive training and mentorship events.
  - 5 IAs have introduced policy-level measures promoting women's participation in enterprises.
- **Social Inclusion:**
  - Over half (53%) of IA members belong to **indigenous and marginalized groups**, ensuring equitable benefit sharing.
  - Awareness and capacity-building interventions are tailored to include smallholder enterprises.

The IAs embody a socially inclusive and gender-responsive institutional model, translating APART's equity objectives into tangible outcomes at the enterprise level.

The Industry Associations established under APART have evolved into dynamic institutional platforms driving enterprise development, market integration and social inclusion across Assam's agribusiness landscape. Their demonstrated progress in turnover, market expansion and governance underscores their potential as sustainable, community-owned business institutions. To ensure long-term impact, the focus must now shift from project-led facilitation to self-sustained business ecosystems, underpinned by financial independence, professional management and inclusive growth. Strengthened and scaled, these IAs can serve as enduring pillars for Assam's agribusiness transformation.

3.3.1.2 Common Facility Center (CFC)

Under the cluster development framework, the Common Facility Centers (CFCs) serve as shared industrial and processing infrastructure, designed to strengthen productivity, competitiveness and market access for Industry Associations (IAs). Seven out of eight sanctioned CFCs were covered under the survey, spanning **Biswanath, Jorhat, Kamrup (Rural), Karbi Anglong, Lakhimpur, Morigaon and Sonitpur** districts, comprising 7 Industry Associations. These centers collectively reflect a diverse mix of sectors - mustard processing, rice milling, banana chips, fruits and vegetables and handloom, representing the region's agro-industrial profile.

Relevance

CFCs are conceptualized as collective assets that buffer small enterprises and farmers against market and production shocks by pooling resources and providing centralized access to technology and services. All CFCs have successfully mobilized IA members, completed company registration and secured clearances, indicating institutional readiness. Despite initial challenges in SPV mobilization due to financial constraints, each SPV raised an average Rs. 22.14 lakh in paid-up capital and five of seven attracted additional private investment. This hybrid financing mix enhances resilience against funding volatility. With all CFCs having completed land conversion and five having supervision mechanisms in place, the clusters are better equipped to absorb implementation delays and operational risks.

Efficiency

The CFCs are designed to enhance efficiency across production, processing and marketing chains. Five CFCs confirmed that member IAs would directly benefit from access to machinery and processing facilities, reducing production costs and improving throughput. Completion of public consultations and environmental/social clearances across all CFCs reflects streamlined procedural management. All CFCs have completed the tendering process and training of procurement committees. Further, handholding support in bid management signal gradual capacity enhancement. The project costs underscore the capital-intensive nature of infrastructure creation, warranting careful efficiency monitoring in utilization and governance.

Effectiveness

100% CFCs completed foundational steps (mobilization, registration, consultations, clearances, land) with 85% finalizing supervision mechanisms. All CFCs have approved DPR or tendering, demonstrating forward momentum. Five CFCs have confirmed that members are expected to benefit directly through access to facilities, processing units and dividend earnings- indicating alignment of interventions with beneficiary needs. Three CFCs have divided operational roles among shareholders (monitoring, supervision, engineering), supporting effectiveness through shared accountability. Thus, while structural and procedural effectiveness is high, operational and financial execution effectiveness remains moderate and requires accelerated coordination.

Sustainability

Sustainability is embedded in the CFC model through institutionalization, collective ownership and market-oriented operations. The establishment of SPVs with private capital and functioning boards indicates a governance model capable of sustaining operations beyond project cycles.

Five CFCs reported that value chain viability will improve through profitable operations, while four underscored branding and market recognition as critical to long-term competitiveness.

All CFCs obtained environmental and social clearances, reflecting compliance and awareness of sustainability standards. Continued supervision and audit mechanisms will reinforce responsible resource use and social accountability.

***Table 13:** CFC details*

SN	District	CFC Name	Total Nos. of SPV members	Female members (%)	Project Cost (in lakhs)	Project Grant (in lakhs)	Approval Date	Production Start date	Focused commodity (Products)	Average daily capacity	Average Production
1	Lakhimpur	Subanshiri Enterprises Pvt Ltd	20	20	435.11	348.09	18/09/21	06/12/24	Kacchi Ghani Mustard Oil Processing	10 MT/Day	10 MT/Day, oil cakes - 45 kgs (**Daily**)
2	Karbi Anglong	Hamren Natural Food Processors Pvt Ltd	20	30	129.68	103.74	03/06/21	28/05/25	Fruits and Vegetable & Packaging	50 Kg/hour	Banana Chips-10 qnt (Rs. 350 per kg) Turmeric 5 quintal (Rs. 300 per kg) Pickle - 50kg (Rs. 300 per kg) (**Quarterly**)
3	Morigaon	Morigaon Integrated Fruits & Vegetable Pvt Ltd	36	28	316.54	253.23	23/05/21	13/08/25	Fruit and Vegetable and Spices	**Spice:** 500 kg/hour **Pickle:** 50 kg/hour **PET bottle:** 1200-1500 bottles/hour **Cold storage:** 10 MT	2 quintals (Rs. 280 per kg) (**Quarterly**)
4	Sonitpur	Brahmaputra Rice Cluster Pvt Ltd	20	5	789.55	631.64	08/09/21	18/09/25	Par boiled rice processing	4 MT/hour	-
5	Biswanath	Biswanath Mustard Oil Pvt Ltd	22	18	261.26	209.01	06/06/21	16/08/25	Mustard Oil Processing	6 MT/Day	945 liters (Rs. 175 per liter), Oil Cakes - Rs. 35 per kg (**Quarterly**)
6	Jorhat	Jorhat Agro Pvt Ltd	20	5	738.69	590.95	03/05/23	27/11/25	Raw Rice Processing	4 MT/hour	-
7	Kamrup (Metro)	Borhomthuri Pvt Ltd.	21	43	550.38	440.3	06/05/21	15/11/25	Eri Yarn	720 Kg per year	-
									Eri Fabric	3600 m per year	-
									Muga Yarn	284.4 Kg per year	-
									Muga Fabric	900 m per year	-

Subanshiri Enterprises Pvt Ltd., Bramahputra Rice Cluster Pvt Ltd. and Jorhat Agro Pvt Ltd. sells to distributors and obtain raw materials directly from local farmers. Hamren Natural Food Processors Pvt Ltd. and Biswanath Mustard Oil Pvt Ltd. sells to consumers and obtain raw materials directly from local farmers. Morigaon Integrated Fruits & Vegetable Pvt Ltd. sells to distributors and retailers and obtain raw materials directly from local farmers. Borhomthuri Pvt Ltd. has plans to export their products.

A review of the seven Common Facility Centers (CFCs) across Assam indicates varied progress in operationalization, commodity focus and production capacity. Most CFCs were approved between May and September 2021, with one later approval in May 2023 (Jorhat). Out of the seven units, **four have already commenced production**, while **three are scheduled to begin in November 2025**, indicating a generally steady but staggered rollout. Though most CFCs are in the early stages of commercial production, the projected and emerging impacts are noteworthy.

Mustard and rice emerge as major commodity clusters, supported by high-capacity processing units in Lakhimpur, Biswanath followed by Hojai, Sonitpur and Jorhat. Mustard oil units in Lakhimpur and Biswanath have also initiated production with substantial daily throughput.

CFCs focusing on fruits, vegetables and spices (Karbi Anglong and Morigaon) are progressing but have relatively smaller processing capacities. These diversified units are expected to support local smallholders by enabling value addition in bananas, turmeric, pickles and spices.

Gender participation among SPV members varies considerably, ranging from **5% to 43%**, with Kamrup (Metro) exhibiting the highest female representation. This mixed pattern suggests opportunities for targeted inclusion strategies in some districts. Project costs vary widely- from Rs. 129.68 lakhs to Rs. 789.55 lakhs- reflecting differences in infrastructure scale, technology and commodity types.

Production across the CFCs shows a varied pattern, largely influenced by the type of commodity and the stage of operationalization. The mustard oil units in Lakhimpur and Biswanath report the most consistent and high-volume output, with daily capacities of **6-10 MT/day** and steady production of both oil and oil cakes- indicating stable market demand and efficient utilization of installed machinery.

Fruit and vegetable processing units in Karbi Anglong and Morigaon’s quarterly figures, reflect the seasonal availability of raw materials. Their diversified product baskets banana chips, turmeric, pickles and spices provide value addition but remain modest in scale, suggesting potential for expansion once raw material supply chains are strengthened.

The textile unit in Kamrup (Metro) focuses on Eri and Muga yarn and fabric with annual capacities rather than daily outputs, reflecting the craft-oriented nature of the sector. Production will begin in November 2025.

Overall, operational CFCs exhibit **moderate to strong production performance**, but several units, especially rice and textile, are still in the ramp-up phase. Strengthening raw material linkages and ensuring timely commissioning will be critical for achieving full production potential across centers.

Equity

CFCs demonstrate emerging inclusion but still require a more balanced social representation to realize equitable growth. The 7 CFCs have 159 SPV members out of which 35 (22%) are females. The share of SC (1.14) and ST (4.43) members, though present, indicates the need for more targeted inclusion of marginalized groups. One CFC has already adopted a profit-sharing mechanism, and all have conducted board meetings, ensuring member’s participation in governance and benefit distribution. Six CFCs highlighted that small farmers and millers would benefit through better price realization and direct access to organized markets, thereby improving equity in market participation and returns.

Once operationalized fully, CFCs can emerge as resilient, efficient and inclusive local enterprise hubs, driving equitable industrial growth across Assam’s diverse clusters.

3.3.2 B2. Supply chain support

3.3.2.1 B2.1: Rehabilitation of access roads

As a part of infrastructure development and increased access to markets, 200 kilometers of climate-resilient roads have been planned under APART in the project districts, through different phases, benefitting around 87,751 households across 21 districts.

The status is as follows:

- Target : 200 kms
- Completed : 213.5 kms

In the **end-line study**, 20 roads upgraded under the project were assessed from 13 districts. The average length of the constructed roads is 1.8 km, with an average width of 12.05 feet. Each road serves a catchment area covering an average population of 6,326, caters to 5 villages and 3 production clusters on average. Road Management Committees (RMCs) were established for all surveyed roads and all 15 out of 20 respondents confirmed that they are part of the Roads Management Committee. They have also confirmed that stakeholder consultations were held during pre and construction phases.

Changes in Travel Pattern- A shift in travel patterns has been reported. Prior to the upgradation, two-wheelers and bicycles were the most used modes of transport. After rehabilitation, the use of cars and three-wheelers/tempos has increased and the movement of heavy vehicles such as trucks has also become more frequent.

Vehicular Flow on the Rehabilitated Road- Survey findings indicate a noticeable increase in vehicular movement following road upgradation. The road is now frequented by a variety of vehicles, with hired cars, two-wheelers and three-wheelers showing higher daily traffic volumes (often exceeding 100 per day). In contrast, animal-driven carts and bicycles are mostly limited to fewer than 25 trips a day, suggesting a gradual shift from traditional to motorized modes of transport. Overall, the data reflects enhanced mobility and diversified traffic patterns on the improved road.

***Table 14:** Vehicles Plying on the Road Post-Upgradation*

N=20	Less than 25 a day	25-100 a day	More than 100 a day
Animal-driven Carts	12	4	4
Private Car	10	6	4
Hired Car	6	1	13
Two-Wheeler	2	8	10
Three-Wheeler (Auto)	6	7	7
Bicycle	4	8	8
Tempo (Small Carriers)	12	4	2
Bus	9	4	1
Lorry/Truck	8	1	1

Impact of the Road on Improved Access - The construction of the roads has significantly enhanced connectivity and access for local communities. As a result of this improved infrastructure, access to markets (20) and towns (17) has improved, facilitating smoother movement of people and goods and supporting local trade and livelihood. 9 respondents also identified improved linkages to production clusters and 3 mentioned increased access to warehouses. Further, the road connects to State Highways (9) and National Highways (7), greatly improving regional mobility and reducing travel time. Beyond economic benefits, the road has also improved social access, providing easier connectivity to educational institutions (19) and health facilities (15), thereby enhancing access to essential services and contributing to overall socio-economic development in the area.

Other Benefits of the Rehabilitated Road- All respondents acknowledged that the rehabilitated road is of better quality, reflecting visible improvements in surface condition, ride comfort and overall durability. In addition, 16 respondents reported that they can now avail vehicles more easily for travel, indicating improved transport availability and enhanced local connectivity. Supporting this observation, all 20 respondents also noted a visible increase in traffic density on the road following its rehabilitation, suggesting greater usage and improved accessibility for the surrounding communities.

All the respondents from the 20 roads constructed believe that the travel time has reduced due to the rehabilitation of this road, and they also felt that the transportation of goods and commodities have become easier. Universally (N=20), it is believed that the cost of transportation of goods and commodities has reduced after the rehabilitation. All agreed that access to the market increased with the upgradation of roads and obtaining farm inputs like seeds, fertilizers, etc. have eased post rehabilitation.

Overall, the responses indicate that the rehabilitated road has not only enhanced physical connectivity but also contributed to improved mobility, better access to services and strengthened local economic linkages. Also, the FGDs conducted with Road management committee members and villagers reiterated the benefits of the newly constructed roads. These roads are connected to clusters, FPCs and markets.

Condition of road since upgradation- Out of 20 respondents, 5 reported that the road condition had deteriorated after rehabilitation. Among them, 4 attributed this to excessive vehicle load and poor-quality construction material, while 1 felt that the high volume of vehicles had worsened the road quality.

3.3.2.2 B2.2: Warehouse and warehouse receipts development

The objective of this activity is to provide farmers and agro entrepreneurs, with high-quality storage, access to finance through warehouse receipts and the option to sell via commodity exchanges. This would be done by up-gradation and modernization of selected warehouses of the Assam State Warehousing Corporation (ASWC) located within the project districts to provide scientific storage, accreditation and registration of such warehouses with Warehousing Development and Regulatory Authority (WDRA), partnering with commercial banks and collateral management agencies for negotiable warehouse receipt (NWR) financing of the stored goods and piloting to enable online trading of selected commodities which allow such warehouses to be accredited as delivery centers for national electronic commodity exchanges. The ASWC is the nodal state agency under the Cooperation Department of the GoA.

The status is as follows:

- Target : 40 godowns
- Completed : 37 godowns

In the **end-line survey**, 20 warehouse interviews were conducted across multiple districts: Darrang (4), Goalpara (1), Kamrup M (5), Kamrup R (2), Karbi Anglong (2), Kokrajhar (1), Nagaon (2) and Sivasagar (3). The average total land area of the warehouses is 1.48 hectares. Regarding operational timelines, 1 renovated warehouse became functional in 2020, 3 in 2021, 7 in 2022, 7 in 2023 and 2 in 2024. Notably, 18 out of 20 warehouses are accredited and registered with the WDRA, reflecting adherence to regulatory standards and enhanced credibility.

Each warehouse has 3.2 go-downs (average), with an average area of 4,089.7 sq. m per go-down.

The number of FPCs associated with each warehouse averages 6.7, indicating active participation of producer organizations in warehouse operations.

Storage capacity- The warehouses have an average total storage capacity of 4,032.75 MT, with an average monthly storage of 2,088 MT. Four warehouses reported comparatively low monthly storage volumes ranging from 130 to 800 MT, which has contributed to lowering the overall average.

Agri-Commodities stored - Following the upgradation, the warehouses have been utilized for storing a diverse range of agricultural commodities. About 60% of storage capacity is used for agri-horti commodities. The most stored items include paddy, mustard and pulses (black gram, pea, lentil), each reported by 11 respondents. Maize is stored in 10 warehouses, while oilseeds and spices are each stored by 6. This pattern indicates that the upgraded facilities are supporting the storage of both staple food grains and high-value crops, thereby contributing to better post-harvest management and market readiness for farmers.

On average, Rabi crops are stored for 3.25 months and Kharif crops for 3.3 months.

Improved infrastructure & services- 17 warehouse respondents reported using RCC for flooring, with three warehouses employing PVC-moulded floor pallets. Roofing materials include RCC (8 warehouses) and GI sheets (12 warehouses). Floors in all warehouses are chemically treated to prevent mites. Additionally, 17 warehouses have provisions for prophylactic treatment, such as fumigation covers and sprayers.

Eighteen out of 20 warehouses reported adequate availability of labor, with an average of 13.60 male workers and 12.80 female workers. All warehouses have parking facilities, with an average parking area of 3,055 sq. m. Lighting facility is available in all and ventilation systems were rated as good by 16 respondents and satisfactory by 4, with an average of 3.45 exhaust systems per warehouse. Waste management systems were available in 19 warehouses and 18 reported having a drainage system. Web connectivity was available in 10 warehouses, while all had power supply and telephone connectivity. 15 warehouses provide customer-oriented support services.

Availability of Basic Amenities- All 20 warehouses are equipped with fire extinguishers, with an average of 5 per warehouse. First aid boxes are also available at all facilities, averaging 3.45 per warehouse. On average, each warehouse has 1.9 male toilets and 1.45 female toilets. Additionally, the warehouses are equipped with drinking water filters, averaging 1.95 per warehouse, ensuring basic facilities, hygiene and safety for staff and visitors.

Equipment- 17 warehouses reported purchasing equipment post-modernization to bring process automation, while all confirmed following a stacking arrangement. Three warehouses have set up labs for product value preservation. Testing equipment includes grain moisture meters (all 20 warehouses), thermometers (15 warehouses) and grading sets (8 warehouses), with average quantities of 2.25, 2.67 and 1.63 per warehouse, respectively. 19 warehouses had electronic weighing machines and 13 were equipped with weighbridges, with an average of 1.62 weighbridges among those that reported having them.

Accessibility- All 20 warehouses reported that trucks can access their premises. For 19 warehouses, the nearest connecting road is a National Highway, while one is linked to a State Highway. On average, each warehouse serves approximately 5.9 production clusters. All warehouses are well-connected through dedicated approach roads and internal roads, ensuring efficient movement of goods to and from the facility.

Commodities Stored last year- Among the 20 warehouses, maize was stored in 11, mustard in 7, paddy in 16 and pulses in 5. The users of these warehouses come from varied catchment areas: 15 from adjacent villages, 4 from adjacent blocks and 1 from neighboring districts. The maximum storage duration averaged 41.50 days, while the minimum storage duration averaged 12.63 days, resulting in an overall average storage period of 24 days.

WRF and ERP system- 19 out of 20 warehouses mentioned that Warehouse Receipt Financing has started. The installation of an Enterprise Resource Planning (ERP) system in the warehouse was done in 2 of the 20 warehouses.

Labor Compliances- All 20 warehouses reported providing facilities and services to ensure a safe and supportive work environment for laborers. Drinking water, adequate toilet facilities and first aid are available at all warehouses. Security measures to prevent unauthorized entry and safety from visitors are in place across all facilities. Additionally, rules and policies against sexual harassment have been formally adopted in 12 out of 20 warehouses, reflecting efforts to promote a safe and inclusive workplace.

3.3.2.3 B2.3: Up-gradation and modernization of agricultural wholesale markets

The marketing of most agricultural commodities in Assam is fragmented and uncoordinated, involving layers of intermediaries and markets with inadequate infrastructure and facilities and supply chains involving high wastage and losses. The project aspires to upgrade and modernize selected agricultural wholesale markets by enhancing efficiency and reducing transaction costs, enabling automation of the business processes in the selected market and also open-up stand-alone physical markets to distant buyers. To achieve this goal, this activity supports upgrading and modernizing the market infrastructure in agriculture wholesale markets, including wholesale markets managed by Agriculture Produce Market Committees (APMCs) and rural periodic markets (haats) owned by local bodies.

Agricultural produce markets in Assam are controlled by three different agencies. These are: (i) Regulated markets by Regulated Market Committees coming under Assam State Agricultural Marketing Board (ASAMB); (ii) Weekly rural haats managed by Village Panchayats, Anchalik Panchayat or Zilla Parishad and (iii) Town Committees and Municipal Markets, operated and managed by Urban Local Bodies (ULBs). Moreover, a few markets are run by individuals/group of individuals which may be termed as Private Markets. Such markets are fully controlled and managed by private entities.

The status is as follows:

- Target : 99 Markets
- Completed : 96 Markets

The average trade volume of markets is increased by approximately 45.5% after modernization compared to the pre-modernization period.

In the **end-line survey**, 20 market interviews were conducted across 14 districts. The sample included markets regulated by the Assam State Agricultural Marketing Board (ASAMB) - 9, Urban Local Bodies/Municipal Boards - 2 and the P&RD - 9. Among the markets studied, 4 operate daily, 14 function weekly and 2 operate bi-weekly (twice a week). All 20 markets were covered under the Modernization and Improvement Program (MMIP) of APART. The renovated markets became operational in different phases - 8 in FY 2019-2020, 10 in year 2023 and 2 in year 2024.

Market Profile- On average, each market hosts 60.7 traders (median=52.5) and 43.8 vendors (median=45). The average number of grower societies registered under each market is 4.55 (median=5), while the average number of individual sellers registered is 29.9. The average number of registered traders per market stands at 14.2 (median=15).

In terms of trade volume, the markets reported an increase in throughput from an average of 3,461 MT per year before renovation to 4,135 MT per year after renovation indicating enhanced trading activity following modernization efforts.

Commodities Traded - In the last one year, the markets handle a wide variety of agricultural commodities, reflecting the diversity of local production and trading activities. Vegetables and pulses are traded in all surveyed markets (20 each), indicating their consistent demand and supply. Fruits, spices and mustard are also major commodities, each reported by 18 respondents. Paddy and maize are traded in 16 and 11 markets respectively, while oilseeds feature in 14. This composition highlights a balanced mix of food grains, oilseeds and high-value horticultural produce, demonstrating the market's role in supporting both staple and diversified agri-value chains.

***Table 15:** Market arrivals and trade volume of the commodities in the market in FY 2024-25*

Commodities	Average market arrivals (received quantity) in MT	Average Trade Value (in Rs Lakhs)
Rice	191.0	38.2
Maize	15.1	1.3
Black gram	3.6	1.8
Pea	9.7	2.0
Lentil	3.9	1.9
French Beans	14.3	1.6
Cabbage	24.0	2.0
Cauliflower	14.1	1.5
Tomato	4.5	2.4
Brinjal	4.4	2.3
Pumpkin	14.3	1.5
Potato	19.5	3.6
Banana	3.0	2.5
Pineapple	0.4	0.4
Turmeric	1.3	1.3
Ginger	1.1	1.1
Mustard	11.0	5.1
Milk	1.2	3.1
Pork	0.6	1.9
Fish	22.0	5.3

Market Infrastructure and Facilities - The surveyed markets showed wide variation in land area, with an average of 0.95 ha. Office premises were available in 19 out of 20 markets. Wholesale shops were present in 10 markets, averaging 8 shops per market, with an average shop area of 23.70 sq. m. Of these, 3 shops on average had godowns, while 5 shops did not. The monthly rent for wholesale shops averaged Rs 385. No shops were built under the MMIP.

Wholesale sheds were available in 10 markets, with an average of 2.90 sheds per market, while retailer sheds were more common, present in all 20 markets. On average, each market had 14.80 retailer sheds, with an average per-shed area of 10.80 sq. m. The rent for retail sheds averaging Rs 156.50 per month. No markets had cattle sheds or assortment sheds. Auction platforms were available in only one market (area- 15 sq. m) and drying platforms in two markets.

Marketing and selling complexes were reported in 13 markets. Ripening chambers (relevant mainly for bananas and certain fruits) were available in 8 markets, with an average capacity of 9.88 quintals. Six markets had go-downs within the market. Eleven markets had retail sale counters for agricultural products and 11 had for agri-inputs.

However, no markets had cold storage/ cooling chambers, primary processing facilities, packaging facility or separate vegetable packing sheds. Walk-in coolers were reported in only 3 markets.

Basic services and amenities - Adequate labor was reported in 18 markets, with an average of 11.75 male and 9.95 female service providers per market. Drainage facilities, drinking water taps and community toilet blocks are available in all markets. Seven markets provided resting rooms for farmers, while only two had guest houses within the premises, as planned. ATM facilities are also available in 16 markets, averaging 1.10 ATMs per market.

Security services were reported in only 3 markets, arranged by the committee, while garbage disposal bins were present in 7 markets. Loading and unloading bays were available in 6 markets and parking areas in 11 markets, with space for an average of 3 trucks each. However, only 2 respondents felt that the parking space was adequate for the market scale, while most considered it insufficient.

All 20 markets had electricity connections, but none had Wi-Fi connectivity. Auctions (open outcry) did not take place in any of the surveyed markets. Additionally, no production clusters were located within 10 km of the surveyed sites.

Reasons for Thriving in This Market - Most respondents cited the assurance of receiving a fair market price (mentioned by 20 respondents) and the opportunity to fetch good prices for their produce (17 respondents). A significant number also appreciated the competitive pricing environment (7 respondents), which helps maintain profitability and sustains business activity. Additionally, friendly behavior and cooperative interactions among traders and buyers (13 respondents) contribute to a positive trading atmosphere. Only one respondent each also acknowledged the supportive role of market authorities in resolving issues and the ease of accessibility of the market as enabling factors.

The FGDs conducted with buyers, sellers and committee members in the market revealed that the renovation works have increased the footfall of vendors and traders.

Market users - A total of 60 marketplace users (both buyers and sellers) were interviewed (three from each market) about their experiences. Among them, 40 users stated that public consultations were held on the temporary relocation issue. 31 users confirmed that their relocation suggestions were considered. However, only 12 users felt they were adequately relocated and 34 expressed satisfactions with the temporary relocation arrangements.

Of those dissatisfied with the relocation arrangements, only 9 reported having formally registered complaints. Awareness of the new rules and guidelines of the market was reported by 36 out of 60 users.

3.4 Component C: Fostering Market-Led Production and Resilience Enhancement

The objective of this component is to enable producers of the priority value chain commodities, in the targeted clusters to take advantage of the rapidly changing market demand and enhance the resilience of agriculture production systems for increasing production and managing risks associated with climate change. This farm-focused component will adopt a cluster-based value-chain approach for providing support to producers and will closely work with components A and B to inform producers in these clusters of the market demand.

3.4.1 C1: Promoting climate-resilient technologies and its adoption

The objective of this sub-component is to support a sustainable increase in production and productivity of the priority value chains and promote the adoption of climate-resilient solutions.

3.4.1.1 C1.1: Agriculture crop, Horticulture, Spices and condiments value chains

The performance of **Agri-Horti Value Chains** has been strong, with demonstrations on climate-resilient technologies by departments exceeding targets (103%) and training of nursery growers at 119%, while AAU demonstrations reached 95% of the target.

Agriculture

- The Paddy PMIS dataset covered 72,033 demonstrations over 2018 to 2023, with a cumulative demonstration area of 21,044 ha, across 26 districts engaging 19.7% women farmers and 80.3% men.
- The Maize PMIS dataset covered 4,844 demonstrations was implemented between 2018 and 2023, across 16 districts, covered a total of 1,868 ha of farmer fields (average 0.39 ha per demonstration), with 18% of demonstrations involved women farmers.
- The Pulses PMIS dataset showed 6,402 demonstrations from 2018-23 across 13 districts with a cumulative area of 2087.9 ha engaging 22.7% female farmers

Horticulture

- The Horticulture PMIS dataset comprising fruits (banana and pineapple) and vegetables (brinjal. cabbage, cauliflower, potato, pumpkin and tomato) covered 9,671 demonstrations over 2018 to 2023, with a cumulative demonstration area of 2,726.64 ha, across 18 districts engaging 22.7% women.

Spices and Condiments

- The Mustard PMIS dataset from 2018 to 2023 undertook 80,025 demonstrations across 17 districts with a cumulative area of 23,475.9 ha, engaging 28.7% female farmers.
- The Ginger PMIS dataset from 2018-23 undertook 400 demonstrations across 4 districts with a cumulative area of 88.48 ha, engaging 28% female farmers.

Commodity wise Demonstration - Adoption

The table below is based on project data and indicates varying levels of adoption across different commodities. The highest adoption has been observed in paddy. Stress Tolerant Rice Varieties (STRVs) have gained significant popularity among farmers in Assam and have been adopted by a large proportion of farmers who have received demonstration support directly or indirectly.

Adoption farmers include those who have directly benefited from the demonstration activities and continued to follow so along with the fellow farmers (indirect) who have witnessed the successes of those farmers and have adopted those varieties and practices.

Agriculture	Participation	Adoption	%	Horticulture	Participation	Adoption	%
Paddy	80,070	1,67,820	209.59%	Potato	5167	4197	81.23%
Mustard	1,16,107	33,927	29.22%	Brinjal	949	840	88.51%
Pea	1,034	675	65.28%	Cabbage	952	1363	143.17%
Lentil	1,042	725	69.58%	Cauliflower	863	1129	130.82%
Black Gram	5,491	545	9.93%	Pumpkin	862	924	107.19%
Maize	6,543	430	6.57%	Tomato	1046	1236	118.16%
Total	**2,10,287**	**2,04,122**	**97.07%**	Banana	236	209	88.56%
				Ginger	400	337	84.25%
				Pineapple	53	5	9.43%
				Total	**10528**	**10240**	**97.26%**

Source: PMIS (04th December 2025)

Financial Utilization:

OPIU	Provision (AWP19-20) (in Lakhs)	Provision (AWP20-21) (in Lakhs)	Provision (AWP21-22) (in Lakhs)	Provision (AWP23-24) (in Lakhs)	Fund Released in Lakhs	Expenditure (in Lakhs)	Utilization (%)
Agriculture	4,195.32	2,430.58	5,207.59	18,921.57	**19,137.5**	**18,691.81**	**97.67**
Horticulture & Food Processing	1,582.87	2,716.08	2,576.23	16,583.85	**8,763.37**	**8,658.66**	**98.81**
Assam Agricultural University	2,279.38	2,067.83	3,592.98	8,390.27	**9,988.5**	**9,880.48**	**98.92**
Total					**37,889.4**	**37,230.95**	**98.26**

Source: PMIS (04th December 2025)

3.4.1.1.1 Cereals

3.4.1.1.1.1 Paddy

Assam is particularly vulnerable to floods and droughts, which regularly destroy traditional rice crops and impact the livelihoods of farmers. The International Rice Research Institute (IRRI) and the Assam Agricultural University (AAU), in collaboration with APART, have worked to introduce climate resilient rice varieties. APART has been instrumental in promoting climate-resilient agriculture and enhancing regional rice productivity. Key to its success has been the introduction of stress-tolerant rice varieties (STRVs) that benefited lakhs of farmers, bringing around 5,00,000 ha of land under STRVs in Assam. These varieties, engineered to withstand floods, droughts and other stressors, provided agricultural resilience, promoted mechanized farming practices and improved labor productivity and efficiency.

The PMIS dataset covers **72,033 paddy demonstrations** over 2018 to 2023, across 26 districts, with a cumulative demonstration area of **21,044 ha**. Demonstrations expanded rapidly from 8,046 in 2018 to a peak of 14,777 in 2019 and remained high through 2021 (14,097), before tapering slightly in 2022 (11,444) and 2023 (11,223). Average plot size per demonstration has steadily reduced from about 0.61 ha (2018) to 0.16 ha (2023), indicating a strategic shift from fewer, larger plots to smaller plots with wider farmer outreach. Of the 72,033 demonstrations, about **14,205 involve women farmers (19.7%), while 80.3% involve men.** Around 47,287 (66%) Minikit demonstrations covering 6,092 ha were conducted. 4,933 Cluster Demonstrations were conducted in 7,247 ha of land. ICMD - Stress Tolerant Rice Varieties (STRV) account for 11,772 demos in 3,730 ha of land, highlighting a strong focus on climate resilience and stress tolerance. Other important interventions include On-Farm Adaptive Demonstrations, Head-to-Head demonstrations, IPM cluster demonstrations, Wet/Dry DSR, Mechanical Transplanted Rice (MTR), Premium Quality Rice (PQR) and seed production.

Through APART, over 4,500 training programs were conducted for nearly 1,60,000 farmers, 32% of whom were women. These programs empowered the learners to adopt modern agricultural technologies such as mechanized direct seeding of rice, mechanical transplanting, harvesting through reapers and combine harvesters and using axial flow and open drum threshers for threshing, which encouraged the project's sustainability. Through the project, IRRI also developed a Web-GIS Portal and the Rice-based Cropping System Knowledge Bank, offering valuable resources for informed decision-making and knowledge sharing[8].

Endline Results

A sample of **627 paddy farmers** participating in the APART program was interviewed from all 18 sampled districts (Barpeta, Biswanath, Bongaigaon, Cachar, Darrang, Goalpara, Golaghat, Jorhat, Karbi Anglong, Kamrup Rural, Kamrup Metro, Kokarajhar, Lakhimpur, Morigaon, Nagaon, Nalbari, Sivasagar and Sonitpur). A total of **500 Control farmers** from Barpeta, Bongaigaon, Jorhat, Kamrup (R), Karbi-Anglong, Lakhimpur, Nagaon, Sibsagar and Biswanath were selected.

Table 16: *Sample Size - Paddy*

	Total	Male	Female
Total	**1127**	**908**	**219**
Intervention	627	467	160
Control	500	441	59

Background Information of the Farmer

Table 17: *Background information: Paddy farmers*

	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**627**	**467**	**160**	**500**	**441**	**59**
Average age (years)	45.7	46.8	42.5	45.8	46.2	42.7
Education Level	**%**	**%**	**%**	**%**	**%**	**%**
Illiterate	4.8	3.4	8.8	8.4	8.8	5.1
Read and write	3.8	4.7	1.3	2.6	2.3	5.1
Class 1-5	16.3	14.6	21.3	13.0	13.2	11.9
Class 6-8	28.4	30.0	23.8	31.6	30.4	40.7
Class 9-12	40.7	40.9	40.0	37.8	38.3	33.9
Graduation	6.1	6.4	5.0	6.4	6.8	3.4

[8] https://www.irri.org/news-and-events/news/arias-society-irri-plan-sustainable-rice-farming-future-assam-post-apart

	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**627**	**467**	**160**	**500**	**441**	**59**
Above Graduation	0.0	0.0	0.0	0.2	0.2	0.0
Social groups	**%**	**%**	**%**	**%**	**%**	**%**
Scheduled Caste	12.0	15.2	2.5	12.4	12.7	10.2
Scheduled Tribes	22.0	23.1	18.8	29.0	27.9	37.3
OBC	19.9	21.2	16.3	42.6	42.2	45.8
General	46.1	40.5	62.5	16.0	17.2	6.8
Religion	**%**	**%**	**%**	**%**	**%**	**%**
Hindu	60.8	66.6	43.8	85.0	83.9	93.2
Islam	35.9	29.3	55.0	14.8	16.1	5.1
Christian	3.3	4.1	1.3	0.2	0.0	1.7
Family						
Family size (Nos.)	5.4	5.5	5.1	5.0	5.0	4.7
Average Adult Male (Nos.)	2.1	2.2	2.0	1.9	1.9	1.6
Average Adult Female (Nos.)	1.8	1.8	1.8	1.7	1.7	1.7
Average Children Male (Nos.)	0.8	0.9	0.7	0.8	0.8	0.8
Average Children Female (Nos.)	0.7	0.7	0.6	0.6	0.6	0.6
Type of farmer	**%**	**%**	**%**	**%**	**%**	**%**
Marginal Farmers-less than 1 Ha	61.1	56.3	75.0	73.6	72.3	83.1
Small Farmer -1-2 Ha	35.1	39.2	23.1	24.0	24.9	16.9
Semi Medium Farmers 2-4 Ha	3.7	4.3	1.9	2.0	2.3	0.0
Medium 4-10 Ha	0.2	0.2	0.0	0.4	0.5	0.0
Land ownership						
Average agricultural land (ha) owned	0.9	1.0	0.8	0.8	0.8	0.8
Average land is leased in/share-cropped (ha)	0.0	0.0	0.0	0.1	0.1	0.0
Average land is leased out (ha)	0.0	0.0	0.0	0.0	0.0	0.0
Average operational land (ha)	1.0	1.0	0.8	0.9	0.9	0.8
Average amount of land cultivated last season (ha)	0.8	0.8	0.7	0.8	0.8	0.7
Cropping intensity	**%**	**%**	**%**	**%**	**%**	**%**
Once	66.8	66.6	67.5	82.0	80.3	94.9
Twice	32.5	32.5	32.5	17.6	19.3	5.1
Thrice	0.6	0.9	0.0	0.4	0.5	0.0
Income						
Average income in the last 12 months from the selected crop	61,362.7	63,667.5	54,635.8	48,901.2	48,568.2	51,390.5
Average income in the last 12 months from any other crop	42,765.6	46,069.6	33,121.9	28,957.0	28,828.8	29,915.3
Average income in the last 12 months from any other sources	48,714.4	44,447.5	61,168.1	54,391.2	54,843.8	51,008.5

	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**627**	**467**	**160**	**500**	**441**	**59**
Average total HH income	1,52,842.6	1,54,184.6	1,48,925.8	1,32,249.4	1,32,240.7	1,32,314.2
Expenditure						
Average monthly expenditure	7,472.4	7,444.3	7,554.4	6,938.4	6,863.9	7,494.9
Average annual expenditure	89,668.9	89,331.9	90,652.5	83,260.8	82,367.3	89,939.0
Savings						
Average monthly savings	2,214.4	2,135.4	2,444.8	2,756.5	2,827.2	2,228.0
Average annual savings	26,572.2	25,624.6	29,338.1	33,077.6	33,926.1	26,735.6
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**	**%**	**%**	**%**
Yes	7.0	8.1	3.8	5.4	5.9	1.7
No	86.3	83.1	95.6	86.2	85.3	93.2
Went before, not now	6.7	8.8	0.6	8.4	8.8	5.1

Relevance

Paddy (rice) cultivation holds immense relevance in Assam, both economically and culturally: Rice is the staple diet for most of the Assam's population, with per capita consumption among the highest in India. More than 70% of Assam's cropped area is under rice, making it the backbone of the state's agriculture. The state's fertile alluvial soils, abundant rainfall and diverse agro-climatic zones make it naturally suitable for paddy cultivation across seasons (*ahu, sali and boro rice*). A significant share of Assam's rural workforce depends on rice farming for livelihood - either directly as cultivators or indirectly through allied activities like milling, transport and marketing. Paddy cultivation ensures local food security and resilience, especially important in flood- and erosion-prone regions. Paddy and rice-based foods are deeply tied to Assamese culture, festivals (like Bihu) and traditions. In short, paddy cultivation in Assam is not just an economic activity but also a pillar of food security, rural livelihoods and cultural identity.

APART has introduced several stress-tolerant rice varieties (STRVs) in the state. Given Assam's agro-climatic challenges (floods, waterlogging and sometimes drought), STRVs help stabilize production, improve farmer incomes and ensure food security. These are rice varieties that have specific tolerance traits such as submergence (flash or longer floods), waterlogging, drought, etc. - bred into them. e.g. Ranjit Sub-1, Bahadur Sub-1, Swarna Sub-1, Bina Dhan 11, etc.

The benefits of STRV adoption are - (i) climate resilience: STRVs provide farmers with a reliable way to avoid crop losses due to extreme weather events; (ii) increased yields and income: adopting STRVs can lead to higher crop yields, increased income and a better benefit-cost ratio for farmers; (iii) enhanced cropping intensity: introduction of short and medium-duration high-yielding varieties like some STRVs also helps to increase the number of crops farmers can grow in a year. In recent years, adoption of stress-tolerant rice varieties (STRVs) has increased, helping farmers to manage recurrent floods, droughts and climate variability. For instance, 75% of 2018 demonstration farmers, 81.5% of 2019 farmers, 79% of 2020 farmers, 74% of 2021 farmers and 98% of 2022 farmers have continued cultivating STRVs, much after they have received demonstration. The intervention farmers own 0.94 ha of agricultural land on an average, which is slightly more than control farmers who own

0.82 ha (average) of land. Apart from paddy, the farmers also cultivate maize (56%), mustard (36%), pulses (26%), fruits and vegetables.

Efficiency

Paddy cultivation efficiency in Assam has improved significantly under APART interventions, with 81% of farmers adopting recommended Sali season varieties such as Ranjit-Sub1, Bahadur-Sub1, Swarna-Sub1, BINA Dhan 11, BINA Dhan 17 and DRR 44. Stress-tolerant rice varieties (STRVs) like Ranjit-Sub1, Bahadur-Sub1 and Swarna-Sub1 enhance production efficiency by reducing crop losses during floods. In contrast, improved varieties like BINA Dhan and DRR 44 deliver higher yields and better agronomic performance. BINA Dhan is also widely adopted in Boro cultivation (37%), indicating its versatility and efficiency across seasons. Alongside high-yielding and resilient varieties, niche premium quality rice (PQR) types such as Joha, CR Sugandh Dhan 909, and black rice diversify farmer income streams, though adoption remains smaller in scale. 97% of intervention paddy farmers have adopted the seed varieties recommended by APART with 83% female farmers. 76% STRV users have completely adopted the PoPs with more women have adopted than men. Nearly 97% of farmers have shifted to APART-promoted varieties, with women showing particularly high adoption and compliance with the package of practices (PoPs), reflecting efficiency in knowledge transfer and practice adoption.

Input procurement, dominated by private dealers (over 80-90%), ensures timely availability, contributing to operational efficiency, but it also creates risks of higher costs and limited bargaining power due to weak cooperative and FPC systems. Demonstration and training activities have further strengthened efficiency outcomes - 93% of farmers reported yield improvements, 51% reported better quality output through exposure to new varieties and 49% gained from improved farm practices.

APART interventions have enhanced the efficiency of paddy cultivation in Assam by promoting stress-tolerant and high-yielding varieties, improving farmer's resilience to floods, and ensuring higher productivity. Strong adoption of recommended seeds, particularly among women, combined with training and demonstrations, has led to measurable gains in yield, quality and farm practices.

Effectiveness

Paddy cultivation has emerged as a highly effective livelihood activity in Assam, significantly contributing to farm income, household stability and institutional participation. Intervention farmers reported an average annual income of Rs.61,363 from paddy, accounting for 40% of their total household income- underscoring its economic importance. This is notably higher than the Rs.48,901 earned by control farmers, indicating the positive impact of improved practices and linkages. Overall, intervention households recorded a higher average annual income (Rs.1.53 lakh) compared to control households (Rs.1.32 lakh), reflecting enhanced returns from paddy and allied agri-horti activities.

The effectiveness of paddy cultivation is further reinforced by strong institutional engagement- 53% of farmers are associated with Farmer Producer Companies (FPCs), with slightly higher participation among women. Marketing diversification has improved, with 25% selling through FPCs, 22.3% through government procurement systems and 20.6% to processors, while most (91.2%) continue to trade with local buyers. High awareness of the Minimum Support Price (MSP) (67.1%) also indicates growing market literacy. Farmers sell paddy through procurement centers as amount is directly credited to their bank accounts. Among FPC members, 88.5% acknowledged improved collective decision-making as a major benefit, while 38% reported income gains and price stabilization through bulk sales and reduced middlemen.

Together, these outcomes demonstrate that paddy cultivation not only strengthens farm-level profitability but also enhances farmer's institutional capacity, market access and overall livelihood resilience in Assam.

Sustainability

APART's promotion of Stress-Tolerant Rice Varieties (STRVs) has strengthened the sustainability of paddy cultivation in Assam's flood-prone areas. It has significantly contributed to promoting sustainable paddy cultivation in Assam by introducing and distributing STRVs and encouraging climate-resilient farming practices. With technical support from the International Rice Research Institute (IRRI), these initiatives were aimed at strengthening the adaptive capacity of farmers in flood-prone regions. Assam Agricultural University (AAU), through its extension network- Krishi Vigyan Kendras (KVKs) and the Department of Agriculture through the district Agricultural Technology Management Agency (ATMA) - conducted demonstrations with more than 80,000 farmers, including demonstrations on climate-smart seed varieties and farming techniques, conducted farmer field days (FFD), trainings, exposure visits and buyer-seller meet to encourage the farmers.

Adoption of STRVs across nearly 5,00,000 hectares has enhanced the environmental resilience of farming systems, reduced vulnerability to floods, and improved resource-use efficiency. The high adoption rate of the recommended seed varieties and improved production practices reflects a shift toward resilient, resource-efficient agriculture. The resulting improvement in yields and farmer incomes contributes to long-term livelihood stability, while the continued preference for these varieties demonstrates the project's lasting impact in fostering sustainable farming systems that balance productivity, resilience and economic viability.

Impact

Paddy cultivation in Assam has witnessed a marked transformation over the past few years, driven by targeted interventions promoting stress-tolerant rice varieties (STRVs), improved agronomic practices including mechanization and better market linkages. The intervention has significantly enhanced both productivity and profitability among participating farmers compared to non-intervention counterparts.

The comparative analysis of paddy cultivation data between intervention and control farmers clearly demonstrates the positive impact of improved agricultural practices promoted under the intervention (project). The sample includes 627 intervention and 500 control farmers.

The gains observed in the intervention area are considerably higher than in the control areas. The average production among intervention farmers is **4,834 kg**, whereas control farmers produce **3,757 kg**, indicating a **28.6% higher output**. Correspondingly, the **average yield** stands at **5,990.54 kg/ha** for intervention and **4,938.32 kg/ha** for control farmers - a **21.3% improvement in productivity**.

While home consumption remains comparable across both groups (around 1,200 kg), the **marketable surplus** for intervention farmers is considerably higher at **3,673 kg**, compared to **2,503 kg** among control farmers. This difference of nearly **1,170 kg** highlights a stronger commercial orientation and market linkage among intervention participants. The market price of paddy remains almost identical (Rs. 21.38 vs Rs. 21.58 per kg), confirming that productivity gains- not price differentials- drive the higher incomes.

Financially, the impact is substantial. Intervention farmers report an **average revenue of Rs.80,491**, against **Rs.56,945** for control farmers, a 41.3% increase. Despite similar input costs *(includes all major expenditure components incurred by farmers during the crop cycle including the cost of seeds (both purchased and home-saved), farmyard manure (FYM) and other organic inputs, chemical fertilizers, herbicides, fungicides, pesticides, irrigation, labor, machinery or equipment hiring, packing and transportation, storage and loading/unloading*) (around Rs. 28,000), the **net earnings** of intervention farmers are nearly **80.4% higher** (Rs. 51,647 vs Rs.28,625). The value derived from by-products or residues remains broadly comparable between the two groups, suggesting that the main gains stem from yield and efficiency improvements rather than secondary outputs.

Overall, the data strongly indicate that the intervention- through the promotion of improved seed varieties, better agronomic practices, and perhaps exposure to climate-resilient technologies has significantly enhanced **farm productivity, income security and market engagement** of paddy farmers. This validates the effectiveness of the intervention model as a driver of **sustainable agricultural intensification and livelihood improvement** in the region.

Comparison: Intervention vs Control Farmers

Table 18: *Comparison: Intervention vs. Control Farmers - Paddy Cultivation*

	Intervention	Control	Difference	%	Probability	Significance
N	627	500				
	Average	**Average**				****/*** = 1%; * = 5%**
Cultivated Area (Ha)	0.806	0.76				
Quantity Produced (kg)	4834.05	3757.76	1,076.29	28.64%	100%	***
Yield (kg/ha)	**5,990.54**[9]	**4,938.32**	**1,052.22**	**21.31%**	**100%**	***
Home Consumption (kg)	1160.5	1254.456	-93.956	-7.49%	93.15%	n.s.
Marketable surplus (kg)	3,673.55	2,503.31	1,170.24	46.75%	100%	***
Market price (Rs)	21.38	21.59	-0.21	-0.97%	87.91%	n.s.
Residue/ by product (lumpsum) (Rs.)	3,192.65	3,278.86	-86.21	-2.63%	67.44%	n.s.
Revenue (Rs)	**80,490.65**	**56,945.64**	**23,545.01**	**41.35%**	**100%**	***
Input Cost (Rs.)	28,843.90	28,320.93	522.9665	1.85%	83.57%	n.s.
Earnings (Rs.)	**51,646.74**	**28,624.70**	**23,022.04**	**80.43%**	**100%**	***

The above table shows that the average yield, revenue and earnings have significant differences between the intervention and control groups. The interventions provided under the APART project are the key driving force for the success, as the input costs remain almost the same for both Interventions and Control groups.

Gross Margin Analysis: Paddy Cultivation - Intervention vs Control Farmers

[9] Crop productivity can be estimated either as an unweighted mean of individual farmer-level yields (where yield is calculated as production divided by cultivated area for each farmer) or as an area-weighted mean yield, estimated as total production divided by total cultivated area across surveyed farmers. The unweighted mean yield can be sensitive to small plots with unusually high reported yields, which may disproportionately influence the average. Therefore, this assessment uses the area-weighted mean yield, as it provides a more robust estimate of overall land productivity and is consistent with standard agricultural statistics practice for aggregate and program-level reporting.

A gross margin analysis was undertaken to assess the financial efficiency and profitability of paddy cultivation among intervention and control farmers. The gross margin, defined as the difference between total revenue and variable (input) costs, provides a clear indicator of the economic returns from cultivation practices.

Table 19: *Gross Margin Analysis: Paddy Cultivation - Intervention vs Control Farmers*

Indicators	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**627**	**467**	**160**	**500**	**441**	**59**
Average Cultivated Area (ha)	0.806	0.83	0.73	0.76	0.766	0.718
Quantity Produced (kg)	4,834.05	5,060.18	4,174.05	3,757.76	3,758.65	3,751.19
Yield (kg/ha)	**5,990.54**	**6073.27**	**5715.04**	**4,938.32**	**4,903.13**	**5,218.79**
Average Revenue (Rs.) per ha	99,864.33	1,01,142.03	95,102.36	74,835.85	74,344.86	78,749.75
Average Input Cost (Rs.) per ha	35,786.48	34,644.41	39,407.37	37,218.32	36,682.21	41,492.01
Gross Margin per Ha (Rs/Ha)	**64,077.85**	**66,497.63**	**55,694.99**	**37,617.52**	37,662.66	37,257.74
Gross Margin Ratio (%)	**64.16%**	**65.75%**	**58.56%**	**50.27%**	**50.66%**	**47.31%**

The gross margin analysis for paddy cultivation shows a strong economic advantage for the intervention group. The average revenue per hectare for intervention farmers is Rs. 99,864, notably higher than Rs. 74,836 for the control group. Interestingly, the input cost per hectare is slightly lower under intervention (Rs. 35,786) compared to the control (Rs. 37,218), indicating more efficient use of resources and cost management practices. As a result, the gross margin per hectare under intervention stands at Rs. 64,078, which is about 70% higher than the Rs. 37,617 achieved by control farmers. The gross margin ratio of 64.16% under intervention against 50.27% in control further reinforces the higher profitability and better input-output efficiency among intervention farmers. These findings highlight that the intervention has significantly improved paddy productivity and profitability through better agronomic practices, input optimization and enhanced market access.

Gender-wise, male farmers under intervention record the highest yields and revenues, but female farmers also outperform their control counterparts across all key indicators, particularly in revenue per hectare and gross margin ratios. Overall, the results indicate that the intervention has improved land productivity, profitability and cost efficiency, with benefits accruing to both male and female farmers, though the magnitude of gains is higher among male beneficiaries.

The gross margin analysis highlights a substantial improvement in the financial performance of intervention farmers compared to the control group. With a 70% higher gross margin per hectare and a stronger cost-to-return ratio, the intervention has effectively strengthened the economic viability of paddy cultivation. This reinforces the role of technology adoption and improved agronomic practices in driving farm profitability, sustainability and livelihood security.

Results of step-wise ordinary least square (OLS) regression models showing effect of explanatory variables on paddy productivity (dependent variable logarithm of paddy productivity)

The table below presents estimated regression coefficients of OLS of five models. In unadjusted model 1, it has been found that the farmers in the control areas, irrespectively of their usage of seed variety, are significantly less likely to have higher paddy productivity compared to their counterparts using STRVs in the intervention areas. The effect continues to remain statistically significant ($p<0.001$) even after controlling other explanatory and control variables (adjusted model 5). Being a member of FPC significantly facilitates higher productivity of paddy ($p<0.001$, unadjusted model 2) and continues to show positive effect even after controlling other potentially confounding variables though at a lesser degree ($p<0.01$; model 5). Adoption of PoPs has also been found to have a positive and significant influence on paddy productivity independently in unadjusted model 3 ($p<0.001$), and at lesser degree in model 4 ($p<0.01$); however, its effect became statistically insignificant in adjusted model 5 after controlling all other potentially confounded variables in the model.

Explanatory Variables	Model 1	Model 2	Model 3	Model 4	Model 5			
	Coeff	Coeff	Coeff	Coeff	Coeff	P-value	95% CI	
Seed variety used among respondents in intervention & control categories								
Intervention & high-yielding seed variety (ref)	….	….	….	….	….	….	…	….
Intervention & local seed variety	0.03	….	….	0.08	-0.13	0.31	-0.38	0.12
Control & high-yielding seed variety	-0.56***	….	….	-0.41***	-0.61***	0.00	-0.88	-0.34
Control & local seed variety	-0.50***	….	….	-0.35***	-0.50***	0.00	-0.74	-0.25
Member of FPC								
No (ref)	….	….	….	….	….	….	….	….
Yes	….	0.41***	….	0.14*	0.12*	0.08	-0.01	0.26
Adoption of package of practice (PoP)	….	….	0.22***	0.05*	-0.01	0.90	-0.13	0.11
Control variables	No	No	No	No	Yes			
District fixed effect	No	No	No	No	Yes			
Adjusted R square	**0.10**	**0.06**	**0.06**	**0.11**	**0.32**			
Note 1: ***: p<0.001; **: p<0.05; *: p<0.10								
Note 2: Control variables are gender of the farmer, educational qualification, age, religion, social category, logarithm of per capita household income.								
Note 3: P-values and Confidence Interval have been given only for the final adjusted model.								

Distribution used for testing individual coefficient in the model: t-distribution
Distribution used for testing overall model significance: f-distribution

Since only 19% farmers are using STRVs in control areas and the rest are still using local seed varieties, the productivity is less in control areas as compared to the intervention areas, these results hold even after controlling all other socio-demographic and economic variables. Nearly 88.5% farmers who are member of FPCs said that the primary benefit of joining FPC is improved collective decision making related to farm inputs and practices. 72% of the intervention farmers reported adopting the package of practices.

Comparison with Baseline Study (Independent Samples)

The sample for paddy in the baseline study included 4,227 farmers selected from 14 districts for intervention and 1,936 for control. The independent sample comparison between 2019 and 2025 shows clear improvements in paddy cultivation performance across both intervention and control groups, with the intervention farmers maintaining a distinct advantage.

The analysis compares independent samples of paddy farmers surveyed in 2019 and 2025, under both intervention and control conditions. The data provides insights into how productivity, cultivation patterns and market dynamics have evolved over time across different farmer cohorts.

Table 20: *Differences in Mean: Paddy Cultivation*

Parameter	Intervention 2019	Intervention 2025	P values	95% CI		Significance (t-test)	Control 2019	Control 2025	P values	95% CI		Significance (t-test)	Effect
	Average	Average				***: p<0.001; **: p<0.05; *: p<0.10	Average	Average				***: p<0.001; **: p<0.05; *: p<0.10	
N	4227	627	-	-	-	-	1936	500				-	-
Cultivated Area (Ha)	0.717	0.806	-	-	-	-	0.774	0.76				-	-
Production (kg)	3,554.21	4,834.05	-	-	-	-	2,674.46	3,757.76				-	196.54
Yield (kg/ha)	4,956.26	5,990.54	P(T<t) = 0.699 P(|T|>|t|) = 0.66 P(T>t) = 0.33	-17524.53	27656.11	n.s.	3,455.03	4,938.32	P(T<t) = 0.0001 P(|T|>|t|) = 0.0002 P(T>t) = 0.999	-1614.76	-491.69	***	-449.01
Market Price (Rs/kg)	15	21.38				-	14.91	21.58				-	-0.29

Note: The baseline data mentioned a yield (kg/ha) of 4,956.26 for intervention and 3,455.03 for control, which looks higher for 2018-19 and indicates possible reporting inconsistencies in the baseline. Hence, the Difference of Means results do not show a strong impact when compared with the baseline data, although positive results are visible when comparing intervention and control in the endline. In 2018-19, the total paddy (rice) production in Assam was an estimated 52.14 lakh tones. The yield was approximately **2,271 kg per hectare** in total (across all seasons), based on the Statistical Hand Book Assam, 2019 - Directorate of Economics and Statistics[10].

Paddy cultivation in Assam has evolved from a subsistence-oriented practice to a more commercially viable and sustainable farming system, contributing to enhanced rural livelihoods, food security and climate resilience across the state.

Equity

APART has reached out to 15,940 (20%) female paddy farmers through various demonstrations. It has been observed that adoption rates among female farmers are good. They in general, stick onto their preferred seed varieties and practices, once they are convinced.

In end term assessment, 1127 paddy farmers were interviewed, out of which 19.4% are females; among intervention farmers 25.5% respondents and among control 11.8% respondents are females.

In the control group, incomes are roughly equal between genders, while Intervention appears to raise income for both genders, with a small male advantage. It appears that female spends more than males in both intervention and control areas. In the control households the male saves more than the females, while in intervention households the female saves more than the males.

[10] Statistical Hand Book Assam, 2019 - Directorate of Economics and Statistics - Table - 5.06: Average Yield Under Food and Non-Food Crops covered by Crop Forecast in Assam- Page 74

Income, Expenditure and Savings Patterns: Intervention households report higher annual incomes (Rs.61,362) from Paddy (Rs.63,667 for males, Rs.54,635 for females) than control households (Rs. 48,901 - Rs.48,568 for males, Rs.51,390.5 for females). Notably, female farmers under intervention display better financial prudence, with higher average savings (Rs.29,338) than their male counterparts (Rs.25,625). This reflects women's increasing financial agency and a tendency to allocate resources more judiciously for household welfare, even when incomes are modestly lower.

Women tend to spend more on household needs but also save more under the intervention, reflecting better financial control and decision-making. Encouraging women in income-generating activities can further strengthen gender equity in both consumption and savings.

The comparative analysis of male and female farmers across intervention and control groups highlights significant progress in promoting gender equity within agricultural livelihoods. While disparities persist in landholding size and total earnings, the intervention has demonstrably enhanced women's participation, productivity and economic outcomes.

Participation and Landholding: Female farmers constitute about 26% of the intervention sample, indicating improved inclusion compared to traditional participation levels. However, women continue to cultivate smaller areas (0.73 ha vs 0.83 ha for men), reflecting the structural constraints of limited land ownership and access to productive assets. The intervention's gender-sensitive outreach appears to have broadened access, even if not yet achieving parity.

Production and Marketable Surplus: Both male and female farmers under the intervention demonstrate substantial productivity gains compared to the control group. Female farmer's average production increased from 3,751 kg to 4,174 kg and their marketable surplus rose from 2,398 kg to 3,224 kg. This improvement signifies that technical support, improved inputs and capacity-building initiatives have been effective for women producers, narrowing the gender gap in output and market participation.

Profitability and Economic Empowerment: Average net earnings for female farmers increased markedly from Rs.37,258 (control) to Rs.55,695 (intervention) - a 49% improvement, while male farmers saw a corresponding increase from Rs.37,663 to Rs.66,498. This suggests that interventions have contributed meaningfully to women's income security and economic empowerment. Despite earning less than male farmers in absolute terms, women show stronger relative gains, demonstrating equitable benefits of the program.

The intervention has fostered tangible progress toward gender equity in agriculture. Women farmers have achieved greater productivity, income stability and financial control, though structural barriers such as unequal landholding and limited access to credit and technology persist. Continued focus on gender-responsive extension services, women-led Farmer Producer Organizations (FPOs), financial literacy and market integration will be critical to sustaining and deepening gender equity outcomes.

In summary, the data evidence shows that gender-sensitive agricultural interventions not only enhance productivity but also strengthen women's socio-economic position, contributing to more inclusive, resilient and sustainable rural livelihoods.

Grievance management: More than 77% paddy farmers are aware of the grievance registration process and only 24% have ever registered their grievances.

3.4.1.1.1.2 Maize

Traditionally, maize in Assam was mostly a *kharif* (monsoon) crop. Over time, there has been a strong move to utilize *rabi* (winter) season fallows. APART project has been able to introduce better practices and thereby an increase in cropping area and production, particularly as a Rabi crop[11].

Across the APART period, maize demonstrations have expanded rapidly in scale and spatial coverage, with a strong focus on Rabi fodder maize. The PMIS dataset covers **4,844 demonstrations** implemented between 2018 and 2023, across 16 districts, covering a total of about **1,868 ha** of farmer fields (average **0.39 ha per demonstration**). After a modest start in **2018–2019** (about **809 demonstrations** over **206 ha**, roughly **17%** of all demos), activities dipped in **2021** (49 demos, 15.8 ha), and then scaled up in **2022**, when **3,426 demonstrations** were organized over **1,505.9 ha**. In 2022 alone, maize accounted for about **71% of all demonstrations** and **81% of total maize area** in the period, indicating a deliberate, programmatic upscaling of maize-based interventions.

Participation has been predominantly male, but with a visible, if still limited, involvement of women and socially disadvantaged groups. Overall, **about 18% of demonstrations involve women farmers** (877 out of 4,844), while **SC and ST farmers constitute roughly one-fourth (24%)** of all cases, showing a reasonable level of social inclusion given maize's positioning as a fodder and commercial crop. Demonstrations are fairly spread, with districts like **Golaghat, Bongaigaon, Darrang, Kamrup and Karbi Anglong** emerging as major hubs in terms of area under demonstrations.

Technically, the maize program is dominated by **Rabi season demonstrations (over 85%)**, reflecting a clear push for **fodder maize** to support the livestock and dairy components of APART, with Kharif and Sali maize playing a smaller role. In varietal terms, **'African Tall'** has been the overwhelmingly dominant variety, accounting for **about 61% of all demonstrations**, followed by **JHO 2000-4, MMH 731, PAC 751** and a few other hybrids. improving inclusion of women and SC/ST farmers within the demonstration portfolio.

Endline Results: **132 farmers** from three districts (Bongaigaon, Darrang and Kokrajhar) were interviewed for Maize, of which 84.8% are males and 15.2% are females.

Table 21: *Background information - Maize farmers*

	Intervention		
	Total	**Male**	**Female**
N	**132**	**112**	**20**
Average age	42.8	43.0	41.4
Education Level	**%**	**%**	**%**
Illiterate	5.3	2.7	20.0
Read and write	4.5	4.5	5.0
Class 1-5	15.9	15.2	20.0
Class 6-8	27.3	26.8	30.0
Class 9-12	37.9	40.2	25.0
Graduation	8.3	9.8	0.0
Above Graduation	0.8	0.9	0.0
Social groups	**%**	**%**	**%**
Scheduled Caste	0.0	0.0	0.0
Scheduled Tribes	20.5	14.3	55.0
OBC	0.0	0.0	0.0
General	79.5	85.7	45.0

[11] https://icar.org.in/en/golden-grains-change-how-maize-powering-rural-revolution-assam-0

	Intervention		
	Total	**Male**	**Female**
N	**132**	**112**	**20**
Religion	**%**	**%**	**%**
Hindu	37.1	33.0	60.0
Islam	62.9	67.0	40.0
Christian	0.0	0.0	0.0
Family			
Family size (Nos.)	4.8	4.9	4.5
Average Adult Male (Nos.)	2.0	2.0	2.0
Average Adult Female (Nos.)	1.6	1.6	1.8
Average Children Male (Nos.)	0.7	0.7	0.5
Average Children Female (Nos.)	0.6	0.7	0.3
Type of farmer	**%**	**%**	**%**
Marginal Farmers- less than 1 Ha	85.6	84.8	90.0
Small Farmer -1-2 Ha	12.1	12.5	10.0
Semi Medium Farmers 2-4 Ha	2.3	2.7	0.0
Medium 4-10 Ha	0.0	0.0	0.0
Land ownership			
Average agricultural land (ha) owned	0.7	0.7	0.6
Average land is leased in/share-cropped (ha)	0.0	0.0	0.0
Average land is leased out (ha)	0.0	0.0	0.0
Average operational land (ha)	0.7	0.7	0.6
Average amount of land cultivated last season (ha)	0.6	0.6	0.5
Cropping intensity	**%**	**%**	**%**
Once	6.8	2.7	30.0
Twice	93.2	97.3	70.0
Thrice	0.0	0.0	0.0
Income			
Average income in the last 12 months from the selected crop	67,284.1	68,080.0	62,827.3
Average income in the last 12 months from any other crop	50,857.6	51,850.0	45,300.0
Average income in the last 12 months from any other sources	67,757.6	67,401.8	69,750.0
Average total HH income	1,85,899.3	1,87,331.8	1,77,877.3
Expenditure			
Average monthly expenditure	6,522.7	6,750.0	5,250.0
Average annual expenditure	78,272.7	81,000.0	63,000.0
Savings			
Average monthly savings	2,103.0	2,081.3	2,225.0
Average annual savings	25,236.4	24,975.0	26,700.0
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**

	Intervention		
	Total	Male	Female
N	**132**	**112**	**20**
Yes	0.0	0.0	0.0
No	98.5	98.2	100.0
Went before, not now	1.5	1.8	0.0

Relevance

Maize farming in Assam has become increasingly relevant, moving from marginal status toward becoming a key crop in the state's agricultural and rural economy. Around 86% maize farmers are marginal farmers, while 12% are small farmers who cultivated maize on an average 0.6 ha of land. More than 98% paddy farmers are engaged in maize cultivation and more than 93% crop twice annually - paddy as kharif and maize as rabi crop. This helps make use of fallow land after paddy harvest, improves soil fertility and farmers can double-crop instead of leaving land idle, thereby increasing their annual income.

Efficiency

The ETA showed that the farmers prefer 4 out of the 6 APART-recommended seed varieties. 87% farmers have reported using the APART-recommended seed varieties. Nearly 13% farmers use other seed varieties. The most popular variety seems to be NMH-731 (45%) and the next one is PAC-751 (28%). More than 50% completely adopted the package of practices (PoP) related to NMH-713, 62% of users of NMH-731 and ADV-756 and nearly 73% of users of PAC-751. Farmers are aware of where from to procure preferred seeds - while NMH-731 is bought from government agencies and cooperatives, almost all of PAC-751 is bought from government agencies. A small portion of ADV-756 is also procured from fellow farmers and very few retained their own seeds. Farmers procure fertilizers and other supplies primarily from private local dealers; some also procure from government agencies and cooperatives. When asked about the benefits of APART demonstrations, 96% said that they obtained an improvement in crop yield, 88% said that they were introduced to new seed varieties and 82% said that they learned improved farm practices. APART has been able to inform the farmers about using quality seeds, inputs and following good farming procedures.

Effectiveness

Maize cultivation has proven to be an effective source of income diversification for farmers in Assam. On average, households reported earning around Rs.67,284 annually from maize in the last 12 months, with men earning marginally more than women. This income accounts for about 36.2% of their total household earnings, highlighting maize as a significant contributor to livelihoods. Despite only 11.4% of farmers being members of Farmer Producer Companies (FPCs), nearly all farmers (99.2%) are successfully able to sell their produce, primarily to traders, and about one-fourth (23.5%) have direct linkages with processors. Furthermore, 100% of farmers are aware of the Minimum Support Price (MSP), reflecting strong policy awareness and potential security in pricing. Together, these factors show that maize cultivation not only strengthens household income but also offers opportunities for further market and institutional integration.

Sustainability

Nearly 88% farmers have adopted the recommended seed varieties and among them more than 65% have continued using the recommended seed varieties and have adopted and followed the PoPs completely. Considering that more than 28% of farmers had received demonstration support as early as 2018 and 2019, more than 84% have cultivated the recommended seed varieties in the last year. It should be noted that 100% female farmers continued with the recommended seed varieties. It can be well assumed that these seed varieties and improved practices have been well accepted by the farmers and have realized the benefits of doing so and hence they are going to continue using these seed varieties and follow the practices till further improved options are available.

Impact

A total of 132 intervention farmers cultivated maize in Assam across 75.78 hectares, adopting recommended varieties such as NMH-713, NMH-731, ADV-756 and PAC-751. The cumulative production reached **6,98,490 kg**, of which **35,020 kg** was retained for home consumption. The remaining marketable surplus generated an estimated **Rs.1.25 crore** in revenue at the prevailing average market price of **Rs.18.93/kg**.

Table 22: *Yield, Revenue and Earnings - Maize*

Revenue and Earnings	Intervention
N	**132**
Average cultivated area (Ha)	0.57
Average Yet to sell/Home consumption /Seeds (In kgs)	265.30
Average Total Production (In kgs)	**5,291.59**
Average yield (in kgs per ha)	**9,216.56**
Average Marketable Surplus, (In kgs)	5,026.29
Average Market Price (In Rs.)	18.93
Average Revenue (In Rs.)	94,710.83
Average Input Cost (In Rs.)	33,554.67
Average Earnings (In Rs.)	**61,156.16**

Comparing yield with state averages: According to the Statistical Handbook Assam 2024 (Directorate of Economics and Statistics), the average yield of maize in the state during 2023-24 is approximately 5,143 kg/ha. In comparison, the average yield recorded among the intervention farmers under APART is 9,216.56 kg/ha, which is significantly higher than the state average. This substantial improvement clearly indicates enhanced productivity and reflects the effectiveness of the interventions implemented under the project.

Table 23: *Gross Margin Analysis: Maize Cultivation*

	Intervention		
	Total	Male	Female
N	**132**	**112**	**20**
Average cultivated area (ha)	0.57	0.58	0.54
Yield (kg/ha)	**9,216.56**	**9,334.69**	**8,508.53**
Average Revenue (Rs.)	94,710.83	96,529.73	84,525.00
Average Revenue (Rs/ha)	**1,66,159.35**	**1,66,455.71**	**1,56,005.16**
Average Input Cost (Rs.)	33,554.67	34,593.23	27,738.75
Average Input Cost per ha	**58,867.84**	**59,652.51**	**51,196.55**
Gross Margin (Rs.)	61,156.16	61,936.50	56,786.25
Gross Margin (Rs.) per ha	**1,07,291.51**	**1,06,803.20**	**1,04,808.61**
Gross Margin (%)	**64.57%**	**64.16%**	**67.18%**

Maize cultivation shows strong profitability across all farmer categories, with an overall gross margin of Rs. 61,156 per farmer and a high gross margin ratio of 64.57%. Male farmers achieve slightly higher yields and absolute gross margins, driven by marginally higher input use and cultivated area. However, female farmers demonstrate greater cost efficiency, reflected in lower input costs per hectare and the highest gross margin ratio (67.18%). Gross margin per hectare remains consistently high across genders (Rs. 1.05-1.07 lakh/ha), indicating that maize is an economically efficient crop under the intervention, delivering stable returns for both male and female farmers despite scale differences.

Comparison with Baseline Study (Independent Samples)

The sample for maize in the baseline study was very small - only 26 farmers from 3 districts were interviewed.

Table 24: *Comparison with Baseline Data: Maize Cultivation*

	Sample	Total area	Total production	Productivity	Significance (Mann-Whitney U-test)	Market Price
				Average	*****: p<0.001; **: p<0.05; *: p<0.10**	
Baseline (2019)	26	13 ha	37,500 kgs	2,884.61 kg/ ha	***	Rs.15.79
Endline (2025)	132	75.8 ha	6,98,490 kgs	9,216.56 kg/ha		Rs.18.93

Note: It is important to note that the baseline findings were based on a relatively small sample size, which may have influenced the comparability of results.

Test used: Mann-Whiteney test (non-parametric)
Test statistics value: -7.522
P-value: 0.000

Between 2019 and 2025, the interventions led to:

- **Average productivity (kg/ha)** - Increase in 222%. A 3.3-fold rise in productivity, from 2.88 to 9.21 tons/ha - a clear outcome of improved seed varieties, better agronomic practices and mechanization support.
- **Market price (Rs.)** - Increase of 19.9%. Improved price realization by nearly 20%, reflecting enhanced grain quality and better market access.
- **Revenue (Rs. per ha)** - Increase of 292% from Rs. 45,548 to Rs.1,78,283. The revenue and gross margins increased by almost four times, highlighting a substantial improvement in farmers' profitability and economic resilience.

The interventions have had a **transformational impact** on farming systems, enhancing productivity, market competitiveness and income levels. The strong growth in gross margins underscores the **sustainability and scalability** of improved cultivation practices, positioning participating farmers for **long-term resilience and economic development**.

Equity

An analysis of household-level economic indicators reveals that while income levels between male and female farmers remain relatively close, women display more prudent financial behavior in terms of expenditure and savings. Male farmers reported an average annual household income of **Rs.1.87 lakh**, marginally higher than **Rs.1.78 lakh** among female farmers. Average household expenditure is notably lower among female farmers (**Rs.63,000**) compared to **Rs.81,000** among male farmers. This suggests that women manage household finances more judiciously. Female farmers also demonstrate a slightly higher average savings level (**Rs.2,225**) compared to male farmers (**Rs.2,081**). Despite earning marginally less, their capacity to save more underscores stronger financial discipline and resilience, an important factor in sustaining household stability during income fluctuations.

Female farmers, though earning marginally less than their male counterparts, exhibit stronger financial prudence - **spending less and saving more**. Strengthening women's access to income-generating opportunities, financial literacy and credit linkages can amplify their role in building resilient and equitable rural households.

The gender-wise comparison of the data reveals important insights into equity in access, performance, and benefits within the farming system. While both male and female farmers participate actively in crop production, certain structural differences in landholding, resource access, and income levels persist.

Land and Production Scale: Male farmers cultivate an average of 0.58 ha compared to 0.54 ha among female farmers, reflecting slightly lower land access for women. This difference in operational area translates into higher total production for men (5,413 kg vs. 4,610 kg), highlighting a scale advantage rather than a productivity gap alone.

Productivity and Market Performance: Yields among male farmers (9334.69 kg/ha) are about 9.7% higher than those of female farmers (8508.53 kg/ha). However, female farmers tend to realize better market prices (Rs.19.20/kg against Rs.18.88/kg), suggesting that they may focus on quality or smaller but better-valued market segments.

Profitability and Efficiency: Despite lower production volumes, female farmers manage input costs more efficiently (Rs.27,739 vs. Rs.34,593), narrowing the earnings gap. Their average net earnings (Rs.56,786) are only about 9% lower than those of male farmers (Rs.61,937), indicating relatively equitable economic performance when adjusted for resource use.

Equity Perspective: The data points to a moderate gender gap in scale and income but demonstrates strong efficiency and resilience among female farmers. Enhancing women's access to land, inputs, extension support and collective marketing can further strengthen equity outcomes. Given their cost-effective management and competitive price realization, women farmers represent a key group for inclusive growth in the agricultural sector.

Hence, while men currently dominate in scale and total output, women exhibit comparable productivity and profitability efficiency. Interventions promoting equitable access to productive resources and decision-making opportunities will ensure that the benefits of agricultural growth are shared more inclusively across genders.

Grievance management: More than 55% maize farmers are aware of the grievance registration process.

3.4.1.1.2 Pulses

Pulses such as black gram, lentil and pea hold immense importance in Assam's agricultural and nutritional landscape. As nitrogen-fixing crops, they play a vital role in maintaining soil fertility, reducing dependence on chemical fertilizers and ensuring long-term sustainability of the farming system. Cultivation of pulses also offers an effective means of crop diversification in Assam's predominantly rice-based farming systems, particularly during the rabi season when residual soil moisture can be optimally utilized. Economically, pulses provide an additional and stable income source for small and marginal farmers due to their relatively low input costs and growing market demand for protein-rich foods. From a nutritional perspective, they address widespread protein deficiency among rural households, making them crucial for food and nutritional security.

Moreover, the short-duration nature of pulse crops allows farmers to integrate them efficiently within crop rotations, improving resource use efficiency and resilience to climate variability. Thus, promoting pulse cultivation in Assam is integral not only to enhancing farm incomes but also to achieving environmental sustainability and regional food security.

The APART project's pulses demonstrations expanded sharply over 2018-2023, both in terms of farmer coverage and area brought under demonstrations, reflecting a clear evolution in crop focus. In 2018, the program started with 222 demonstrations on about 50.95 ha, split almost evenly between lentil (115 demos; 28.49 ha) and pea (107; 22.46 ha). In 2019, activity intensified modestly to 279 demonstrations on 71 ha, driven largely by pea (around 80% of demos), indicating an early preference for pea as the main demonstration crop. There was a temporary contraction in 2020 to 132 demonstrations on 33.8 ha, still shared between pea and lentil in almost equal measure, suggesting a consolidation phase rather than a complete scale-back. From 2021 onwards, the pulses strategy scaled up dramatically and diversified: demonstrations jumped to 969 on 372.15 ha with the introduction of black gram (316 demos; 78.3 ha) alongside substantial pea (411; 157.75 ha) and lentil (242; 136.1 ha) coverage. The peak came in 2022, when pulses demonstrations surged to 3,660 on 1,275 ha - more than a 16.5-fold increase in number and a 25-fold increase in area compared to 2018, dominated by black gram (2,860 demos; 1,079 ha), with lentil (560; 128 ha) and pea (240; 68 ha) playing a complementary role. In 2023, the program appears to have shifted to a more focused, possibly consolidation-oriented phase with 160 black gram demonstrations on 40 ha.

Overall, the time series indicates a clear transition under APART moving from small, mixed lentil-pea pilots to a large-scale pulse’s intensification effort, particularly around black gram, while maintaining a diversified basket of pulses to support crop diversification, soil health and income enhancement objectives.

Across all APART pulse demonstrations, Black Gram recorded the largest total demonstration area (1,197.3 ha across 3,336 demos), indicating its strong focus and scalability under the program. Lentil followed with 325.09 ha across 1,042 demonstrations, while Pea had a similar coverage of 320.51 ha across 1,044 demonstrations. On a per-farmer basis, Black Gram also had the highest average area (0.36 ha), compared to Lentil (0.31 ha) and Pea (0.31 ha). This pattern shows that Black Gram was promoted at a significantly larger scale - both in total area and average plot size - whereas Lentil and Pea demonstrations were conducted on comparatively smaller but almost similar land parcels.

Endline Results: A sample of **387 farmers** participating in the APART program was interviewed from seven districts (Barpeta, Biswanath, Golaghat, Jorhat, Kamrup, Morigaon and Sonitpur). A total of 127 Lentil farmers, 133 Black Gram farmers and 127 Peas farmers were interviewed.

Table 25: *Sample Size - Pulses*

	Total	Male	Female	SC	ST	OBC	General
Total	**387**	276	111	44	22	136	185

Background Information on farmers:

Table 26: *Background Information - Pulses farmers*

	Intervention		
	Total	**Male**	**Female**
N	**387**	**276**	**111**
Average age	44.8	46.1	41.4
Education Level	**%**	**%**	**%**
Illiterate	3.1	3.6	1.8
Read and write	6.5	8.3	1.8
Class 1-5	12.4	13.4	9.9

	Intervention		
	Total	**Male**	**Female**
N	**387**	**276**	**111**
Class 6-8	25.8	25.7	26.1
Class 9-12	47.8	43.8	57.7
Graduation	4.4	5.1	2.7
Above Graduation	0.0	0.0	0.0
Social groups	**%**	**%**	**%**
Scheduled Caste	11.4	4.3	28.8
Scheduled Tribes	5.7	5.4	6.3
OBC	35.1	32.6	41.4
General	47.5	57.2	23.4
Religion	**%**	**%**	**%**
Hindu	64.9	54.7	90.1
Islam	34.9	44.9	9.9
Christian	0.0	0.0	0.0
Family			
Family size (Nos.)	5.9	6.0	5.9
Average Adult Male (Nos.)	2.3	2.3	2.2
Average Adult Female (Nos.)	2.0	2.0	2.0
Average Children Male (Nos.)	0.9	0.9	0.9
Average Children Female (Nos.)	0.7	0.7	0.7
Type of farmer	**%**	**%**	**%**
Marginal Farmers- less than 1 Ha	51.2	52.2	48.6
Small Farmer -1-2 Ha	41.9	40.9	44.1
Semi Medium Farmers 2-4 Ha	7.0	6.9	7.2
Land ownership			
Average agricultural land (ha) owned	1.0	1.0	1.0
Average land is leased in/share-cropped (ha)	0.1	0.1	0.1
Average land is leased out (ha)	0.0	0.0	0.0
Average operational land (ha)	1.3	1.4	1.2
Average amount of land cultivated last season (ha)	0.5	0.5	0.5
Cropping intensity	**%**	**%**	**%**
Once	78.0	72.8	91.0
Twice	22.0	27.2	9.0
Thrice	0.0	0.0	0.0
Income			
Average income in the last 12 months from the selected crop	29,489.1	29,961.6	28,314.4
Average income in the last 12 months from any other crop	75,597.1	69,244.7	91,392.3
Average income in the last 12 months from any other sources	79,879.8	75,619.6	90,473.0
Average total HH income	1,84,966.1	1,74,825.9	2,10,179.7

	Intervention		
	Total	**Male**	**Female**
N	**387**	**276**	**111**
Expenditure			
Average monthly expenditure	8,715.5	8,283.7	9,789.2
Average annual expenditure	1,04,586.0	99,404.3	1,17,470.3
Savings			
Average monthly savings	2,572.0	2,729.3	2,180.6
Average annual savings	30,863.6	32,752.2	26,167.6
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**
Yes	3.4	4.3	0.9
No	93.3	91.3	98.2
Went before, not now	3.4	4.3	0.9

Relevance

Over the last 7-8 years, the cultivation of pulses such as black gram, lentil and pea has gained increasing relevance in Assam due to their multifaceted benefits for agriculture, economy and nutrition. The sample data reveal that marginal farmers, owning less than one hectare of land, constitute the majority at 51.2%, followed by small farmers with holdings between 1-2 hectares, reflecting the dominance of smallholder agriculture in the state. 87% pulses farmers cultivate paddy and 40% cultivate mustard and vegetables. This diversification not only enhances income stability and risk management but also supports food and nutritional security. Pulses contribute significantly to soil health as nitrogen-fixing crops, enhancing fertility and reducing dependence on chemical fertilizers, which is particularly important for Assam's predominantly rice-based farming systems. Despite the state producing only a fraction of its total pulse requirement, there has been a steady increase in both area under cultivation and production, supported by state and central schemes like the **National Food Security Mission for Pulses (NFSM-Pulses)** and initiatives under Assam's **"Agri Vision 2025**[12]**."** Economically, pulses provide a low-input, high-value cropping option, offering small and marginal farmers an additional source of income and helping diversify farming systems. Overall, pulses have become increasingly relevant in Assam not only for enhancing food and nutritional security but also for promoting sustainable agriculture, improving farmer livelihoods and strengthening the resilience of the state's farming systems.

Efficiency

Pulses cultivation in Assam has emerged as an efficient and promising component of the state's agricultural system, contributing to both livelihood enhancement and soil health improvement. The adoption of improved varieties such as **Black gram PU-31, Lentil WBL 77, Green Pea NS 1100, Green Pea KSS 110 and Field Pea AMAN** under the APART interventions has significantly enhanced productivity and adaptability under Assam's diverse agro-climatic conditions. Around **71% of intervention farmers** adopted these improved varieties, supported by strong compliance with recommended Packages of Practices (PoPs). High adoption rates, ranging from **71% to over 90%**, reflect efficient uptake of agronomic practices that optimize yields and input use.

[12] https://diragri.assam.gov.in/information-services/agri-vision-2025

The efficiency of pulses cultivation is also demonstrated by the **integration of local and improved seed systems**, where even traditional varieties report over **90% adoption** of modern PoPs, indicating diffusion of best practices across farming systems. Moreover, the predominance of **private input networks** (with over 90% of farmers sourcing seeds and inputs from local dealers) ensures timely availability and accessibility, while emerging roles of government agencies, cooperatives and Farmer Producer Companies enhance distribution efficiency. Collectively, these factors have improved resource-use efficiency, increased profitability and strengthened resilience among small and marginal farmers. Pulses cultivation in Assam thus represents a sustainable and efficient pathway toward crop diversification, nutritional security and climate-resilient farming systems.

Effectiveness

Pulses cultivation in Assam has proven highly effective in enhancing farmer livelihoods, promoting sustainable cropping systems and improving overall farm efficiency. Under the APART interventions, about **71% of farmers** adopted improved varieties such as **Black gram PU-31, Lentil WBL 77, Green Pea NS 1100, Green Pea KSS 110 and Field Pea AMAN**, which demonstrated better yield performance and adaptability to local conditions. The strong adoption of **Packages of Practices (PoPs)**, ranging from 71% to over 90% across varieties, reflects farmer's growing confidence in improved agronomic methods. This has translated into tangible economic outcomes, with households earning an average annual income of **Rs.1.85 lakh**, of which pulses contribute significantly (**Rs.29,489**, 16%), alongside other crops and non-farm activities. While male farmers reported a total annual income of Rs.1.75 lakh, female farmers earned significantly higher at Rs.2.10 lakh, indicating better diversification and efficiency in their livelihood strategies. Income from pulses cultivation contributes about Rs.29,489 annually, with minimal gender variation. Efficiency in water use is notable, as a majority of farmers (58.1%) rely on rainfed conditions, while those adopting drip or sprinkler systems (31.8%) demonstrate resource-efficient irrigation practices. The effectiveness of pulses cultivation is further reinforced by strong institutional participation, **64.1% of farmers are FPC members**, facilitating collective decision-making, better price realization, and access to credit. Moreover, APART demonstrations have improved yields (reported by 93.8% of farmers), enhanced crop quality, and expanded knowledge on modern farming techniques. With **99%** of farmers actively engaged in markets and **100%** aware of the Minimum Support Price (MSP), pulses cultivation in Assam exemplifies an effective, resilient and market-oriented agricultural practice that strengthens income security and fosters sustainable rural development.

Sustainability

Pulses are critical to Assam's food and nutritional security, soil health, and rural livelihoods, yet current production (~80,000 MT) meets only a fraction of the projected state requirement (945,913 MT for 2025-26)[13]. Sustainable expansion of pulses requires an integrated approach that addresses soil acidity and fertility, seed systems, climate resilience, value chain gaps (storage/processing/markets), and social inclusion.

Adoption of seed varieties and the package of practices among pulse farmers is good. APART has been able to show a headway. The All India Coordinated Research Project (AICRP) on pulses, implemented at the Assam Agricultural University (AAU), has already developed several suitable varieties. These need to be promoted among the farmers. Farmer's access to small-scale and affordable farm machinery for tasks like land preparation, sowing, and implementing integrated pest management (IPM) techniques to minimize crop damage can boost pulses production. Utilizing rice fallows, promoting intercropping and crop rotation and targeting specific districts would expand the cultivation area of pulses. Ensuring that farmers have full access to state and central government

[13] Agri Vision 2025

initiatives, such as the **Mission for Aatmanirbharta in Pulses** and the **National Food Security Mission (NFSM)-Pulses**, which provide seeds, demonstrations and market linkages would help in carrying forward the interventions initiated by APART.

Sustainably scaling pulses production in Assam is both necessary and feasible, but requires simultaneous action across soil health, seed systems, post-harvest infrastructure, markets, and social inclusion. With targeted public investments, strengthened extension and seed systems and market-oriented value chain development; while centering women and smallholders, Assam can significantly close the pulses supply gap, improve rural incomes and deliver nutritional and environmental co-benefits.

Impact

The comparative performance of lentil, black gram and pea reveals distinct variations in their outcomes. **Lentil** stands out as the most profitable and resource-efficient crop, with the highest **earnings (Rs. 31,242.36/ha)**. It's superior market price (Rs. 73/kg) and moderate input cost structure (Rs. 9,957.32/ha) make it an economically resilient crop. The combination of higher price realization, good yield and relatively low cultivation cost demonstrates lentil's strong potential to enhance smallholder income stability while maintaining efficient input use.

In contrast, **black gram** shows moderate profitability, with earnings **of Rs. 10,733.95/ha**. Despite comparable yields (966.75 kg/ha), higher input costs (Rs. 22,319.70/ha) constrain its net returns. Strengthening access to quality seeds, promoting integrated pest management and improving market linkages could further enhance its profitability and sustainability potential.

Pea, on the other hand, exhibits limited economic viability, recording the lowest **gross margin (Rs. 2,760.28/ha)**, mainly due to its low market price (Rs. 22.84/kg) and moderate productivity. While its cultivation involves lower input costs, the economic returns remain minimal. Promoting improved varieties with higher yield and market demand, along with post-harvest value addition, could make pea cultivation more remunerative and sustainable in the long run.

***Table 27**: Yield, Revenue and Earnings - Pulses*

	Total Pulses	Black Gram	Pea	Lentil
N	**387**	**133**	**127**	**127**
Area, in Ha	0.59	0.76	0.41	0.59
Yet to sell/Home consumption /Seeds, In kgs	119.30	153.53	34.75	169.88
Total Production, In kgs	**675.41**	**738.07**	**547.35**	**738.86**
Productivity (kg/ha)	**1141.85**	**966.75**	**1332.32**	**1246.82**
Marketable Surplus, In kgs	555.75	584.53	512.60	568.98
Market Price, In Rs.	50.9	56.94	22.84	73
Residue/By-product (Lumpsum Cost), In Rs.	184.72	-	184.72	-
Revenue, In Rs.	**28,612.15**	**33,053.65**	**11,730.24**	**41,038.4**
Input Cost, In Rs.	13,902.25	22,319.70	8,969.96	9,957.32
Earnings, In Rs.	**14,762.25**	**10,733.95**	**2,760.28**	**31,242.36**

Comparing yield with state averages: According to the Statistical Handbook Assam 2024 (Directorate of Economics and Statistics), the average yield of pulses in the state during 2023-24 is approximately 801 kg/ha. In comparison, the average yield recorded among the intervention farmers under APART is 1,141.85 kg/ha, which is significantly higher than the state average. This substantial improvement clearly indicates enhanced productivity and reflects the effectiveness of the interventions implemented under the project.

- **Lentil** offers the **best economic return and input efficiency**, suitable for scaling as a high-value pulse. It achieves the **highest revenue per hectare (Rs. 69,277.4)** and **gross margin (Rs. 52,740.57/ha)**, alongside the **lowest input cost (Rs. 16,809.08/ha)**. This results in a **gross margin ratio of 76.12%**, indicating excellent cost efficiency and return on investment. Lentil's strong market price and lower input needs make it a highly sustainable crop choice, both economically and environmentally.
- **Black gram,** with earning a **gross margin of Rs. 14,069.77/ha** and gross margin ratio of **32.47%**, provides moderate profit. Despite decent yields, its higher input costs (Rs. 29,235.25/ha) limit profitability. Nonetheless, black gram contributes positively to soil fertility and crop diversification, making it agronomically valuable.
- **Pea,** remains **least profitable** with a **gross margin of Rs. 6,718.95/ha** and a **margin ratio of just 23.53%**. While not financially attractive, pea cultivation supports ecological sustainability through nitrogen fixation and soil enrichment, which can complement crop rotations.

Table 28: *Gross Margin Analysis: Pulses Cultivation*

	Intervention		
	Total	**Male**	**Female**
N	**387**	**276**	**111**
Average cultivated area (ha)	0.59	0.59	0.59
Yield (kg/ha)	**1,141.85**	**1,143.92**	**1,136.80**
Average Revenue (Rs.) per ha	48,365.18	47,614.99	50,200.40
Average Input Cost (Rs.) per ha	23,499.99	23,954.71	22,387.59
Average Gross Margin (Rs.) per ha	24,953.70	23,784.98	27,812.81
Gross Margin Ratio (%)	**51.59%**	**49.95%**	**55.40%**

Under the intervention, average cultivated area and yields are nearly identical across male and female farmers, indicating comparable production performance. However, female farmers realise higher economic returns, with greater average revenue per hectare (Rs. 50,200 vs Rs. 47,614) and a higher gross margin per hectare (Rs. 27,813 vs Rs. 23,785). This is driven by relatively lower input costs per hectare among women farmers, resulting in a stronger gross margin ratio (55.40%) compared to male farmers (49.95%). Overall, the intervention demonstrates gender-inclusive outcomes, with women farmers achieving equal productivity and superior cost efficiency and profitability.

Comparison with Baseline Study (Independent Samples)

The sample for pulses in the baseline study was very small - only 9 farmers from 4 districts were selected. Out of 9 farmers, 6 are lentil farmers and 3 are combined pulses farmers (black gram, green gram and pigeon pea).

Table 29: *Comparison with Baseline Data - Pulses Cultivation*

	Sample	Area	Production	Productivity	Significance (Mann-Whitney U-test)	Market Price
		Average	**Average**	**Average**	*****: p<0.001; **: p<0.05; *: p<0.10**	
Baseline (2019)	9	0.45 ha	1,150 kgs	2,545 kg/ ha	n.s.	Rs. 56.96

Endline (2025)	387	0.59 ha	673.99 kgs	1,141.85 kg/ha		Rs. 51.00

Note: It is important to note that the baseline findings were based on a relatively small sample size, which may have influenced the comparability of results. Moreover, the baseline data mentioned a yield (kg/ha) of 2,545 for pulses, which looks higher for 2018-19 and indicates possible reporting inconsistencies in the baseline. Hence, the results do not show a significant impact when compared with the baseline data. The yield was approximately 755 kg per hectare, based on the Statistical Hand Book Assam, 2019 - Directorate of Economics and Statistics[14].

Test used: Mann-Whiteney test (non-parametric)

Test statistics value: 1.593

P-value: 0.1111

SN	Crop	Area (Ha)	Production (Ton)	Productivity (Quintals/ha)
1	Green Gram	143.5	58.26	4.06
2	Black Gram	1364	636.98	4.67
3	Gram	213	100	4.70
4	Lentil	2050.5	1060.10	5.17
5	Peas	883	675.50	7.65

Source: AAU Annual Report[15] 2018-19

Equity

The analysis highlights clear gender differences in income, expenditure, productivity and market participation among pulse farmers in Assam. Female farmers report higher average annual incomes (Rs. 2.10 lakh) than males (Rs.1.75 lakh), owing to their involvement in diversified livelihoods such as livestock rearing, vegetable cultivation and non-farm enterprises. However, women also face higher household expenditure burdens (Rs.1.17 lakh vs. Rs. 99,404), which limit their savings capacity despite higher earnings.

In terms of cultivation, men cultivate slightly larger areas in Black gram and Pea, reflecting continued male dominance in land ownership, while women have a higher average area under Lentil (0.66 ha) - a crop where they play a traditional and active role. Productivity pattern shows that female farmers match male farmers in lentil productivity, demonstrating their efficiency when access barriers are minimized.

Market participation remains gender-skewed, with men engaging more directly with traders and formal markets, while women retain a larger share of produce for household consumption and seed use, particularly in Lentil. Notably, women realize better prices for Lentil (Rs. 74.3/kg vs. Rs. 72.3/kg), suggesting strong quality management and market responsiveness.

Emerging trends indicate that women increasingly prefer Lentil cultivation due to its low input needs and labor compatibility. The findings underline that when women have comparable access to land, inputs and information, their productivity and profitability can match or exceed that of men.

Overall, women are emerging as key contributors to the pulse economy in Assam, particularly through Lentil cultivation. Strengthening their access to productive assets, financial services, market linkages and institutional support will be essential for achieving inclusive and gender-equitable growth in the state's pulse sector.

[14] Statistical Hand Book Assam, 2019 - Directorate of Economics and Statistics - Table - 5.06: Average Yield Under Food and Non-Food Crops covered by Crop Forecast in Assam- Page 74

[15] https://kvkchirang.aau.ac.in/pdf/annual_report/2018-19.pdf

Grievance Redressal: 86.6% of the farmers were aware that they could register their grievances. Out of all respondents, 20.9% reported their grievances to the Grievance Redressal Cell.

3.4.1.1.3 Fruits and Vegetables

3.4.1.1.3.1 Banana and Pineapple

Cultivating bananas is popular in Assam due to its significant economic, cultural and nutritional value. The state's favorable climate allows for year-round cultivation and bananas are a vital cash crop for small farmers, providing income, employment and food security. Furthermore, the crop holds deep cultural importance, with its leaves and other parts used extensively in social and religious functions, making it ubiquitous in homestead gardens.

Due to the ideal agro-climatic conditions of Assam and the potential for economic growth through both domestic sales and export, cultivating pineapples is widespread. Assam is one of India's top pineapple-producing states and its traditional practice of organic farming provides a competitive edge in global markets.

APART has been able to provide individual demonstration inputs to 236 banana farmers (14.4% female farmers; 18% farmers from indigenous groups) and 53 pineapple farmers (19% female farmers; 77% farmers from indigenous groups). Many Farmer Producer Companies (FPCs) are dealing with Banana as their focused commodities. For instance, Srijoni FPC through its Common Service Center (CSC) from Goalpara has ventured as a Banana Ripening Chamber through support from APART. The project has introduced a special variety like G-9 (Grand Naine) which is a high-yielding, tissue-cultured cavendish type, known for its superior fruit quality and high yield. It may be noted that Asia’s largest Banana market is in Daranggiri, Goalpara.

OPIU Horticulture under APART highlighted the potential of banana with substantial increase in production via area expansion and productivity increase and linkage to the post-harvest management and marketing[16]. Major interventions from APART in Production Enhancement Program of Banana are as follows:

- Use of Secondary hardened Tissue Culture G9 variety
- Imparting recommended Package of Practices (PoPs)
- Nutrient Management with proper fertilization-both Major and Micronutrients
- Proper intercultural operations like weeding, desuckering, earthing up, pruning of leaves, propping etc.
- Convergence with Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) for micro irrigation arrangement with the banana beneficiaries.
- The practice of using Bunch Cover with perforated polythene bags to protect the fruit from sunburn, dust, insects and birds. It also increases the yield and early maturity.
- Post Harvest activities including optimizing the harvesting time, advocating for proper ripening, bunch handling for extending shelf-life and quality of the fruits. Promoting the benefit of carbide free ripening.

Banana demonstrations under APART were more widespread and sustained across years, with significant implementation in 2018–19 and a later shift to larger consolidated plots. In contrast, pineapple demonstrations were more targeted, occurring only in 2021–22 but showing a rapid scale-up in 2022. Overall, banana had substantially higher outreach and area coverage, while pineapple exhibited focused intensification within a shorter time span. These trends highlight APART’s adaptive demonstration strategy, balancing early widespread interventions in banana with later value-chain strengthening in pineapple.

[16] Assam State Portal - Knowledge Transfer Document for Production Enhancement Programme of Banana

- **Banana**: 236 demonstrations were conducted covering **57.5 ha** across all years.
- **Pineapple**: 53 demonstrations conducted covering **12.06 ha** across two years.

Endline Results

A sample of **164 fruit farmers** participating in the APART program was interviewed from eight districts - Cachar, Darrang, Goalpara, Jorhat, Kamrup, Lakhimpur, Morigaon and Sonitpur. In the sample of 164 farmers selected, 146 Banana farmers and 18 pineapple farmers. 91% respondents are males and 9% are females.

Table 30: *Sample Size - Fruits (Banana and Pineapple)*

	Total	Male	Female	SC	ST	OBC	General
Total	**164**	**149**	**15**	**33**	**32**	**43**	**56**
Banana	146	133	13	33	16	41	56
Pineapple	18	16	2	0	16	2	0

Background Information of Farmers:

Table 31: *Background Information - Fruits farmers*

	Intervention		
	Total	**Male**	**Female**
N	**164**	**149**	**15**
Average age	46.4	46.8	41.7
Education Level	**%**	**%**	**%**
Illiterate	2.4	2.7	0.0
Read and write	5.5	6.0	0.0
Class 1-5	7.9	8.1	6.7
Class 6-8	34.1	33.6	40.0
Class 9-12	46.3	45.6	53.3
Graduation	3.7	4.0	0.0
Above Graduation	0.0	0.0	0.0
Social groups	**%**	**%**	**%**
Scheduled Caste	20.1	20.1	20.0
Scheduled Tribes	19.5	18.1	33.3
OBC	26.2	27.5	13.3
General	34.1	34.2	33.3
Religion	**%**	**%**	**%**
Hindu	85.4	84.6	93.3
Islam	14.6	15.4	6.7
Family			
Family size (Nos.)	6.0	6.0	6.1
Average Adult Male (Nos.)	2.6	2.6	2.3
Average Adult Female (Nos.)	2.0	2.0	2.1
Average Children Male (Nos.)	0.9	0.9	1.1
Average Children Female (Nos.)	0.5	0.5	0.6
Type of farmer	**%**	**%**	**%**

	Intervention		
	Total	**Male**	**Female**
N	**164**	**149**	**15**
Marginal Farmers- less than 1 Ha	53.7	54.4	46.7
Small Farmer -1-2 Ha	43.9	43.0	53.3
Semi Medium Farmers 2-4 Ha	2.4	2.7	0.0
Medium 4-10 Ha	0.0	0.0	0.0
Land ownership			
Average agricultural land (ha) owned	1.0	1.0	1.0
Average land is leased in/share-cropped (ha)	0.0	0.0	0.1
Average land is leased out (ha)	0.0	0.0	0.0
Average operational land (ha)	1.0	1.0	1.1
Average amount of land cultivated last season (ha)	0.5	0.5	0.3
Cropping intensity	**%**	**%**	**%**
Once	86.6	85.9	93.3
Twice	13.4	14.1	6.7
Thrice	0.0	0.0	0.0
Income			
Average income in the last 12 months from the selected crop	1,02,910.4	1,03,498.7	97,066.7
Average income in the last 12 months from any other crop	54,176.8	55,000.0	46,000.0
Average income in the last 12 months from any other sources	44,524.4	43,275.2	56,933.3
Average total HH income	2,01,611.6	2,01,773.8	2,00,000.0
Expenditure			
Average monthly expenditure	10,137.2	10,120.8	10,300.0
Average annual expenditure	1,21,646.3	1,21,449.7	1,23,600.0
Savings			
Average monthly savings	3,945.7	4,040.9	3,000.0
Average annual savings	47,348.8	48,491.3	36,000.0
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**
Yes	4.3	4.7	0.0
No	88.4	87.2	100.0
Went before, not now	7.3	8.1	0.0

Relevance (with focus on Banana and Pineapple)

Fruit farming holds significant importance in Assam’s agrarian economy due to its favorable agro-climatic conditions, abundant rainfall and fertile soil that support the cultivation of a wide variety of tropical and subtropical fruits. Among these, **banana and pineapple** are the two most prominent fruit crops contributing to rural livelihoods, nutrition and market linkages.

Banana cultivation is widespread across all districts of Assam, providing both food security and steady income to small and marginal farmers. It serves as a year-round source of livelihood, with varieties like *Malbhog*, *Jahaji* and *Cheni Champa* being highly popular in both local and regional markets. Banana cultivation has gained prominence due to the adoption of high-yielding and market-preferred varieties such as the **G9 (Grand Naine)**. This variety is valued for its **uniform fruit size, attractive color, longer shelf life and suitability for commercial markets**. Banana farming also offers employment opportunities in harvesting, processing and trading, while its by-products are increasingly being utilized for value addition and handicrafts.

Pineapple cultivation is another major horticultural activity, particularly in the hilly and foothill areas such as Cachar, Karbi Anglong and Kamrup. Assam's *Queen* and *Kew* varieties are known for their sweetness and aroma, holding strong potential for processing and export. Pineapple farming supports women and tribal farmers and contributes to sustainable land use in sloping terrains.

Overall, farming banana and pineapple plays a crucial role in **diversifying Assam's agriculture**, enhancing **income security** and promoting **agro-based industries and value chains**. With growing market demand and government support through schemes like the Horticulture Mission for North East and APART, these sectors have strong potential for expansion, processing and export, reinforcing Assam's position as a horticultural hub in the Northeast.

Efficiency (with focus on Banana and Pineapple)

Pineapple

The efficiency of pineapple cultivation has improved significantly under APART interventions, as reflected in the high adoption rate of recommended seed varieties and package of practices (PoPs). All surveyed farmers (100%) have adopted improved seed varieties with 78% opting for Kew and 22% for Queen. Among them, 79% of Kew and 75% of Queen growers have continued to follow the demonstrated PoPs even after several years, indicating strong technology retention and farmer confidence in the improved practices.

Seed sourcing patterns highlight a healthy mix of institutional and informal systems. While most Kew growers (71%) procure seeds from private input dealers, smaller but significant shares rely on government agencies (14%), cooperatives (21%) and own reserves (14%). Interestingly, 43% of farmers depend on fellow farmers for seeds, reflecting active community-level seed exchange networks that strengthen local accessibility.

In terms of inputs and fertilizer sourcing, the dominance of private dealers (71%) is evident, though half of the farmers also access government-supplied inputs. Around 50% of pineapple growers reported that their cultivation required irrigation (drip/sprinkler or flood), underscoring a moderate dependence on irrigation for yield enhancement.

Overall, the high adoption of improved varieties, sustained adherence to PoPs and diversified input sourcing collectively suggest strong efficiency and resilience within the pineapple value chain.

Banana

Banana cultivation in Assam shows a progressive shift towards improved and commercially viable varieties, led by G9 (31.5%) and Malbhog (48%) - both promoted under APART. Around 20.5% continue cultivating local varieties such as Amrit Sagar and Jahaji. The adoption efficiency of improved varieties is notable: 80% of G9 and 93% of Malbhog users have fully adopted the improved seed and PoPs, with 100% of Malbhog growers adhering to the recommended practices.

Input and seed procurement systems show the dominance of private markets but also the importance of farmer networks and recycling. For G9, 70% procured planting material from private dealers, 47.8% from fellow farmers and 28.3% used their own seeds. Malbhog farmers sourced from a broader base of 42.9% from fellow farmers, 30% own seeds and smaller portions from government (15.7%) and cooperatives (10%). Local banana growers displayed even stronger dependence on private and informal networks, with 88.9% sourcing from private dealers and 62.2% from fellow farmers.

The G9 variety has steadily replaced traditional cultivars like Malbhog and Jahaji in many districts, driven by its higher productivity, disease tolerance and market suitability for both local and export-oriented value chains. This varietal shift reflects strong technical and economic efficiency, aligning with project goals for enhancing farmer income and supply chain competitiveness.

Irrigation adoption remains limited, with only 28% of banana farmers reporting irrigation use (mostly flood method - 26%, drip/sprinkler - 4%), indicating a potential area for improvement in water management efficiency.

However, challenges in implementing PoPs remain. Over half of the farmers (52%) found it difficult to apply PoPs fully in the field; 36% could not recall all practices and 15% cited resource constraints.

Fruit cultivation in Assam, particularly banana and pineapple, demonstrates strong efficiency improvements through the adoption of high-yielding, market-preferred varieties and recommended practices. While the Pineapple-Kew and Banana-G9/Malbhog value chains show technological and economic viability, sustained efficiency will depend on continuous extension support, irrigation access, input market strengthening and peer-led capacity building.

Effectiveness (with focus on Banana and Pineapple)

Fruit cultivation in Assam has emerged as one of the most promising sub-sectors within horticulture, contributing significantly to farm income diversification, nutritional security and livelihood enhancement. APART’s interventions have strengthened the sector through technological support, improved input access and collective marketing initiatives.

Adoption and Productivity Improvements: Under APART, fruit farmers have demonstrated strong adoption of improved seed varieties and scientific crop management practices. For instance, 100% of pineapple farmers adopted the recommended seed varieties, with popular use of Kew and Queen varieties and a high proportion reported complete adherence to the Package of Practices (PoPs). Such adoption has translated into enhanced productivity and yield stability, with farmers reporting improvements in both yield and fruit quality. These gains reflect the effectiveness of demonstration-based learning and the accessibility of improved inputs, farm mechanization and efficient water and fertilizer management. The introduction of short-duration and disease-resistant varieties has also contributed to greater climate resilience and reduced crop losses due to pests and erratic rainfall.

Economic and Social Impacts: The economic effectiveness of fruit cultivation is evident in the increased income levels and market participation among farmers. Households report an average annual income of Rs. 2.02 lakh, comprising earnings from fruits (Rs.1,02,910), other crops (Rs. 54,177) and non-farm sources (Rs. 44,524), fruit cultivation accounting for the largest share of household income. Membership in Farmer Producer Companies (FPCs) has helped them negotiate better prices collectively has enhanced profitability. Nearly 44.5% of fruit farmers are now members of FPCs, benefiting from collective decision-making (91.8%), access to credit and insurance (41.1%) and higher sale prices (35.6%). The sector has also supported women’s economic participation, with about one-third of female fruit farmers being FPC members and actively involved in production and marketing activities. Enhanced skill-building and cross-learning opportunities have strengthened their confidence and decision-making roles within the household and farmer groups.

Market Linkages and Institutional Strengthening: Despite the continued dominance of trader-led marketing (98.8% of farmers sell to traders), the emergence of FPCs and processors as alternative marketing channels indicates a gradual but meaningful shift toward structured and value-driven supply chains. About 25% of farmers now market through FPCs, often as seed producers, highlighting the growing institutional capacity to handle aggregation, grading and market negotiation.

Overall, fruit cultivation in Assam has proven highly effective in improving farm productivity, incomes and resilience, supported by institutional mechanisms such as FPCs and capacity-building under APART. The transition from subsistence-level production to market-oriented, organized fruit farming reflects a structural improvement in Assam's rural economy.

Sustainability (with focus on Banana and Pineapple)

Fruit farming in Assam, particularly **banana and pineapple cultivation**, has emerged as a sustainable and resilient livelihood option for small and marginal farmers.

Fruit cultivation has proven **economically viable and profitable** across scales of operation.

- **High productivity and returns:** Banana yield an average productivity of **22,487.58 kg/ha** with earnings of around **Rs.4.48 lakhs per farmer per ha**, while pineapple records **24,343.42 kg/ha** with net earnings of **Rs.3.72 lakhs per farmer per ha**.
- **Robust gross margins:** Both crops show strong profitability- **70.3% for banana** and **68.8% for pineapple**, indicating high returns on investment and efficient resource use.
- **Gender inclusion in profitability:** Women farmers, though cultivating smaller areas, demonstrate higher productivity and cost efficiency, particularly in pineapple farming, strengthening household resilience and income diversification.

Fruit-based farming systems support **soil conservation and biodiversity**, making them environmentally sound choices.

- Perennial crops like banana and pineapple **reduce soil erosion** and **maintain ground cover**, especially in hilly and undulating terrain.
- Adoption of **improved varieties and Package of Practices (PoPs)** promoted under APART has led to **optimized fertilizer use, organic manuring and integrated pest management**, thereby minimizing chemical dependence.

Fruit farming has fostered **community participation and institutional linkages** through Farmer Producer Companies (FPCs) and collective marketing efforts.

- Over **44% of fruit farmers** are FPC members, enabling **collective input procurement, aggregation and market access**.
- Enhanced participation of **women and youth** in cultivation, processing and marketing activities strengthens social inclusiveness.
- Capacity building, exposure to improved techniques and handholding support from APART ensure **knowledge sustainability** and long-term self-reliance among farmers.

Fruit farming in Assam demonstrates a **balanced integration of profitability, ecological health and social inclusiveness**. Supported by APART's interventions in improved varieties, PoPs, FPC strengthening and gender-responsive training, the sector is moving toward a **sustainable horticultural ecosystem**. Continued focus on **post-harvest management, value addition and climate resilience** will ensure that banana and pineapple cultivation remain long-term sustainable livelihood avenues for the state's farming communities.

Impact (with focus on Banana and Pineapple)

Banana

Banana cultivation shows strong profitability and productivity, with an average yield of **21,791.59 kg/ha** and revenue of **Rs.1,40,263.12**. After accounting for input costs of **Rs.41,600.40**, net earnings are **Rs.98,662.72**. The crop's high marketable surplus and additional income from residues indicate **efficient production, good market potential and strong economic viability** for smallholders.

Pineapple

Pineapple cultivation demonstrates high productivity and profitability, with an average yield of **24,565.43 kg/ha** and revenue of **Rs.1,78,616.67**. After accounting for input costs of **Rs.55,682.67**, farmers earn a substantial gross margin of **Rs.1,22,934**. The crop's strong marketable surplus and moderate cultivation area (0.33 ha) reflect efficient management, good market returns and strong income potential, making pineapple a **commercially attractive and economically viable crop** option.

Table 32: *Yield, Revenue and Earnings - Fruits (Banana and Pineapple)*

	Banana	Pineapple
N	**146**	**18**
Average cultivated area (Ha)	0.219	0.327
Average Yet to sell/Home consumption /Seeds (Kg)	789.31	1233.33
Average Production (Kg)	4,792.24	**8,033.33**
Average Productivity (kg/ha)	**21,791.59**	**24,565.43**
Average Marketable Surplus (Kg)	4,002.92	6,800
Average Market Price (Rs.)	34.53	26.39
Average Residue/By-product (Lumpsum Cost) (Rs.)	2,907.62	-
Average Revenue (Rs.)	**1,40,263.12**	**1,78,616.67**
Average Input Cost (Rs.)	41,600.40	55,682.67
Average Earnings (Rs.)	**98,662.72**	**1,22,934**

Comparing yield with state averages: According to the Statistical Handbook Assam 2024 (Directorate of Economics and Statistics), the average yield of banana and pineapple in the state during 2023-24 is approximately 19,236 kg/ha and 16,475 kg/ha respectively. In comparison, the average yield recorded among the intervention farmers under APART is 21,791.59 kg/ha for banana and 24,565.43 kg/ha for pineapple, which are significantly higher than the state averages. This substantial improvement clearly indicates enhanced productivity and reflects the effectiveness of the interventions implemented under the project.

Gross Margin

Table 33: *Gross Margin Analysis: Fruits Cultivation*

Indicator	Banana			Pineapple		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**146**	**133**	**13**	**18**	**16**	**2**
	Average	**Average**	**Average**	**Average**	**Average**	**Average**
Cultivated Area (Ha)	0.219	0.221	0.198	0.327	0.334	0.267
Yield (kg/ha)	**21,791.59**	**21,766.59**	**22,076.90**	**24,565.43**	**24,387.05**	**26,349.23**
Revenue (Rs.) per ha	6,37,813.83	6,37,331.12	6,43,323.32	546198.64	5,38,776.35	6,20,421.59

Indicator	Banana			Pineapple		
	Total	Male	Female	Total	Male	Female
N	146	133	13	18	16	2
Input Cost (Rs.) per ha	1,89,168.13	1,90,174.32	1,77,683.70	1,70,274.12	1,74,415.65	1,28,858.95
Gross Margin per Ha (Rs/Ha)	4,48,645.69	4,47,156.80	4,65,639.61	3,75,924.51	3,64,360.70	4,91,562.64
Gross Margin Ratio (%)	**70.34%**	**70.16%**	**72.38%**	**68.83%**	**67.63%**	**79.23%**

Both banana and pineapple cultivation demonstrate strong profitability, though their economic profiles differ. Pineapple records higher yields and higher average gross margins per farmer (Rs.1.23 lakh) compared to banana (Rs. 0.986 lakh), reflecting higher absolute returns despite a larger cultivated area. However, banana outperforms pineapple in terms of economic efficiency per unit of land, with a higher gross margin per hectare (Rs. 4.48 lakh/ha vs Rs. 3.75 lakh/ha) and a marginally higher gross margin ratio (70.34% vs 68.83%).

Gender-wise, female farmers in both crops exhibit superior cost efficiency and profitability ratios. In banana, women achieve a higher gross margin ratio (72.38%) and gross margin per hectare than male farmers, despite cultivating slightly smaller areas. This pattern is even more pronounced in pineapple, where female farmers record substantially higher gross margin per hectare (Rs. 4.91 lakh/ha) and the highest gross margin ratio (79.23%), driven by significantly lower input costs per hectare. Overall, the results indicate that both crops are economically attractive, with banana being more land-efficient and pineapple offering higher absolute returns, while women farmers consistently demonstrate stronger financial efficiency across crops.

The analysis compares the profitability of banana and pineapple cultivation, focusing on revenue generation, input costs and gross margins per hectare.

- **Profitability:** Both crops exhibit strong profitability with gross margin ratios above 65%, indicating efficient cost management and good market performance.
  - **Banana:** Rs. 98,662.72 average earnings (70.34% margin)
  - **Pineapple:** Rs. 1,22,934 average earnings (68.83% margin)
- **Revenue and Scale:** Banana generates higher total revenue per ha than pineapple but also incurs higher input costs, but more cost-efficient, yielding a slightly higher gross margin ratio and better return per hectare.
- **Efficiency:** Banana shows higher gross margin per ha (Rs. 4.48 lakh) compared to pineapple (Rs. 3.72 lakh), suggesting more productive land use and stronger economic efficiency.

Comparison with Baseline Study (Independent Samples)

The baseline survey for banana cultivation included only 9 farmers with a total area of 3.27 ha, whereas the endline survey covered 146 farmers cultivating 60.66 ha. Due to this large difference in sample size, the data is not directly comparable. However, the results have been presented below for reference.

Table 34: *Comparison with Baseline Data - Fruits Cultivation (Banana)*

	Sample	Area	Production	Productivity	Significance (Mann-Whitney U test)	Market Price
		Average	Average	Average	***: p<0.001; **: p<0.05; *: p<0.10	Average

Baseline (2019)	9	0.36 ha	5,488.9 kg	15,122.5 kg/ ha	*	Rs. 7.67
Endline (2025)	146	0.21 ha	4,792.24 kg	21,791.59 kg/ha		Rs. 34.52

Note: It is important to note that the baseline findings were based on a relatively small sample size, which may have influenced the comparability of results.

Test used: Mann-Whiteney test (non-parametric)
Test statistics value: -2.141
P-value: 0.0323

It is also noted that pineapple was not included in the baseline survey.

Equity

Fruit cultivation in Assam, particularly banana and pineapple, has shown encouraging signs of **gender inclusion and equity**, with women playing an increasingly active role in production and management. Although the participation of women remains lower in numerical terms, **13 out of 146 banana farmers** and **2 out of 18 pineapple farmers**, their performance indicators reveal strong productivity and efficiency, underscoring their potential as key contributors to Assam's fruit economy.

- Women operate on **smaller landholdings**, **0.2 ha for banana** and **0.32 ha for pineapple**, compared to men (0.22 ha and 0.33 ha respectively).
- Despite this scale difference, women maintain **competitive production efficiency**, often compensating with better management, input optimization and adherence to recommended practices.
- **Female banana farmers** reported a **competitive productivity (22,076.90 kg/ha)** compared to male banana farmers **(21,766.59 kg/ha)**.
- This indicates that women, though cultivating smaller plots, are **more efficient producers**, achieving comparable or superior yields.
- Women also benefit from **slightly higher market prices**, Rs. 34.53/kg for banana (vs Rs. 34.36 for men) and Rs. 26.39/kg for pineapple (vs Rs. 26.38 for men).
- This may reflect **better grading, quality management or local market engagement**, suggesting that women's produce fetches a price premium in some contexts.

The gender analysis of fruit farming in Assam demonstrates that **women farmers are equally or more productive than their male counterparts**, despite smaller landholdings and limited access to resources. Their efficient use of inputs, higher quality produce and better market performance underscore the importance of **gender-responsive interventions** in the fruit value chain. Promoting **capacity building, leadership roles in FPCs and improved market linkages for women** will be essential to achieving inclusive and sustainable growth in Assam's horticulture sector.

Grievance Redressal: Around 148 or 90.2% of the farmers were aware that they could register their grievances. Out of all respondents, 23.0% reported their grievances to the Grievance Redressal Cell.

3.4.1.1.3.2 Potato

Potato is one of the focused commodities of APART which has gained a lot of acceptance among farmers. The project has been able to promote various climate-resilient practices and newer seed varieties, with inputs from international knowledge partners. It can be said that it is through APART that the farmers of Assam were introduced to processed variety potatoes.

More than 5,000 farmers (25% female farmers; 17% from Scheduled Tribes) have received various demonstrations related to Potato. Three kind of demonstrations were undertaken (1) technical demonstrations - (i) zero-tillage with paddy straw mulching, (ii) raised bed with paddy straw mulch, (iii) partial root-zone drying method and (iv) best management practices (BMP) (2) on seed varieties- (i) high-yielding solid varieties, (ii) virus-resistant varieties, (iii) early maturing potato and (iv) seed production- low cost net house; and (3) low-cost farm mechanization demonstrations- (i) for potato planters, (ii) for potato diggers and (iii) small power tillers with planters.

In total, **4,628 demonstrations** were conducted on about **1,210 ha** across 11-15 districts each year, indicating consistent geographic spread. The initiative started strongly in **2018** with **468 demonstrations on 227.35 ha** (average 0.49 ha per demo), largely centered on *Kufri Pukhraj* in 15 districts. In **2019-2020**, the program shifted towards smaller plot sizes but maintained momentum, with **466 demos on 92.35 ha** in 2019 and **270 demos on 59.30 ha** in 2020, while new improved varieties such as *Kufri Surya*, *Lady Rossetta* and *Chipsona-3* began to feature prominently. From **2021 onwards**, APART moved into a clear intensification phase. Demonstrations rose to **665** in 2021 (124.32 ha) and **612** in 2022 (177.01 ha), with a balanced mix of table and processing varieties. *Kufri Surya*, *Kufri Pukhraj*, *Lady Rossetta* and *Chipsona-3* dominated these years, reflecting a deliberate strategy to promote climate-resilient and processing-suitable cultivars. The **breakthrough came in 2023**, when the program scaled up to **2,147 demonstrations on 529.81 ha**, driven largely by the rapid expansion of *Lady Rossetta* (over 1,000 demos) and *Chipsona-3*, supported by *Kufri Surya* and *Kufri Himalini*. This marks a transition from piloting to near programmatic saturation in key potato-growing pockets.

Gender-disaggregated data show that male farmers form the majority of participants, but women's involvement is significant and non-marginal. Overall, about **24-25% of the demonstration farmers are women** (1,128 out of 4,628), with female participation peaking around **40% in 2020** and then stabilizing between **23-30%** in later years. potato value chain.

The APART project shows a strong and deliberate shift towards **processed potato varieties**, both in scale and outreach. Processed varieties such as *Lady Rossetta* and *Chipsona-3* account for **2,117 demonstrations**, more than **double** the number of table potato demonstrations (**947**). This indicates a strategic push toward varieties suitable for chips, crisps and processing industries, aligning with value-chain development goals in Assam. In terms of demonstration area, processed potatoes collectively cover **499.15 ha**, compared to **288.89 ha** under table potato varieties. While processed varieties dominate in total area, the **average plot size** is larger for table potatoes (**0.31 ha/demo**) than for processed potatoes (**0.24 ha/demo**), suggesting that table potatoes are grown on relatively bigger individual plots, whereas processed potato demonstrations focus on reaching many more farmers with moderately sized plots.

Endline Results

A total number of **906 potato farmers** from 17 districts were interviewed for the survey. 606 farmers comprising 303 APART beneficiaries and 303 Control farmers for table variety potato were selected, another 300 farmers engaged with processed variety potato were also interviewed. Overall, 22.4% were female farmers.

Table 35: *Sample Size - Potato*

	Total			Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**
TOTAL	906	703	203	603	433	170	303	270	33
Potato (Table variety)	606	501	105	303	231	72	303	270	33

Potato (Processed)	300	202	98	300	202	98	0	0	0

Background Information of farmers:

Table 36: *Background Information - Potato farmers*

	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**603**	**433**	**170**	**303**	**270**	**33**
Average age	46.0	47.5	42.3	44.0	44.3	41.6
Education Level	%	%	%	%	%	%
Illiterate	3.0	3.2	2.4	2.0	1.9	3.0
Read and write	4.3	4.6	3.5	5.0	5.2	3.0
Class 1-5	13.9	14.1	13.5	22.1	19.6	42.4
Class 6-8	27.7	28.2	26.5	25.4	24.8	30.3
Class 9-12	47.3	45.7	51.2	39.6	41.9	21.2
Graduation	3.6	3.9	2.9	5.9	6.7	0.0
Above Graduation	0.2	0.2	0.0	0.0	0.0	0.0
Social groups	%	%	%	%	%	%
Scheduled Caste	14.9	14.8	15.3	17.5	18.9	6.1
Scheduled Tribes	17.2	18.0	15.3	32.0	28.9	57.6
OBC	35.2	29.6	49.4	27.7	28.9	18.2
General	32.7	37.6	20.0	22.8	23.3	18.2
Religion	%	%	%	%	%	%
Hindu	78.8	74.6	89.4	83.5	83.0	87.9
Islam	18.7	22.9	8.2	16.5	17.0	12.1
Christian	2.5	2.5	2.4	0.0	0.0	0.0
Family						
Family size (Nos.)	5.1	5.1	5.1	5.0	5.0	4.8
Average Adult Male (Nos.)	2.0	2.0	2.0	2.1	2.1	2.1
Average Adult Female (Nos.)	1.7	1.8	1.7	1.8	1.8	1.8
Average Children Male (Nos.)	0.8	0.8	0.8	0.6	0.6	0.6
Average Children Female (Nos.)	0.6	0.6	0.6	0.5	0.5	0.3
Type of farmer	%	%	%	%	%	%
Marginal Farmers-less than 1 Ha	68.8	69.1	68.2	81.2	80.0	90.9
Small Farmer -1-2 Ha	30.3	30.0	31.2	14.2	15.2	6.1
Semi Medium Farmers 2-4 Ha	0.8	0.9	0.6	3.3	3.3	3.0
Medium 4-10 Ha	0.0	0.0	0.0	1.3	1.5	0.0
Land ownership						
Average agricultural land (ha) owned	0.8	0.9	0.8	0.8	0.8	0.7
Average land is leased in/share-cropped (ha)	0.0	0.0	0.0	0.0	0.0	0.0
Average land is leased out (ha)	0.0	0.0	0.0	0.0	0.0	0.0

	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**603**	**433**	**170**	**303**	**270**	**33**
Average operational land (ha)	0.9	0.9	0.8	0.8	0.8	0.7
Average amount of land cultivated last season (ha)	0.6	0.6	0.5	0.5	0.5	0.5
Cropping intensity	**%**	**%**	**%**	**%**	**%**	**%**
Once	85.4	85.9	84.1	60.7	57.0	90.9
Twice	14.6	14.1	15.9	39.3	43.0	9.1
Thrice	0.0	0.0	0.0	0.0	0.0	0.0
Income						
Average income in the last 12 months from the selected crop	80,889.7	81,523.4	79,275.5	48,894.5	47,614.6	59,366.7
Average income in the last 12 months from any other crop	47,714.1	47,724.2	47,688.3	50,412.9	51,481.9	41,666.7
Average income in the last 12 months from any other sources	50,592.0	50,092.4	51,864.7	45,158.4	45,892.6	39,151.5
Average total HH income	1,79,195.8	1,79,340.0	1,78,828.5	1,44,465.8	1,44,989.1	1,40,184.8
Expenditure						
Average monthly expenditure	8,091.7	8,242.6	7,707.4	6,476.9	6,441.1	6,769.7
Average annual expenditure	97,100.2	98,910.9	92,488.2	77,722.8	77,293.3	81,236.4
Savings						
Average monthly savings	3,221.4	3,205.1	3,262.9	2,750.9	2,701.8	3,152.5
Average annual savings	38,657.0	38,461.3	39,155.3	33,010.6	32,421.5	37,830.3
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**	**%**	**%**	**%**
Yes	2.8	3.2	1.8	3.3	3.3	3.0
No	95.0	94.5	96.5	90.1	90.4	87.9
Went before, not now	2.2	2.3	1.8	6.6	6.3	9.1

Relevance

Potato cultivation is highly relevant for Assam, given the state's favorable climatic and soil conditions, especially in rice-fallow lands. As a crop with consistently high demand, it offers farmers a reliable source of income while also reducing dependence on inter-state imports and strengthening local food security. With the adoption of improved practices such as timely planting, use of quality seeds and scientific crop management, Assam has significant potential to enhance yields and expand production. Beyond fresh consumption, the growing market for processed potato products like chips and frozen varieties further increases its economic importance. Since most potato farmers are marginal (73%) and small (25%) farmers owning less than a hectare of land, potato provides an accessible and profitable option within their limited holdings. Moreover, with 91% of potato growers also cultivating paddy, potato serves as an ideal complementary rabi crop to rice, thereby optimizing land use and diversifying farm incomes.

Efficiency

APART interventions have significantly improved the efficiency of potato farming in Assam by promoting high-performing seed varieties, scientific practices and better input access. Intervention farmers have efficiently adopted table varieties like Kufri Pukhraj (51.5%), Kufri Surya (38%), Kufri Jyoti (9.6%) and Kufri Khyati (1%), while Chipsona-3 (53%) and Lady Rosetta (41%) dominate in the processing segment, ensuring suitability for both consumption and value-added markets. Female farmers have preferred Kufri Surya and Chipsona-3 more. The farmers who have stated their preferred seed varieties - 96.6% Kufri Surya users, 92.4% Kufri Pukhraj users, 93.1% Kufri Jyoti users and 100% Kufri Khyati users have completely adopted these seed varieties. Among the processed potato farmers - 94.3% Lady Rosetta users, 60% Chipsona-4 users and 55.5% Chipsona-3 users have adopted their preferred varieties.

The widespread adoption of Packages of Practices (PoPs) has enhanced efficiency in crop management across both male and female farmers. 94.8% Kufri Surya users, 92.4% Kufri Pukhraj users, 89.6% and all Kufri Khyati users have completely adopted the PoPs. Among the processed potato variety users - 96.7% Lady Rosetta users, 60% Chipsona-4 users and 52.2% Chipsona-3 users have completely adopted the recommended PoPs.

Input procurement is streamlined, with private dealers as the main suppliers, though Lady Rosetta and Khyati growers demonstrate greater efficiency through collective sourcing from FPCs and government agencies. 48% of potato farmers said that they require irrigation; among those 77.6% rely on flood irrigation and the rest on drip/sprinklers. 20.9% farmers have received training on farm machines.

Demonstrations under APART have further boosted efficiency: 94% of farmers achieved higher yields, 50% improved crop quality, 49.6% learned better farm practices and 47.6% were introduced to new seed varieties. Trainings and Farmer Field Days (FFDs) have contributed to the adoption process. Overall, the program has enabled farmers to maximize output, reduce inefficiencies in input use and strengthen market readiness through adoption of improved seeds and practices. Hence, efficiency can be seen as seed efficiency, practice efficiency, input efficiency, yield efficiency and knowledge efficiency.

Effectiveness

Potato farming has proven highly effective in enhancing farmer incomes and strengthening livelihoods in Assam. Intervention farmers reported an average annual income of Rs. 80,890/- from potato cultivation, which contributes 45% of their total annual household income - clearly positioning it as a key income-generating crop. In comparison the potato farmers from the control area reported average annual income to be Rs.48,895/- significantly lower than the intervention farmers.

Its effectiveness is further reflected in the fact that 62.2% of farmers are engaged through Farmer Producer Companies, with slightly higher participation among males (64%) than females (57.6%). Only 13.9% of farmers reported marketing their produce through FPCs, indicating that while membership is moderate, actual use of FPCs for marketing remains limited. FPCs are emerging as important platforms, especially for collective decision-making and market access, but their role in direct marketing, financial services and sustainable practices is still limited. Women farmers appear to benefit relatively more in terms of access to credit/insurance. Strengthening the marketing and service-delivery functions of FPCs could significantly enhance farmer incomes and reduce intermediary dependence.

Additionally, 43% of farmers expanded their cultivation area after APART demonstrations and 87% successfully marketed the increased produce, translating into higher income and improved economic resilience. Hence, the promotion of potato farming in through APART has (i) increased household incomes, (ii) learning through demonstrations have facilitated increase in cultivation area, (iii) increased produce is sold in the markets, leading to higher incomes and improved economic resilience and (iv) facilitated collective engagement through FPCs.

Sustainability

APART has strengthened the sustainability of potato farming in Assam by introducing processing varieties and fostering long-term industry linkages through contract farming. Partnerships with companies such as Pepsico, Siddhi Vinayak and Haldirams not only brought in new seed varieties and packages of practices but also built a system where FPC-led area expansion made collective participation more viable. Farmers trained under APART were able to seamlessly adopt industry guidelines, ensuring consistent productivity and quality. This reflects a sustainable model where knowledge transfer, farmer participation and industry engagement reinforce each other. It may be pointed out, that Pepsico is setting up a 75,000 MT per year plant in Nalbari district. It is expected that the raw materials (processed potatoes) would be sourced locally, through contract farming with FPCs.

The adoption of recommended seed varieties by 77% of farmers and the fact that 98% now directly sell produce to traders further highlight sustainable practices that reduce dependency on middlemen, enhance market access and secure long-term livelihood opportunities for farmers.

Impact

APART has not only improved incomes but also built efficiency, resilience and long-term growth opportunities in Assam's potato value chain. APART has been able to facilitate the following key interventions to boost potato cultivation in Assam:

- **Promoting Value Chain Schools (VCS):** enabled farmers to understand the full potato value chain- from planting to marketing- strengthening decision-making on varieties, demand trends and pricing.
- **Introducing improved seeds:** using breeder seed and mini tubers from credible institutions, multiplied locally in KVKs/AAU net houses, improved genetic quality and seed health, resulting in higher yields.
- **Establishing climate-resilient technologies:** practices like zero tillage, rice-straw mulching, and BMPs reduced labor and input costs, optimized planting windows, improved water-use efficiency and lowered production risks.
- **Introducing mechanization:** demonstration of potato planters and harvesters reduced labor dependency, cut costs and time and improved uniformity in operations.
- **Processing and value-addition:** Promotion of varieties such as Chipsona-3 and Lady Rosetta, along with tie-ups with processors, opened new markets, added value and reduced post-harvest losses.
- **Facilitating market linkages and farmer organizations:** formation of FPCs, contract arrangements with private companies and facilitation of direct trader linkages reduced dependence on middlemen, giving farmers better price realization and stronger bargaining power.
- **Training and extension:** Hands-on training in cleaning, grading, storage and BMPs reduced spoilage, improved quality and enhanced shelf life and market price of produce.
- **Productivity gains:** Though varied across locations, integration of improved seeds, practices and technologies demonstrated clear potential for significantly raising yields and profitability.

Comparison: Intervention and Control Farmers - Potato (Table Varieties)

Production (kg)

- **Intervention:** 8,807.49 kg
- **Control:** 3,933.47 kg
- **Difference:** +4,874.02 kg (**+123.91%**)

Intervention farmers produce more than **double** the quantity of table potatoes.

Yield (kg/ha)

- **Intervention:** 17,042.46 kg/ha
- **Control:** 8,074.10 kg/ha
- **Difference:** +8,968.36 kg/ha (**+111.08%**)

Productivity improves significantly, showing better crop performance under the intervention.

Market Price (Rs/kg)

- **Intervention:** Rs. 13.56
- **Control:** Rs. 13.52
- **Difference:** +0.04 (**non-significant**)

Both groups sell at the **same market rate**, meaning income differences are driven by production gains, not prices.

Marketable Surplus (kg)

- **Intervention:** 8,320.39 kg
- **Control:** 3,425.32 kg
- **Difference:** +4,895.07 kg (**+142.91%**)

Intervention farmers have **over 2× more** surplus available for sale.

Revenue (Rs)

- **Intervention:** Rs. 107,835.84
- **Control:** Rs. 47,827.86
- **Difference:** +Rs. 60,007.98 (**+125.47%**)

Revenue is **over double** under the intervention group.

Input Cost (Rs)

- **Intervention:** Rs. 49,145.46
- **Control:** Rs. 29,460.11
- **Difference:** +Rs. 19,685.35 (**+66.82%**)

Intervention farmers invest more, mainly due to better seeds, nutrients and practices. (Input costs *include all major expenditure components incurred by farmers during the crop cycle including the cost of seeds (both purchased and home-saved), farmyard manure (FYM) and other organic inputs, chemical fertilizers, herbicides, fungicides, pesticides, irrigation, labor, machinery or equipment hiring, packing and transportation, storage and loading/unloading*)

Earnings (Net Income) (Rs)

- **Intervention:** Rs. 58,690.38
- **Control:** Rs. 18,367.75
- **Difference:** +Rs. 40,322.63 (**+219.53%**)

Despite higher input costs, **earnings are more than triple**, showing very high profitability of the intervention.

Intervention farmers achieve **substantial improvements** across all production and economic indicators. They produce more, yield more and earn significantly higher profits, even with increased input expenditure. Market prices are same for both the groups, reinforcing that the income gains are driven purely by higher productivity and marketable surplus.

Overall, the intervention demonstrates **strong, statistically robust improvements** in productivity, marketable surplus, revenue and net earnings. Almost all key performance indicators show ***highly significant positive impacts***, indicating that the intervention is both **effective and economically transformative** for participating farmers.

Table 37: *Comparison: Intervention and Control Farmers - Potato (Table Varieties)*

N	Intervention	Control	Difference	%	Probability	Significance
	303	303				
	Average	Average				**/*** = 1%; * = 5%
Cultivated Area (Ha)	0.516	0.49				
Quantity Produced (kg)	**8,807.49**	**3,933.47**	**4,874.02**	**123.91%**	**100.00%**	***
Yield (kg/ha)	**17,042.46**	**8,074.10**	**8,968.36**	**111.08%**	**100.00%**	***
Home Consumption (kg)	521.32	508.15	13.17	2.59%	64.21%	n.s.
Marketable surplus (kg)	**8,320.39**	**3,425.32**	**4,895.07**	**142.91%**	**100.00%**	***
Market price (Rs)	13.56	13.52	0.04	0.30%	61.81%	n.s
Residue/ by product (lumpsum) (Rs.)	**2,495.05**	**1,652.48**	**842.57**	**50.99%**	**100.00%**	***
Revenue (Rs)	**1,07,835.84**	**47,827.86**	**60,007.98**	**125.47%**	**100.00%**	***
Input Cost (Rs.)	**49,145.46**	**29,460.11**	**19,685.35**	**66.82%**	**100.00%**	***
Earnings (Rs.)	**58,690.38**	**18,367.75**	**40,322.63**	**219.53%**	**100.00%**	***

The comparison between intervention and control farmers in the **table potato value chain** highlights substantial gains across all dimensions of production, productivity and profitability intervention households achieved.

Overall, the interventions have successfully strengthened **farm-level productivity**, **market integration** and **economic sustainability** of table potato cultivation. The strong evidence of profitability and performance improvement underscores the potential for scaling and replication across similar farming communities.

Comparison with Table varieties and Processed varieties of Potato

Average Production (kg)

- **Table:** 8,807.49 kg
- **Processed:** 8,682.75 kg

Processed potatoes show **lower production** as cultivated on smaller area.

Yield (kg/ha)

- **Table:** 17,016.22 kg/ha
- **Processed:** 17,676.77 kg/ha

Processed variety has **higher productivity**, indicating better variety performance or improved input use.

Home Consumption / Seeds (kg)

- **Table:** 521.31 kg
- **Processed:** 298.15 kg

Table potatoes retain more for household use, reducing market availability.

Marketable Surplus (kg)

- **Table:** 8,320.39 kg
- **Processed:** 8,386.58 kg

Despite cultivated over smaller area, processed potatoes have **slightly higher marketable surplus**.

Market Price (Rs/kg)

- **Table:** Rs. 13.56
- **Processed:** Rs. 15.29

Processed potatoes attract a **higher market price** (+Rs. 1.73/kg), consistent with processing-grade quality standards.

Residue / By-product Value (Rs.)

- **Table:** Rs. 2,495.05
- **Processed:** Rs. 2,519.34

Both varieties generate similar by-product value.

Revenue (Rs.)

- **Table:** Rs. 1,07,835.84
- **Processed:** Rs. 1,30,955.83

Processed potatoes earn **higher gross revenue** due to better yield and higher price.

Input Cost (Rs.)

- **Table:** Rs. 49,145.46
- **Processed:** Rs. 57,575.98

Producing processed potatoes requires **higher input investment** (+17%), likely due to improved seed and greater nutrient requirements.

Gross Margin (Rs.)

- **Table:** Rs. 58,690.38
- **Processed:** Rs. 73,379.86

Table potatoes generate **higher profit**.

Gross Margin per ha

- **Table:** Rs. 1,13,565.65
- **Processed:** Rs. 1,49,390.31

Profitability per hectare is also **higher in processed potato.**

Gross Margin Ratio (%)

- **Table:** 54.43%
- **Processed:** 56.03%

Processed potatoes deliver better **profit efficiency**, earning more net profit per rupee spent.

The comparative analysis of table and processed potato varieties shows distinct strengths across production and economic indicators. The processed variety performs better in productivity, achieving higher yield (17,676.77 kg/ha) and securing a superior market price (Rs. 15.29/kg) compared to the table variety. These advantages translate into slightly higher overall revenue, despite having significantly higher input investment. Its gross margin ratio (56.03%) exceeds that of the table variety, indicating better cost efficiency. Overall, the processed variety offers higher productivity, price gains, stronger profitability and more favorable economic returns for farmers.

Table 38: *Gross Margin Analysis: Potato Cultivation*

	Table Variety (Intervention)			Table Variety (Control)			Processed Variety (Intervention)		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**
N	303	231	72	303	270	33	300	202	98
Average Area (ha)	0.52	0.53	0.46	0.49	0.49	0.49	0.49	0.49	0.49
Quantity Produced (kg)	8,807.49	9,144.54	7,726.11	3,933.47	3,847.90	4,633.64	8,682.75	8,575.74	8,903.32
Yield (kg/ha)	**17,042.45**	**17,098.02**	**16,834.70**	**8,074.11**	**7,905.10**	**9,446.25**	**17,676.77**	**17,427.82**	**18,192.72**
Average Revenue (Rs/ha)	2,08,661.90	2,07,828.46	2,11,777.99	98,174.66	96,043.73	1,15,475.76	2,66,606.30	2,63,542.90	2,72,955.37
Average Input Cost (Rs/ha)	95,096.25	93,677.43	1,00,401.05	60,471.79	59,161.69	71,108.48	1,17,215.99	1,18,465.21	1,14,626.96
Gross Margin (Rs. per ha)	**1,13,565.65**	**1,14,151.04**	**1,11,376.95**	**37,702.88**	**36,882.04**	**44,367.28**	**1,49,390.31**	**1,45,077.65**	**1,58,328.40**
Gross Margin Ratio (%)	**54.43%**	**54.93%**	**52.59%**	**38.40%**	**38.40%**	**38.42%**	**56.03%**	**55.05%**	**58.01%**

The intervention in table potato cultivation delivers substantial gains over the control group. Yields under intervention are almost double those of the control (17.0 vs 9.4 tons/ha), resulting in markedly higher average revenue (Rs. 1.08 lakh vs Rs. 0.49 lakh) and gross margin per hectare (Rs. 1.13 lakh vs Rs. 0.377 lakh). Despite slightly higher input costs per hectare, intervention farmers achieve a much stronger gross margin ratio (54.43%) compared to the control group (38.4%), underscoring the effectiveness of improved varieties and practices.

Processed potato varieties under intervention outperform both table potato groups in terms of productivity and profitability. They record the highest revenue (Rs. 1.31 lakh) and gross margin per hectare (Rs. 1.49 lakh), along with the highest gross margin ratio (56.03%). This indicates that processed varieties offer superior economic returns and are better aligned with value-chain-oriented interventions.

Gender-wise, female farmers perform on par with or better than male farmers across all categories. In the control group, women achieve higher yields and gross margins per hectare than men. Under intervention, women cultivating processed varieties register the highest gross margin per hectare (Rs. 1.58 lakh/ha) and the highest gross margin ratio (58.01%), reflecting greater cost efficiency. Overall, the results demonstrate strong intervention impact, with processed potato varieties emerging as the most profitable option and women farmers consistently showing high economic efficiency.

Results of step-wise ordinary least square (OLS) regression models showing effect of explanatory variables on potato productivity (dependent variable logarithm of potato productivity)

The table below depicts estimated regression coefficients of OLS of five models. In unadjusted model 1, it has been found that the farmers who have used higher-yielding seed varieties even in the control areas are significantly more likely to have higher potato productivity compared to their counterparts using high-yielding variety in the intervention areas. The effect continues to remain statistically significant (p<0.05) even after controlling other explanatory and control variables (adjusted model 5). This could be seen as a ‘bandwagon effect’ or ‘demonstration effect’ of the project, where farmers of the control areas were also using high-yielding seed varieties (25%) and having a better productivity compared to their counterparts. At the same time, farmers in the control areas who are not using high-yielding seed varieties, are significantly less likely to have better potato productivity compared to their counterparts who are using high-yielding seed varieties in unadjusted model 1 (p<0.05) and continue to demonstrate such effect in model 4 and adjusted model 5 (p<0.05). Being a member of FPC significantly facilitates higher productivity of potato (p<0.01) in model 2; however, became insignificant after controlling other potentially confounding variables (model 4 and model 5). Adoption of PoPs has been found to have a positive and significant influence on potato productivity independently in unadjusted model 3 (p<0.001) and at lesser degree in model 4 (p<0.01); however, its effect became statistically insignificant in adjusted model 5 after controlling all other potentially confounded variables in the model.

Explanatory Variables	Model 1	Model 2	Model 3	Model 4	Model 5			
	Coeff	Coeff	Coeff	Coeff	Coeff	P-value	95% CI	
Seed variety used among respondents in intervention & control categories								
Intervention & high-yield seed variety (ref)	….	….	….	….	….	….	….	….
Control & high-yield seed variety	0.21**	….	….	0.38**	0.51**	0.008	0.13	0.88
Control & local seed variety	-1.08***	….	….	-0.91**	-0.76*	0.000	-1.09	-0.43
Member of FPC								
No (ref)	….	….	….	….	….	….	….	….
Yes	….	0.49*	….	0.03	-0.16	0.17	-0.40	0.07
Increased package of practice (PoP)	….	….	-0.45	-0.14	-0.24	0.011	-0.41	-0.06
Control variables	No	No	No	No	Yes			
District fixed effect	No	No	No	No	Yes			
Adjusted R square	**0.27**	**0.04**	**0.11**	**0.27**	**0.45**			

Note 1: ***: p<0.001; **: p<0.05; *: p<0.10

Note 2: Control variables are gender of the farmer, educational qualification, age, religion, social category, logarithm of per capita house hold income.

***Note 3:** Due to multicollinearity between seed variety used among respondents in intervention & control categories and increased Package of Practice (PoP) the interaction effect between these two variables has been controlled in Model 4 & Model 5*

Note 4: P-value and Confidence Interval have been given only for the final adjusted model.

Distribution used for testing individual coefficient in the model: t-distribution
Distribution used for testing overall model significance: f-distribution

Comparison with Baseline Study (Independent Samples)

The analysis compares independent samples of potato farmers surveyed in 2019 and 2025 under both intervention and control conditions. Since the samples are different sets of farmers, the analysis reflects aggregate means. The data provides insights into how productivity, cultivation patterns and market dynamics have evolved over time across independent farmer cohorts.

Table 39: *Differences in Mean: Potato Cultivation*

	Intervention 2019	Intervention 2025	P values	95% CI		Significance (t-test)	Control 2019	Control 2025	P values	95% CI		Significance (t-test)	Effect
	Average	**Average**				*****:p<0.001; **: p<0.05; *: p<0.10**	**Average**	**Average**				*****:p<0.001; **: p<0.05; *: p<0.10**	
Sample	**63**	**303**	-	-	-		**66**	**303**					
Area (Ha)	0.38	0.516	-	-	-		0.16	0.49					
Production (kg)	2,015.87	8,807.5	-	-	-	-	864.4	3,933.47				-	+3,722.56
Productivity (kg/ha)	5,271.9	17,042.5	P(T<t) = 0.000	11397.84	-6799.98	***	5,501.50	8,074.1	P(T<t)= 0.0002	-5366.22	-1590.24	***	+9,198
			P(|T|>|t|)=0.000						P(|T|>|t|)=0.0003				
			P(T>t) = 1.00						P(T>t)= 0.9998				
Market price (Rs)	12.39	13.56				-	11.76	13.52				-	-0.59

Note: It is important to note that the baseline findings were based on a relatively small sample size, which may have influenced the comparability of results.

- **Changes in Production and Productivity:** The **positive and substantial difference in mean values** for production and productivity confirm that project interventions - such as dissemination of quality planting materials, improved irrigation and farmer training - had a **significant positive effect**.
- **Market Price Trend:** The **slightly negative price** suggests a relative softening of prices for intervention farmers, possibly due to increased supply or delayed marketing.
- The project has achieved **strong technical efficiency and production gains**, though future efforts should strengthen **market linkages and price realization mechanisms** to sustain income gains.

Between the baseline (2019) and endline (2025), both intervention and control farmers experienced notable improvements in agricultural performance. However, the **magnitude of improvement under intervention areas far exceeded that of the control**, particularly in productivity and total output.

Equity

Around 1300 (25%) (out of 5167 farmers) received demonstration support from APART for potato cultivation. The end-term assessment captured responses from 203 (22.4%) female potato farmers.

- **Intervention Table Varieties**: Men lead in production, surplus and earnings.
- **Control Table Varieties**: Women consistently perform better than men.
- **Processed Varieties**: Women slightly outperform men in production, revenue and earnings.

Men benefit more under **intervention table varieties**. Women do better in **control** (despite smaller scale) and particularly shine in **processed varieties**, where they achieve the **highest net earnings across all groups.**

Grievance Management: More than 50% potato farmers are aware of the grievance registration process; only 14% have ever registered their grievances.

3.4.1.1.3.3 Other Vegetables (Cabbage, Cauliflower, Tomato, Pumpkin and Brinjal)

Under APART, demonstrations on various vegetables reached over **4,670 farmers** through bulk production clusters. These interventions introduced **climate-resilient technologies**, **stress-tolerant varieties** and **market linkage support** to enhance productivity and profitability.

The **Assam Agricultural University (AAU)**, in collaboration with the **World Vegetable Center**, updated the **package of practices (PoPs)** and introduced improved seed varieties. Integrated pest management was promoted through **border crops (maize, mustard)** and **trap crops (marigold)**, reducing pesticide use and increasing farmers' income.

Key technologies and practices that were successfully introduced:

- **Pro-tray nurseries:** Improved germination, healthier seedlings, reduced mortality and easier handling, resulting in higher field establishment and cost efficiency.
- **Pheromone traps:** Eco-friendly, pest-specific devices reducing chemical pesticide use while protecting beneficial insects.
- **Yellow and blue sticky traps:** Non-toxic pest control targeting whiteflies, aphids, thrips and leaf miners, suitable for organic farming.
- **Staking of tomato plants:** Promoted better air circulation, disease reduction and higher yields, especially in indeterminate varieties.
- **Summer tomato promotion:** Addressed challenges of monsoon tomato cultivation by introducing off-season (summer) production to stabilize farmer incomes[17].

Additionally, **nursery development** introduced **grafting technologies** and supported **entrepreneurship models**, enabling farmers to access quality saplings with lower mortality and saving time in crop establishment.

Table 40: *Beneficiaries of Other Vegetables- PMIS*

	Total	Female	%	ST (P&H)	%	Adopted

[17] https://avrdc.org/new-technologies-lead-to-bumper-tomato-yields-in-assam/

	Total	Female	%	ST (P&H)	%	Adopted
Brinjal	950	212	22.32	95	10.00	840
Cabbage	952	197	20.69	115	12.08	1363
Cauliflower	863	190	22.02	146	16.92	1129
Pumpkin	862	179	20.77	112	12.99	924
Tomato	1046	229	21.89	67	6.41	1236
	4673	**1007**	**21.55**	**535**	**11.45**	**5492**

Source: *PMIS*

Brinjal - Demonstrations increased strongly from **2018 (138)** to **2020 (289)**. Demonstration area peaked in **2020 (234.65 ha)** - the highest among all crops that year. After 2021, both numbers and area declined, indicating consolidation.

Cabbage - Strong uptake in **2021**, with **351 demonstrations** and **305.86 ha**, the highest area for any crop-year combination. Moderate activity in 2018-2020, followed by a major spike in 2021. Decline in 2022–23 suggests the crop reached maturity in demonstration cycles.

Cauliflower - Consistent implementation across all years. Highest demonstrations in **2021 (288)** and area **46.9 ha**. Remained a key winter vegetable focus throughout the years.

Pumpkin - Steady growth from 2018-2021 (125 → 281 demonstrations). Area expanded significantly, peaking at **44.68 ha in 2021**. Even in 2022, pumpkin area remained relatively high (45.10 ha) despite fewer demonstrations, indicating larger plots per demo.

Tomato: High demonstration numbers in 2021 (**352**, highest among all crops). Area peaked in 2021 (**54.33 ha**), showing strong emphasis during that year. Tomato consistently maintained large-scale demonstrations across years.

Across the five major vegetables - Brinjal, Cabbage, Cauliflower, Pumpkin and Tomato - the APART project demonstrated a clear scale-up strategy culminating in a major expansion phase in 2021, when all crops reached peak outreach and area coverage. Brinjal and cabbage recorded the highest land coverage in 2020 and 2021 respectively, while tomato consistently maintained large-scale demonstrations. Pumpkin and cauliflower followed stable upward trends, with substantial scaling in the mid-project years. The subsequent decline in 2022–23 reflects a planned consolidation phase. Overall, the demonstration patterns highlight APART's strategic crop-wise prioritization, ensuring wide farmer adoption, varietal dissemination, and improved vegetable production practices across project districts.

Endline Results

A sample of **736 vegetable farmers** participating in the APART's horticulture demonstrations program were interviewed from all sampled eighteen districts. A total of 131 brinjal farmers, 155 cabbage farmers, 187 cauliflower farmers, 132 pumpkin farmers and 131 tomato farmers were interviewed.

Table 41: *Sample Size - Other Vegetables*

	Total	Male	Female	SC	ST	OBC	General
	736	**599**	**137**	**128**	**74**	**115**	**419**
Brinjal	**131**	123	8	30	10	3	88
Cabbage	**155**	116	39	13	10	7	125
Cauliflower	**187**	157	30	11	22	36	118
Pumpkin	**132**	108	24	52	10	42	28

	Total	Male	Female	SC	ST	OBC	General
	736	**599**	**137**	**128**	**74**	**115**	**419**
Tomato	**131**	95	36	22	22	27	60

Background Information of farmers:

Table 42: *Background information - Vegetable farmers*

	Intervention		
	Total	**Male**	**Female**
N	**736**	**599**	**137**
Average age	45.9	46.9	41.7
Education Level	**%**	**%**	**%**
Illiterate	4.3	4.7	2.9
Read and write	4.8	5.5	1.5
Class 1-5	19.7	20.5	16.1
Class 6-8	34.2	32.4	42.3
Class 9-12	33.0	32.7	34.3
Graduation	3.7	4.0	2.2
Above Graduation	0.3	0.2	0.7
Social groups	**%**	**%**	**%**
Scheduled Caste	17.4	19.0	10.2
Scheduled Tribes	10.1	10.7	7.3
OBC	15.6	15.4	16.8
General	56.9	54.9	65.7
Religion	**%**	**%**	**%**
Hindu	48.9	50.4	42.3
Islam	50.4	48.7	57.7
Christian	0.7	0.8	0.0
Family			
Family size (Nos.)	5.6	5.7	5.2
Average Adult Male (Nos.)	2.2	2.2	2.0
Average Adult Female (Nos.)	1.8	1.9	1.6
Average Children Male (Nos.)	0.9	0.9	0.9
Average Children Female (Nos.)	0.8	0.8	0.7
Type of farmer	**%**	**%**	**%**
Marginal Farmers- less than 1 Ha	62.0	60.1	70.1
Small Farmer -1-2 Ha	35.9	37.4	29.2
Semi Medium Farmers 2-4 Ha	2.2	2.5	0.7
Medium 4-10 Ha	0.0	0.0	0.0
Land ownership			
Average agricultural land (ha) owned	0.9	0.9	0.8
Average land is leased in/share-cropped (ha)	0.2	0.2	0.2
Average land is leased out (ha)	0.0	0.0	0.0

	Intervention		
	Total	**Male**	**Female**
N	**736**	**599**	**137**
Average operational land (ha)	0.9	1.0	0.8
Average amount of land cultivated last season (ha)	0.5	0.5	0.5
Cropping intensity	**%**	**%**	**%**
Once	77.3	78.6	71.5
Twice	22.7	21.4	28.5
Thrice	0.0	0.0	0.0
Income			
Average income in the last 12 months from the selected crop	72,911.1	72,788.4	73,447.5
Average income in the last 12 months from any other crop	50,262.1	51,259.3	45,902.2
Average income in the last 12 months from any other sources	46,716.2	46,020.4	49,758.4
Average total HH income	1,69,889.3	1,70,068.0	1,69,108.1
Expenditure			
Average monthly expenditure	7,575.8	7,633.2	7,324.8
Average annual expenditure	90,909.8	91,598.7	87,897.8
Savings			
Average monthly savings	3,271.0	3,306.7	3,114.8
Average annual savings	39,251.4	39,680.0	37,377.5
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**
Yes	6.0	7.2	0.7
No	84.6	82.5	94.2
Went before, not now	9.4	10.4	5.1

Relevance

Vegetable farming plays a vital role in Assam's agricultural economy, contributing significantly to household nutrition, income diversification and rural employment. The state's favorable agro-climatic conditions, abundant rainfall and diverse soil types support year-round vegetable cultivation, including crops such as tomato, brinjal, cabbage, cauliflower, tomato and pumpkin.

These vegetables are integral to household food security and nutrition, as they provide essential vitamins and minerals and support dietary diversity. Economically, they offer short-duration cropping cycles and steady market demand, allowing farmers, especially small and marginal holders, to earn regular cash income throughout the year. Many of these crops also fit well into mixed and rotational farming systems, improving land use efficiency and soil health. Vegetable cultivation also creates livelihood opportunities for women, who are often involved in transplanting, harvesting and local marketing. In this way, it promotes inclusive and gender-responsive agricultural growth.

Despite its potential, the sector faces challenges such as pest and disease infestations, post-harvest losses and weak value chain linkages. Initiatives under APART have addressed these gaps by promoting improved seed varieties, pro-tray nurseries, grafting, staking and integrated pest management practices using traps and border crops. These interventions have improved productivity, sustainability and market access for vegetable growers.

Overall, cultivation of brinjal, cabbage, cauliflower, tomato and pumpkin are highly relevant to Assam's agricultural transformation - contributing to income generation, nutritional security, women's empowerment and climate-resilient farming systems.

Efficiency

Vegetable farming in Assam has become increasingly efficient owing to the widespread adoption of improved varieties, scientific crop management and diversified input sourcing promoted under the APART initiative. The efficiency gains are visible across production practices, input management and farmer-level decision-making.

A high proportion of farmers have adopted APART-recommended seed varieties across major crops - Brinjal (98%), Cabbage (95%), Cauliflower (80%), Pumpkin (75%) and Tomato (92%) - reflecting strong uptake of improved technologies. The most popular varieties such as Rabada (Brinjal), BC 90/76 (Cabbage), Tetris and Madhuri (Cauliflower), Arjun (Pumpkin), Trishul and Rocky (Tomato), have demonstrated better yields and resilience. Notably, farmers continue to combine improved and traditional local varieties, suggesting a balanced transition toward modern seed use without losing local adaptability.

The adoption of package of practices (PoPs) is also robust, with more than 90% adherence in major crops like tomato and cauliflower. High levels of PoP adoption (ranging between 88-98%) indicate improved farm management efficiency, reflecting farmer's capacity to apply training outcomes in nutrient management, pest control and water use. Even local varieties exhibit high adoption of improved cultivation techniques, demonstrating spill-over effects of APART interventions.

Input and seed procurement systems have also improved efficiency in supply and access. Private local dealers remain the dominant source of seeds and fertilizers, ensuring easy availability at village levels. Government agencies and cooperatives supplement input delivery for specific varieties, while Farmer Producer Companies (FPCs) are emerging as reliable local intermediaries. This diversified sourcing system reduces input delays and enhances quality assurance.

Vegetable farmers, cultivating on average 0.9 ha, maintain a diversified cropping pattern combining paddy, mustard and multiple vegetables, thereby improving land-use efficiency and risk resilience. The integration of irrigation technologies, though still limited, marks gradual progress: around 16.8% of farmers have adopted drip or sprinkler irrigation, reduced water wastage and improving crop productivity compared to traditional flood methods.

Overall, the efficiency of vegetable farming in Assam has been strengthened through a combination of improved varietal adoption, scientific crop management and institutional linkages. The gradual shift from traditional to improved systems, supported by private-public partnerships and farmer networks, signifies enhanced productivity, better resource use and growing sustainability in Assam's vegetable sector.

Effectiveness

Vegetable farming in Assam has emerged as one of the most effective components of agricultural diversification under the APART program. The interventions have led to demonstrable improvements in productivity, profitability and resilience through adoption of improved seed varieties, scientific production practices and strengthened farmer institutions.

Adoption and Technological Effectiveness: The effectiveness of vegetable farming is evident from the high adoption of APART-recommended seed varieties - Brinjal (98%), Cabbage (95%), Cauliflower (80%), Pumpkin (75%) and Tomato (92%). Popular hybrids such as Rabada, BC 90/76, Tetris, Arjun and Trishul/Rocky have shown superior yield performance and adaptability. More than 90% of farmers reported following the recommended package of practices (PoPs), leading to better pest management, nutrient efficiency and water conservation. The introduction of improved irrigation systems, mechanization and quality input supply has further enhanced farm-level performance and reduced risks associated with traditional methods.

Economic Effectiveness: Average annual household income stands at Rs.1.70 lakh, with vegetables contributing the largest share (Rs.72,911). This signifies the economic viability of vegetable cultivation as a major income source. Despite moderate savings (Rs.39,251 annually), farmers have diversified income portfolios, balancing farm and non-farm earnings. Reduced input costs, improved yields and better market access together reflect a significant rise in return on investment, demonstrating economic effectiveness at the household level.

Institutional and Social Effectiveness: Around 45% of vegetable farmers are members of Farmer Producer Companies (FPCs), gaining from collective marketing, shared decision-making and improved access to credit, insurance and markets. Benefits reported include enhanced collective decision-making (78.7%), price stabilization (32.9%) and access to new markets (19.8%). FPCs have improved farmer's bargaining power and market connectivity, making vegetable production more organized and sustainable.

Learning and Behavioral Change: Farmer's feedback underscores the effectiveness of APART demonstrations in knowledge transfer. They reported improved crop yields (92.3%), better quality (57.2%) and exposure to new seed varieties (55.8%). Many also learned efficient fertilizer and pesticide use, water-saving techniques and post-harvest management. These behavioral changes have enhanced farm productivity while reducing costs and environmental pressures.

Market Effectiveness: The marketing system is becoming more diversified. While 98% of farmers continue selling to private traders, an increasing share now markets through processors (24.7%) and FPCs (18.3%), including 8.6% selling seeds. This gradual shift toward organized channels signifies improved market integration and better price realization for farmers.

Overall, vegetable farming in Assam has proven highly effective in improving productivity, profitability and sustainability. The combined effects of technological innovation, institutional support and farmer learning have transformed it into a dynamic and resilient sub-sector. Continued focus on irrigation access, FPC strengthening and value chain linkages will help consolidate these gains and ensure long-term effectiveness in Assam's vegetable economy.

Sustainability

The horticulture sector in Assam has gained renewed momentum through the combined efforts of the **Horticulture Mission for North Eastern and Himalayan States (HMNEH)** and the **MIDH Suraksha initiative** under the **Mission for Integrated Development of Horticulture (MIDH)**. These programs will carry forward the APART learnings to the **long-term sustainability, productivity and resilience** of fruit and vegetable cultivation in the state.

Promotion of Climate-Resilient and Diversified Cropping Systems

- HMNEH has encouraged diversification into **high-value horticultural APART crops** such as banana (G9), pineapple (Kew and Queen), brinjal, cabbage, cauliflower, tomato and pumpkin enabling farmers to move beyond traditional mono-cropping.
- The **adoption of stress-tolerant varieties** and **protected cultivation technologies** by APART farmers has enhanced resilience to climatic variability like drought and flooding, common in Assam's agro-ecological zones.

Soil Health, Water Management and Natural Resource Efficiency

- The Schemes promote APART initiated practices like drip and sprinkler irrigation, mulching, and rainwater harvesting, ensuring water-use efficiency and minimizing land degradation.
- The adoption of APART's demonstration models like **INM (Integrated Nutrient Management)** and **IPM (Integrated Pest Management)** practices reduces chemical dependency, promoting environmentally sustainable cultivation.

Capacity Building and Technological Empowerment

- Under HMNEH and MIDH Suraksha, extensive **training and capacity building** of farmers through Krishi Vigyan Kendras (KVKs), Assam Agricultural University (AAU) and extension agencies has led to improved understanding of modern horticultural practices.
- Farmers are increasingly adopting APART recommended practices like **plastic mulching, shade nets, raised beds and seedling trays**, ensuring higher productivity with lower input use.

Post-Harvest Management and Value Chain Integration

- Sustainability has been reinforced through the creation of **post-harvest infrastructure**, pack houses, cold storage units, ripening chambers and transport facilities - supported under HMNEH and MIDH. These facilities reduce post-harvest losses (previously up to 25–30%), enhance shelf life and ensure **better price realization**.
- Farmer Producer Companies (FPCs) and cooperatives, supported under both schemes, play a critical role in aggregation, value addition and direct marketing - making horticulture economically viable and socially inclusive.

Through climate-smart interventions, efficient resource use and strong value chain integration, these schemes will secure the **sustainability of fruit and vegetable farming systems**, empowering smallholders and reinforcing Assam's position as a leading horticultural hub in the North Eastern region, a path laid by APART.

Impact

The introduction and expansion of scientific vegetable farming practices under the Assam Agribusiness and Rural Transformation Project (APART) have led to remarkable improvements in agricultural productivity, profitability and rural livelihoods across the state. The collaboration between Assam Agricultural University (AAU), World Vegetable Center and other partners has transformed traditional vegetable cultivation into a more commercial, climate-resilient and market-driven enterprise.

Vegetable cultivation under APART-supported interventions in Assam demonstrates high productivity and profitability across key crops such as brinjal, cabbage, cauliflower, pumpkin and tomato. Farmers have adopted improved varieties, enhanced package of practices (PoPs), and climate-resilient technologies, resulting in notable economic returns.

***Table 43:** Yield, Revenue and Earnings - Vegetable Cultivation*

	Brinjal	Cabbage	Cauliflower	Pumpkin	Tomato
N	**131**	**155**	**187**	**132**	**131**
Average Area cultivated (Ha)	0.40	0.71	0.51	0.43	0.32
Average Yet to sell/Home consumption/Seeds (kgs)	199.77	161.01	177.65	115.15	134.77
Average Production (kgs)	6,592.26	12,350.65	9,751.98	6,906.21	8,015.31
Average Productivity (kg/ha)	**16,637.29**	**17,366.13**	**19,051.69**	**16,109.51**	**25,318.53**

	Brinjal	Cabbage	Cauliflower	Pumpkin	Tomato
N	**131**	**155**	**187**	**132**	**131**
Average Marketable Surplus (kgs)	6,392.49	12,189.64	9,574.33	6,791.06	7,880.53
Average Market Price (Rs.)	20.02	19.91	24.46	21.30	20.61
Average Residue/By-product (Lumpsum Cost) (Rs.)	-	-	3,006.25	2,000	5,293.75
Average Revenue (Rs.)	**1,27,793.22**	**2,40,598.20**	**2,35,749.20**	**1,43,480.00**	**1,63,008.93**
Average Input Cost (Rs.)	23,425.20	36,005.95	27,462.57	24,389.85	24,389.85
Average Earnings (Rs.)	**1,04,368.02**	**2,04,592.25**	**2,08,286.63**	**1,19,090.15**	**1,19,090.15**

- **Cauliflower** emerges as the **most profitable crop overall**, combining high productivity, strong revenue and efficient input utilization.
- **Cabbage** performs closely, benefiting from high yields and steady market prices.
- **Tomato** has **the highest productivity**, but moderate gross margins suggest greater input intensity or market price fluctuations.
- **Pumpkin** and **Brinjal** are **moderately profitable**, with lower per-hectare productivity but stable earnings and lower risk.

Aspect	Best Performing Crop	Remarks
Productivity	**Tomato**	Highest yield potential and intensive cultivation.
Revenue	**Cabbage**	Highest gross returns per hectare.
Earnings (Profit)	**Cauliflower**	Most profitable after accounting for input costs.
Input Efficiency	**Pumpkin & Brinjal**	Low-input crops with good margins; suitable for smallholders.
Market Risk	**Tomato**	Price volatility can affect income stability.

Vegetable cultivation in Assam, particularly for brinjal, cabbage and cauliflower, is **highly productive, profitable and commercially sustainable**. The integration of improved practices under APART has enabled farmers to realize substantial economic gains, reinforcing the role of diversified vegetable farming as a key livelihood avenue in the state.

Comparing yield with state averages: According to the Statistical Handbook Assam 2024 (Directorate of Economics and Statistics), the average yield of vegetables in the state during 2023-24 is approximately 19,160 kg/ha for vegetables (including all). The average yield recorded among APART intervention farmers stands at 18,896.63 kg/ha which matches with the state average, demonstrating comparable productivity levels.

Gross Margin Analysis

- The **highest gross margin per hectare** is seen in **Cauliflower (Rs. 4.07 lakh/ha)**, followed by **Tomato (Rs. 3.76 lakh/ha)**.
- **Cabbage** (Rs. 2.88 lakh/ha) and **Pumpkin** (Rs. 2.78 lakh/ha) also offer good per hectare profitability.
- **Brinjal** lags slightly behind with Rs. 2.63 lakh/ha.

Cauliflower's superior yield-to-cost ratio makes it the **most efficient and lucrative crop** per unit area, suitable for commercial cultivation with assured market linkage.

Among all vegetables studied:

- **Cauliflower** is the **most profitable and efficient**, offering the **highest gross margin and cost efficiency**.
- **Cabbage** follows closely, providing **excellent returns** though at a higher input cost.
- **Tomato**, while highly productive, faces **price volatility**, making its gross margin percentage relatively lower.
- **Pumpkin** and **Brinjal** are **low-cost, moderate-profit** options suitable for small and marginal farmers seeking stable income with minimal risk exposure.

Table 44: *Gross Margin Analysis - Other Vegetables*

	Brinjal	Cabbage	Cauliflower	Pumpkin	Tomato
N	**131**	**155**	**187**	**132**	**131**
Area (ha)	0.40	0.71	0.51	0.43	0.32
Average Production (kgs)	6,592.26	12,350.65	9,751.98	6,906.21	8,015.31
Average Productivity (kg/ha)	**16,637.29**	**17,366.13**	**19,051.69**	**16,109.51**	**25,318.53**
Revenue (Rs/ha)	3,22,519.66	3,38,302.86	4,60,565.07	3,34,683.07	5,14,908.20
Input Cost (Rs/ha)	59,119.62	50,627.63	53,651.50	56,892.04	77,041.99
Gross Margin (Rs/ha)	**2,63,400.04**	**2,87,675.23**	**4,06,913.57**	**2,77,791.03**	**3,76,178.75**
Gross Margin Ratio (%)	**81.67%**	**85.03%**	**88.35%**	**83.0%**	**73.06%**

Comparison with Baseline Study (Independent Samples)

The **comparison between the baseline (2019) and endline (2025)** clearly demonstrates a significant transformation in vegetable cultivation practices and outcomes across the project areas. The findings reveal marked improvements in **productivity and market prices**, indicating that the benefits of capacity-building, access to quality inputs and strengthened market linkages have extended beyond the initial beneficiary groups. Crops such as **Cauliflower, Tomato and Pumpkin** show remarkable gains in yield and price realization, reflecting widespread adoption of improved agronomic practices and hybrid varieties. Even traditionally stable crops like **Brinjal and Cabbage** have registered strong market responses and expanded cultivation areas. Overall, the endline data highlights a **systemic and sustainable shift toward commercial, high-value vegetable production**, underscoring the project's role in enhancing **farm-level profitability, diversification and resilience** in local agricultural systems.

Table 45: *Comparison with Baseline Data - Other Vegetables*

	Sample	Total area	Total production	Productivity (kg/ha)	Test Used	P value	95% CI		Significance	Market Price
									*****: p<0.001; **: p<0.05; *: p<0.10**	
Cabbage										
Baseline (2019)	60	8.93 ha	1,63,600 kgs	18,313.43	T test	P(T<t) = 0.9896	371.1213	4466.556	*	Rs. 13.21
Endline (2025)	155	110.23 ha	19,14,350 kgs	17,366.13		P(|T|>|t|) = 0.0208 P(T>t) = 0.0104				Rs. 19.91
Cauliflower										
Baseline (2019)	70	29.33 ha	2,31,750 kgs	7,900.56	T test	P(T<t) = 0.0001	-6258.748	-1910.864	***	Rs. 12.41
Endline (2025)	187	95.72 ha	18,23,620 kgs	19,051.69		P(|T|>|t|) = 0.0003 P(T>t) = 0.9999				Rs. 21.46
Tomato										
Baseline (2019)	60	22.66 ha	2,02,400 kgs	8,929.41	T test	P(T<t) = 0.000	-14931.7	-8352.358	***	Rs. 17.64
Endline (2025)	131	41.47 ha	10,50,005 kgs	25,318.5		P(|T|>|t|) = 0.000 P(T>t) = 1.000				Rs. 20.61
Pumpkin										
Baseline (2019)	12	3.26 ha	19,600 kgs	6,000	Mann-Whiteney test (non-parametric)	P(Z>|z|) = 0.0218	…	…	*	Rs. 12.81
Endline (2025)	132	56.59 ha	911,620 kgs	16,109.5						Rs. 21.30
Brinjal										
Baseline (2019)	48	9.86 ha	1,06,000 kgs	10,743.24	Mann-Whiteney test (non-parametric)	P(Z>|z|) = 0.0018	…	…	**	Rs. 14.54
Endline (2025)	131	51.90 ha	8,63,586 kgs	16,637.29						Rs. 20.02

Equity

Vegetable cultivation in Assam, supported through initiative like APART, has significantly enhanced smallholder incomes, diversified cropping systems and promoted women's participation in commercial farming. Traditionally considered a male-dominated domain, vegetable production is now witnessing **increased involvement of women**, both as cultivators and decision-makers. The analysis of 736 participating farmers, including **137 women (19%)**, provides critical insights into gender differentials in productivity, efficiency and income, highlights emerging pathways for gender equity in the sector.

Women constitute a growing but still underrepresented segment of vegetable cultivators. The data indicate **nearly equal land access**, with women cultivating on an average of **0.49 ha** compared to **0.48 ha among men**.

Women farmers in Assam exhibit higher technical efficiency and crop management proficiency compared to their male counterparts.

- **Average productivity:** 19,291 kg/ha (female) vs. 18,241 kg/ha (male).
- **Average production per household:** 9,494 kg (female) vs. 8,785 kg (male).

This superior performance is attributed to the adoption of **climate-resilient technologies, improved seed varieties and adherence to recommended Package of Practices (PoPs)** under APART demonstrations. Women's greater attention to timely intercultural operations, nutrient management and post-harvest handling has led to better yields and quality produce.

Both men and women demonstrate a high degree of market engagement, with **over 98% of produce being marketable surplus**. Women farmers reported a slightly lower **average market price of Rs. 21.35 per kg**, compared to **Rs. 21.48 per kg for men**.

Even with input costs about **24% higher**, women's **net earnings are 33% higher** than men's. This demonstrates that female farmers achieve better returns per hectare and stronger value retention. The data also suggest that women may reinvest more in quality inputs and hired labor, contributing to productivity and output quality.

Gender equity in agriculture is not merely a social goal but a **driver of productivity and economic growth**. Vegetable cultivation serves as a viable entry point for advancing women's economic empowerment in rural Assam. Aligning gender objectives with broader agri-development programs through targeted investment, capacity support and institutional reforms, can help bridge remaining gaps and ensure inclusive, sustainable rural livelihoods.

Women farmers in Assam are demonstrating remarkable efficiency, productivity, and profitability in vegetable cultivation. They manage nearly equal areas as men but earn substantially higher returns, showcasing the potential of gender-inclusive agricultural transformation.

APART have laid a strong foundation by improving access to technology, knowledge and inputs. Going forward, strengthening women's roles in FPCs, improving market access and addressing systemic constraints will be crucial to achieve full gender equity in the state's horticulture sector.

Grievance Redressal: 78.3% of the farmers were aware that they could register their grievances. Out of all respondents, 32.6% reported their grievances to the Grievance Redressal Cell.

3.4.1.1.4 Spices and Condiments

3.4.1.1.4.1 Mustard

Mustard cultivation holds vital economic and strategic importance for Assam. It is the state's primary oilseed crop, central to local cuisine and nutrition and a key component of the rice-mustard cropping system that helps utilize fallow land and residual soil moisture. Promoting mustard supports edible oil self-sufficiency, reduces dependence on imports and strengthens farmer livelihoods through value addition, processing and employment generation in rural areas. Over the past 7-8 years, mustard cultivation in Assam has expanded significantly, both in area and production. Driven by state-led missions to utilize rice-fallow lands, the area under mustard and toria (Rapeseed) has steadily increased from around 2.5 lakh hectares earlier in the decade to nearly 3 lakh hectares by 2021-22. Production has also risen, positioning Assam among the top ten mustard-producing states in India.

APART with support from DRMR (*Directorate of Rapeseed-Mustard Research* - ICAR-DRMR, Bharatur, Rajasthan) and Department of Agriculture have introduced and promoted (i) varieties of mustard and toria (Rapeseed), (ii) conducted number of demonstrations and field days, (iii) training and capacity building, (iv) provided improved crop management and inputs, (v) post-harvest /value chain and market /awareness and (vi) facilitated expansion of cultivation area.

The mustard demonstrations conducted under the APART project from 2019 to 2023 show a consistent scale-up in outreach, coverage and farmer engagement, reflecting the project's growing influence on mustard cultivation practices across Assam. Demonstrations expanded sharply from 1,175 in 2019 to 10,683 in 2023, while the total area under demonstrations increased almost twenty-fold - from 164.82 ha to 3,245.85 ha - indicating not only wider geographic penetration but also a transition from small pilot plots to large-scale cluster demonstrations. The consistent adoption of improved varieties such as NRCHB-101 across districts suggests a focused varietal promotion strategy aimed at enhancing yields and resilience.

- Demonstrations increased from **1,175 in 2019** to **10,683 in 2023**, reflecting strong adoption and scaling of improved mustard practices among farmers.
- This nearly **nine-fold increase** indicates strengthening outreach, expansion into more districts, and growing farmer confidence in the demonstrated technologies.
- From **164.82 ha (2019)** to **3,245.85 ha (2023)**, showing nearly a **20-time increase**.
- This suggests a shift from small pilot clusters to large-scale field demonstrations, allowing wider geographic coverage and higher visibility of results.
- Female farmer participation also increased steadily. Women's participation grew from **16% in 2019** to **30% in 2023**, reflecting inclusive extension efforts and greater interest among women farmers in mustard cultivation.

Endline Results

A sample of **499 mustard farmers** participating in the APART program were interviewed from all 18 districts. A total of **500 Control farmers** from were selected from 9 districts.

Table 46: *Sample Size - Mustard*

	Total	Male	Female	SC	ST	OBC	General
Total	**999**	**769**	**230**	**203**	**328**	**237**	**231**
Intervention	**499**	**340**	**159**	**117**	**116**	**73**	**193**
Mustard	273	218	55	93	58	29	93
Rapeseed	226	122	104	24	58	44	100
Control	**500**	**429**	**71**	**86**	**212**	**164**	**38**

All figures are in numbers

Background Information on farmers:

***Table 47:** Background information - Mustard farmers*

	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**499**	**340**	**159**	**500**	**429**	**71**
Average age	45.3	46.7	42.2	45.9	46.5	42.4
Education Level	%	%	%	%	%	%
Illiterate	6.2	7.4	3.8	3.4	4.0	0.0
Read and write	6.6	6.8	6.3	6.0	5.8	7.0
Class 1-5	13.4	14.1	11.9	15.8	14.0	26.8
Class 6-8	25.9	25.6	26.4	24.2	24.7	21.1
Class 9-12	44.9	43.2	48.4	43.0	43.8	38.0
Graduation	2.8	2.9	2.5	7.6	7.7	7.0
Above Graduation	0.2	0.0	0.6	0.0	0.0	0.0
Social groups	%	%	%	%	%	%
Scheduled Caste	23.4	27.4	15.1	17.2	18.4	9.9
Scheduled Tribes	23.2	20.3	29.6	42.4	41.5	47.9
OBC	14.6	7.9	28.9	32.8	32.4	35.2
General	38.7	44.4	26.4	7.6	7.7	7.0
Religion	%	%	%	%	%	%
Hindu	72.3	65.3	87.4	94.0	93.9	94.4
Islam	27.5	34.4	12.6	6.0	6.1	5.6
Christian	0.2	0.3	0.0	0.0	0.0	0.0
Family						
Family size (Nos.)	5.5	5.7	5.0	4.9	4.9	4.7
Average Adult Male (Nos.)	2.1	2.2	2.0	2.1	2.1	2.0
Average Adult Female (Nos.)	1.9	1.9	1.9	1.8	1.8	1.9
Average Children Male (Nos.)	0.9	1.0	0.7	0.6	0.6	0.5
Average Children Female (Nos.)	0.5	0.6	0.4	0.5	0.5	0.4
Type of farmer	%	%	%	%	%	%
Marginal Farmers-less than 1 Ha	71.1	67.9	78.0	82.4	82.5	81.7
Small Farmer -1-2 Ha	27.3	29.7	22.0	17.4	17.2	18.3
Semi Medium Farmers 2-4 Ha	1.0	1.5	0.0	0.2	0.2	0.0
Medium 4-10 Ha	0.6	0.9	0.0	0.0	0.0	0.0
Land ownership						
Average agricultural land (ha) owned	0.8	0.9	0.7	0.7	0.7	0.6
Average land is leased in/share-cropped (ha)	0.0	0.0	0.0	0.0	0.0	0.0
Average land is leased out (ha)	0.0	0.0	0.0	0.0	0.0	0.0
Average operational land (ha)	1.0	1.1	0.7	0.7	0.7	0.7
Average amount of land cultivated last season (ha)	0.8	0.9	0.5	0.5	0.5	0.5

	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**499**	**340**	**159**	**500**	**429**	**71**
Cropping intensity	**%**	**%**	**%**	**%**	**%**	**%**
Once	59.9	55.9	68.6	65.8	62.0	88.7
Twice	40.1	44.1	31.4	34.0	37.8	11.3
Thrice	0.0	0.0	0.0	0.2	0.2	0.0
Income						
Average income in the last 12 months from the selected crop	61,794.4	66,244.2	52,279.0	42,208.8	41,818.9	44,564.6
Average income in the last 12 months from any other crop	51,567.2	54,807.6	44,637.9	39,494.0	39,964.1	36,653.2
Average income in the last 12 months from any other sources	49042.5	46,972.9	53,467.9	52,736.6	53,650.1	47,216.9
Average total HH income	1,62,404.0	1,68,024.8	1,50,384.7	1,34,439.3	1,35,433.1	1,28,434.8
Expenditure						
Average monthly expenditure	7,496.6	7,612.7	7,248.4	6,900.8	6,888.3	6,976.1
Average annual expenditure	89,959.7	91,352.6	86,981.1	82,809.6	82,660.1	83,712.7
Savings						
Average monthly savings	2,943.4	3,172.2	2,454.1	2,893.9	2,985.0	2,343.7
Average annual savings	35,320.6	38,066.5	29,449.1	34,726.8	35,819.6	28,123.9
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**	**%**	**%**	**%**
Yes	4.4	6.2	0.6	6.6	7.5	1.4
No	92.0	89.1	98.1	86.6	85.1	95.8
Went before, not now	3.6	4.7	1.3	6.8	7.5	2.8

Relevance

Mustard cultivation holds considerable agronomic, economic and nutritional importance in Assam. As the principal oilseed crop of the state, it contributes significantly to rural livelihoods and the local agrarian economy. Traditionally grown as a rabi crop following the harvest of Sali (winter) paddy, mustard fits perfectly into Assam's rice-based cropping system. It utilizes residual soil moisture during the winter months, ensuring effective use of land that would otherwise remain fallow. This makes mustard a key crop for enhancing land productivity and improving smallholder incomes.

The surveyed farmers reported cultivating mustard over an average area of **0.7 hectares**, with a higher average in the **intervention areas (0.8 ha)** compared to **0.5 ha in control areas**. Nearly **96% of the respondents** cultivated mustard in the last season, indicating its widespread adoption and relevance in the state's agricultural landscape. This demonstrates that mustard is no longer treated as a marginal or secondary crop but has gained importance as a major component of the rabi farming system, particularly where rice-fallow lands are being efficiently utilized.

From an economic perspective, mustard cultivation provides an essential source of edible oil, addressing Assam's dependence on imported oils. The state currently meets only a fraction of its edible oil demand through local production and expanding mustard acreage offers a path toward self-sufficiency and price stability. It also supports a robust local processing industry, including small oil mills and traditional enterprises that generate employment in rural areas.

Nutritionally and culturally, mustard oil and greens are integral to Assamese cuisine and dietary habits, making the crop vital for food and nutritional security. Environmentally, mustard cultivation supports biodiversity, promotes soil health and integrates well with other farming systems such as beekeeping, which adds ecological and income benefits.

With ongoing efforts through government schemes, APART and the involvement of ICAR–DRMR, mustard has emerged as a strategic crop for agricultural diversification, sustainable intensification and rural economic transformation in Assam.

Efficiency

The efficiency of mustard cultivation in Assam has improved significantly in recent years, largely driven by the systematic interventions under the APART in collaboration with the Directorate of Rapeseed-Mustard Research (DRMR). The introduction and widespread adoption of improved, high-yielding and short-duration varieties such as **DRMR 150-35, NRCHB-101, PM-28** and **AAU TS-38** has led to higher productivity and better resource utilization across the state's rice-fallow landscapes.

Survey findings indicate that **99% of intervention farmers** have adopted the recommended seed varieties, demonstrating a high level of technological efficiency and trust in improved inputs. Among these, **PM-28** recorded **100% adoption** of both the seed and the associated package of practices (PoPs), while **NRCHB-101** and **DRMR 150-35** reported adoption levels above **97%**. This uniformity in improved seed use has contributed to yield stability, better pest and disease management and reduced crop failure risks. Notably, **female farmers show strong participation**, comprising about **35% of mustard cultivators** and **65% of rapeseed growers**, with a clear preference for **NRCHB-101**, indicating that gender inclusion is an emerging dimension of efficiency in mustard production. 99% Farmers who have received demonstration support in the year 2020, continued to use the APART recommended seed varieties in the last season, similarly 69% of 2021 farmers and 92% of 2022 farmers have used recommended seed varieties last season.

Resource efficiency is also reflected in farmer's input management and use of available land. The crop effectively utilizes residual soil moisture after paddy, with nearly half of the farmers reporting the use of limited irrigation, mostly through flood irrigation systems. Fertilizer use is widespread and efficiently sourced through private channels (68-99%), supplemented by government agencies for select varieties such as NRCHB-101 and PM-28. However, seed sourcing shows mixed efficiency, while farmers rely heavily on own seeds for DRMR 150-35 and AAU TS-38, varieties like PM-28 exhibit better institutional linkage, with over 50% of farmers procuring seeds through Farmer Producer Companies (FPCs), ensuring better quality and traceability.

Overall, the efficiency of mustard cultivation in Assam is characterized by the effective dissemination of improved technologies, better agronomic practices and growing institutional linkages under APART. Yet, efficiency could be further enhanced through improved irrigation infrastructure, stronger seed replacement systems and post-harvest support to reduce moisture-related losses. With continued technical collaboration between APART and DRMR, mustard cultivation in Assam is steadily evolving into a model of resource-optimized, gender-inclusive and economically sustainable agricultural practice.

Effectiveness

Mustard cultivation in Assam has emerged as an effective crop-based intervention for enhancing farm productivity, profitability and resilience under the APART program. The crop's short duration, low input requirement and compatibility with rice-based systems make it a strategic choice for winter cultivation in Assam's agro-climatic context. Over the last few years, the concerted efforts of **APART** with support from **DRMR** have led to notable improvements in productivity, adoption of improved varieties and diversification of livelihood opportunities for small and marginal farmers.

The effectiveness of mustard cultivation is clearly demonstrated through **significant yield and income gains**. Intervention farmers earned an average income of **Rs. 61,794 per household** from mustard cultivation, which is about **46% higher than control households (Rs. 42,209)**. The adoption of high-yielding and stress-tolerant varieties such as **DRMR 150-35**, **NRCHB-101** and **PM-28** along with improved agronomic practices has played a decisive role in achieving this outcome. Moreover, higher earnings from other agricultural activities (Rs. 51,567 vs. Rs. 39,494 in control) indicate broader spillover effects, as farmers integrated improved practices across their farms.

APART's demonstrations have been particularly effective in **enhancing yield (96%)**, **seed access (59%)** and **improved farm practices (53%)**. The widespread use of recommended seed varieties, 99% among intervention farmers, and the strong adoption of complementary practices like selling by-products (62%), use of sprayers and expeller machines and limited uptake of honeybee cultivation, point to improved farm-level efficiency and resource utilization.

Under the intervention, **rapeseed** farmers achieved higher productivity and profitability compared to **mustard** growers. Rapeseed cultivation covered a larger average area (0.56 ha) than mustard (0.40 ha) and yielded higher total production (955.4 kg vs. 752.5 kg). Consequently, the **marketable surplus** was also higher for rapeseed (820.9 kg) against mustard (600.0 kg), reflecting better yield efficiency. Although the **market price** remained comparable (Rs.63.05/kg for mustard and Rs.62.62/kg for rapeseed), the overall **average revenue** from rapeseed (Rs.53,625) exceeded that of mustard (Rs.38,999). Input costs were higher for rapeseed (Rs.21,023) due to larger area and input intensity, yet the **net earnings** remained superior (Rs.32,602 vs. Rs.24,091). Overall, rapeseed performed better in terms of **production and income generation**, while mustard demonstrated **lower input costs and moderate profitability**, indicating both crop's potential to complement each other in the region's oilseed-based farming systems.

Beyond productivity, mustard cultivation has proven effective in **strengthening institutional linkages** and promoting **inclusive growth**. Around 45% of farmers are FPC members, although only 13% market through them, highlighting progress toward collective action and the potential for scaling up. Women's participation remains comparatively lower, yet their reported benefits in decision-making, resilience and mechanization reflect that mustard cultivation has opened avenues for **gender-inclusive agricultural empowerment**.

Overall, the promotion of mustard under APART demonstrates high effectiveness in translating improved technologies and practices into tangible livelihood gains. It has increased farmer's incomes, diversified production systems and built local capacity for resilient, market-oriented agriculture. Strengthening value chain linkages, improving MSP awareness and enhancing women's engagement can further consolidate the effectiveness and sustainability of mustard cultivation in Assam.

Sustainability

Mustard cultivation in Assam has demonstrated strong potential for long-term sustainability owing to its adaptability, profitability and ecological relevance within the state's rice-based farming systems. The crop fits seamlessly into the **rice-mustard rotation**, allowing efficient utilization of residual soil moisture, low input costs and minimal environmental stress. This makes mustard a viable and sustainable option for enhancing both productivity and livelihood security among small and marginal farmers.

Under the **APART-DRMR collaboration**, sustainability in mustard cultivation has been strengthened through the widespread adoption of **high-yielding, stress-tolerant varieties** such as DRMR 150-35, NRCHB-101 and PM-28, which not only improve productivity but also enhance resilience to climatic variability. The emphasis on **integrated crop management**, judicious fertilizer uses and mechanized operations such as sowing and harvesting has contributed to improved input efficiency and reduced drudgery, particularly for women farmers.

From a socio-economic perspective, mustard has emerged as a sustainable livelihood option due to its **income-enhancing capacity**. Intervention farmers earned significantly higher incomes (Rs.61,794 per household) compared to control farmers (Rs.42,209), reflecting the crop's financial viability. Moreover, the sale of by-products, adoption of bee-keeping and gradual integration with Farmer Producer Companies (FPCs) indicate diversification and value addition- critical dimensions of sustainable rural development.

Gender inclusion also contributes to the sustainability framework. Although female participation in mustard cultivation and FPC activities remains limited, women report greater perceived benefits in resilience, mechanization and collective decision-making. Strengthening women's access to inputs, training and market linkages will ensure equitable and enduring benefits from mustard-based systems.

The Government of Assam has introduced the ***District Mustard Mission*** to expand cultivation and encourage local oilseed processing, an initiative to significantly increase edible oil self-sufficiency by expanding mustard cultivation on fallow land and promoting local processing and branding of mustard oil. The mission empowers Farmer Producer Companies (FPCs) with tools, loans and technical support to procure seeds, operate oil expellers and develop district-specific mustard oil brands. It also aims to boost the aquaculture sector by utilizing the mustard oil cake byproduct for fish feed, creating new growth opportunities in both agriculture and aquaculture sector.

Assam Agricultural University (AAU) through the Krishi Vigyan Kendras (KVK) have promoted improved, high-yielding varieties suited to local agro-climatic conditions. Rising edible oil prices and improved MSP policies have also motivated farmers to diversify into mustard as a profitable winter crop. Additionally, integration with allied activities such as beekeeping has enhanced both yield and rural incomes.

In conclusion, mustard cultivation in Assam represents a sustainable agricultural model that balances **economic viability, environmental responsibility and social inclusiveness**. Continued support for improved seed dissemination, FPC-led value chains, women's empowerment and climate-smart practices will further strengthen the long-term sustainability of mustard cultivation in the state.

Impact

Table 48: *Yield, Revenue and Earnings - Mustard Cultivation*

	Intervention	Control	Difference	%	Probability	Significance
N	**499**	**500**				
	Average	**Average**				****/*** = 1%; * = 5%**
Cultivated Area (Ha)	0.48	0.69				
Quantity Produced (kg)	844.40	767.67	76.73	9.99%	99%	**
Yield (kg/ha)	**1,773.43**	**1,116.18**	**657.25**	**58.88%**	**100%**	***
Home Consumption (kg)	144.33	69.16	75.17	108.69%	100%	***
Marketable surplus (kg)	700.07	698.51	1.56	0.22%	92%	n.s.
Market price (Rs)	62.86	63.48	-0.62	-0.98%	87.72%	n.s.
Residue/ by product (lumpsum) (Rs.)	1,175.75	1,211.00	-35.25	-2.91%	67.44%	n.s.
Revenue (Rs)	45,623.14	46,111.99	-488.85	-1.06%	63%	n.s.
Input Cost (Rs.)	**17,677.35**	**20,834.52**	**-3,157.17**	**-15.15%**	**100%**	***
Earnings (Rs.)	**27,945.79**	**25,277.47**	**2,668.32**	**10.56%**	**95%**	***

The intervention farmers, despite cultivating **smaller landholdings (0.48 ha)** compared to the **control group (0.69 ha),** achieved **higher productivity** with an average production of 844.4 kg against 767.7 kg. The marketable surplus remained almost the same, but intervention farmers retained more for home use and seed purposes, indicating improved household security. While the market price and by-product value were slightly lower for the intervention group, their input costs were considerably reduced **(Rs.17,677 vs Rs.20,835),** leading to higher net earnings **(Rs.27,946 compared to Rs.25,277).** This demonstrates better input efficiency and higher profitability per unit area. Overall, the intervention approach proved more effective in enhancing yield, resource use efficiency and income sustainability in mustard and rapeseed cultivation.

Gross Margin Analysis

The **analysis** indicates that **mustard cultivation under the intervention** was significantly more efficient and profitable than under the control. Although the average cultivated area was smaller (0.48 ha vs. 0.69 ha), intervention farmers achieved almost equal revenue levels while maintaining **lower production costs** (*includes all major expenditure components incurred by farmers during the crop cycle including the cost of seeds (both purchased and home-saved), farmyard manure (FYM) and other organic inputs, chemical fertilizers, herbicides, fungicides, pesticides, irrigation, labor, machinery or equipment hiring, packing and transportation, storage and loading/unloading*).

Table 49: *Gross Margin Analysis: Mustard Cultivation*

	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**499**	**340**	**159**	**500**	**429**	**21**
Average Area (Ha)	0.48	0.46	0.52	0.69	0.69	0.68
Quantity Produced (kg)	844.4	805.66	927.23	767.67	774.52	726.26
Yield (kg/ha)	**1,773.43**	**1,759.85**	**1,799.23**	**1,116.18**	**1,124.61**	**1,064.76**
Average Revenue (Rs.) per ha	95,818.98	95,109.30	97,167.08	66,828.97	67,482.26	64,386.86
Average Input Cost (Rs.) per ha	37,126.45	37,684.08	36,067.19	30,194.96	30,392.30	29,688.37
Gross Margin (Rs/Ha)	**58,692.52**	**57,425.21**	**61,099.89**	**36,634.01**	**37,089.96**	**34,698.49**
Gross Margin Ratio (%)	**61.25%**	**60.38%**	**62.88%**	**54.82%**	**54.96%**	**53.89%**

The intervention group outperforms the control group across all key productivity and profitability indicators. Despite cultivating smaller average landholdings (0.48 ha vs 0.69 ha), intervention farmers achieve substantially higher yields (1,773 kg/ha compared to 1,116 kg/ha) and markedly higher revenue per hectare (Rs. 95,818 vs Rs. 66,828). Input costs per hectare are moderately higher under intervention, but these are more than offset by higher returns, resulting in a significantly higher gross margin per hectare (Rs. 58,692 vs Rs. 36,634) and a stronger gross margin ratio (61.25% vs 54.82%).

Gender-wise, female farmers under the intervention consistently outperform male farmers in terms of yield, revenue per hectare, and gross margin per hectare, while maintaining comparable input costs. In contrast, female farmers in the control group record lower returns and margins than their male counterparts. Overall, the findings indicate that the intervention has improved land productivity, profitability, and economic efficiency, with particularly strong and inclusive gains for women farmers.

Results of step-wise ordinary least square (OLS) regression models showing effect of explanatory variables on mustard productivity (dependent variable logarithm of mustard productivity)

The table below presents estimated regression coefficients of OLS of five models. In unadjusted model 1, it has been found that the farmers in the control areas, irrespectively of their usage of seed variety, are significantly less likely to have higher mustard productivity compared to their counterparts using high-yielding variety in the intervention areas. The effect continues to remain statistically significant ($p<0.001$) even after controlling other explanatory and control variables (adjusted model 5). Being a member of FPC significantly facilitates higher productivity of mustard ($p<0.001$, model 2); however, became statistically insignificant after controlling for background characteristics of the farmers and district fixed-effects (model 5). It has been observed that adoption of PoPs did not have any significant influence on mustard productivity in any of the model 3 to model 5.

Explanatory Variables	Model 1	Model 2	Model 3	Model 4	Model 5			
	Coeff	Coeff	Coeff	Coeff	Coeff	P value	95% CI	
Seed variety used among respondents in intervention & control categories								
Intervention & high-yielding seed variety (ref)	….	….	….	….	….	….	…..	….
Intervention & local seed variety	0.21	….	….	0.14	0.15	0.64	-0.50	0.81
Control & high-yielding seed variety	-1.05***	….	….	-1.12***	-1.09***	0.00	-1.34	-0.84
Control & local seed variety	-0.97***	….	….	-1.04***	-1.02***	0.00	-1.27	-0.77
Member of FPC								
No (ref)	….	….	….	….	….	….	….	….
Yes	….	0.64***	….	0.001	0.04	0.60	-0.12	0.20
Increased Package of Practice (PoP)	….	….	0.50	-0.05	-0.05	0.50	-0.19	0.09
Control variables	No	No	No	No	Yes			
District fixed effect	No	No	No	No	Yes			
Adjusted R square	**0.31**	**0.08**	**0.24**	**0.31**	**0.32**			
Note 1: ****: p<0.001; **: p<0.05; *: p<0.10*								
Note 2: *Control variables are gender of the farmer, educational qualification, age, religion, social category, logarithm of per capita house hold income.*								
Note 3: *Due to multicollinearity between higher-yielding seed variety used among respondents in intervention & control categories and increased package of practice (PoP) the interaction effect between these two variables has been controlled in Model 5.*								
Note: P-values and Confidence Interval have been given only for the final adjusted model.								

Distribution used for testing individual coefficient in the model: t-distribution
Distribution used for testing overall model significance: f-distribution

43.2% farmers are using high-yielding variety mustard seeds in control areas and the rest are still using local seed varieties, the productivity is less in control areas as compared to the intervention areas, these results hold even after controlling all other socio-demographic and economic variables.

Comparison with Baseline Study (Independent Samples)

Table 50: *Differences in Mean: Mustard Cultivation*

	Intervention 2019	Intervention 2025	P values	95% CI		Significance (t-test)	Control 2019	Control 2025	P values	95% CI		Significance (t-test)	Effect
	Average	**Average**				*****:p<0.001; **: p<0.05; *: p<0.10**	**Average**	**Average**				*****:p<0.001; **: p<0.05; *: p<0.10**	
Sample	112	499					145	500					
Area (ha)	0.72	0.48					0.51	0.69					
Production (kg)	930.31	844.4				-	659.31	767.67				-	-194.27
Yield (Kg/ha)	1299.2	1773.43	P(T<t) = 0.0003 P(|T|>|t|) = 0.0007 P(T>t) = 0.9997	-465.98	-126.10	***	1295.4	1116.18	P(T<t)= 1.00 P(|T|>|t|)=0.000 P(T>t)= 0.000	219.48	320.83	***	+295.01
Market price (Rs)	30.38	62.86	474.23			-	30.6	63.48				-	-0.4

- **Production:** Unrealistic results.

  Note: The production data mentioned in baseline study is way above FY 2018-19 averages. The yield reported is 1295.4 kg/ha to 1299.2 kg/ha. Based on the Best Management Practices of Rapeseed - Mustard in Assam, issued by ICAR-Rajasthan states that the yield of mustard-rapeseed for FY 2018-19 was **660 kg/ha**.

  (https://rmkpassam.in/pdf/bulletin_BMP.pdf?utm_source; Page 4).

- **Yield (Productivity):** Unrealistic results.
- **Market Price:** Nearly doubled across both groups, but the difference (-0.4 Rs/kg) is negligible → Indicates that the price increase was market-driven, not intervention-related.

Equity

The combined analysis of income, production, expenditure and savings across intervention and control households highlights complex gender equity dynamics in rural livelihoods. In intervention areas, male farmers earn substantially more than females from high-value crops such as mustard (Rs.66,244 vs Rs.52,279) and other agricultural activities (Rs.54,808 vs Rs.44,638), resulting in a total income gap of about 10.5%, compared to 5.2%

in control households. However, female farmers in intervention households surpass males in non-farm income (Rs.53,468 vs Rs.46,973) and in other crop cultivation, they achieve higher productivity per hectare, with average production of 927.23 kg on 0.52 ha compared to 805.66 kg on 0.46 ha for males. This higher productivity translates into greater revenues (Rs.50,075 vs Rs.43,541) and net earnings (Rs.31,488 vs Rs.26,289), despite slightly higher input costs, demonstrating that interventions have enabled women to capitalize on their labor efficiency and output management. Expenditure patterns show females generally spend slightly less than males in intervention areas, yet their savings remain lower (Rs.29,449 vs Rs.38,067), indicating persistent disparities in financial autonomy. In control households, males dominate both farm and non-farm income streams, with females earning less across production, revenue and net earnings, reflecting traditional gendered constraints. Overall, the intervention has improved both male and female incomes and savings, but it has been particularly effective in **enhancing female productivity, revenue generation and access to non-farm income**, suggesting that targeted interventions can partially bridge gender gaps, though continued focus is needed to ensure equitable access to high-value crop income and financial autonomy for women.

Grievance management: More than 65% mustard farmers are aware of the grievance registration process.

3.4.1.1.4.2 Ginger

Ginger is one of Assam's most important spice crops, extensively grown across hilly and foothill regions. The state's favorable agro-climatic conditions of warm humid climate, well-distributed rainfall and fertile loamy soils, make it ideal for ginger cultivation. Assam ranks among the leading ginger-producing states in India, contributing significantly to both domestic consumption and export markets. Most ginger is sold fresh in local markets; a smaller portion is dried, powdered or processed (candied, pickled, oil/extract). Karbi Anglong district is one of the largest producers of ginger in the state.

The APART project implemented ginger demonstrations consistently across districts since 2018, with clear fluctuations in both outreach and land coverage over the years. A total of **400 demonstrations** were recorded between 2018 and 2023.

- **2018** marked the highest outreach with **156 demonstrations**, covering **35.25 ha**, driven largely by intensive AAU-IRRI supported demonstrations.
- **2019** recorded **108 demonstrations** over **20.7 ha**, indicating steady continuation but at a reduced scale.
- In **2020** and **2021**, demonstration numbers dipped sharply - only **10** and **8** respectively, suggesting operational slowdowns, likely due to pandemic-related field restrictions. However, **average area per demo increased**, especially in **2021 (0.77 ha)**.
- **2022** saw a strong revival with **114 demonstrations**, reaching **20.68 ha**, returning nearly to 2019 levels.
- **2023** saw only **4 demonstrations**, but with larger plot sizes (**1 ha per demo**), indicating a shift toward fewer but more extensive demonstrations.
- Demonstration plot sizes were relatively small in the initial years (0.17-0.23 ha average), indicating compact, farmer-centric demonstrations.
- Large-area demonstrations in **2021 and 2023** (0.77-1.0 ha) may reflect scaling pilots or consolidation under progressive farmers.
- Demonstrations were carried out across major ginger-growing districts such as **Lakhimpur** and **Golaghat**.
- Predominant varieties include **Nadia** and **Rio-de-Generio**, consistently used across years, supporting varietal standardization.

Endline Results

A sample of **132 ginger farmers** participating in the APART program was interviewed from 4 districts Golaghat, Karbi Anglong, Lakhimpur and Sonitpur. In the sample, there were 76% male farmers and 24% female farmers, though a notable share of women cultivators engaged in ginger farming, particularly from Karbi Anglong district.

Table 51: *Sample Size - Ginger*

Total	Male	Female	SC	ST	OBC	General
132	100	32	16	80	18	18

Background Information of the Farmer:

Table 52: *Background information - Ginger farmers*

	Intervention		
	Total	**Male**	**Female**
N	**132**	**100**	**32**
Average age	46.8	48.2	42.5
Education Level	**%**	**%**	**%**
Illiterate	5.3	6.0	3.1
Read and write	10.6	11.0	9.4
Class 1-5	25.8	25.0	28.1
Class 6-8	23.5	20.0	34.4
Class 9-12	30.3	36.0	12.5
Graduation	4.5	2.0	12.5
Above Graduation	0.0	0.0	0.0
Social groups	**%**	**%**	**%**
Scheduled Caste	12.1	16.0	0.0
Scheduled Tribes	60.6	55.0	78.1
OBC	13.6	14.0	12.5
General	13.6	15.0	9.4
Religion	**%**	**%**	**%**
Hindu	99.2	99.0	100.0
Islam	0.8	1.0	0.0
Christian	0.0	0.0	0.0
Family			
Family size (Nos.)	5.3	5.3	5.3
Average Adult Male (Nos.)	2.1	2.1	2.0
Average Adult Female (Nos.)	1.8	1.8	1.8
Average Children Male (Nos.)	0.8	0.7	0.8
Average Children Female (Nos.)	0.6	0.6	0.7
Type of farmer	**%**	**%**	**%**
Marginal Farmers- less than 1 Ha	80.3	79.0	84.4
Small Farmer -1-2 Ha	18.9	21.0	12.5
Semi Medium Farmers 2-4 Ha	0.8	0.0	3.1
Medium 4-10 Ha	0.0	0.0	0.0

	Intervention		
	Total	**Male**	**Female**
N	**132**	**100**	**32**
Land ownership			
Average agricultural land (ha) owned	0.8	0.8	0.8
Average land is leased in/share-cropped (ha)	0.0	0.0	0.0
Average land is leased out (ha)	0.0	0.0	0.0
Average operational land (ha)	0.8	0.8	0.8
Average amount of land cultivated last season (ha)	0.3	0.3	0.3
Cropping intensity	**%**	**%**	**%**
Once	90.9	88.0	100.0
Twice	9.1	12.0	0.0
Thrice	0.0	0.0	0.0
Income			
Average income in the last 12 months from the selected crop	1,13,475.0	1,11,120.0	1,20,834.4
Average income in the last 12 months from any other crop	45,174.0	42,504.7	53,515.6
Average income in the last 12 months from any other sources	60,757.6	61,280.0	59,125.0
Average total HH income	2,19,406.6	2,14,904.7	2,33,475.0
Expenditure			
Average monthly expenditure	8,550.8	8,121.0	9,893.8
Average annual expenditure	1,02,609.1	97,452.0	1,18,725.0
Savings			
Average monthly savings	3,154.8	3,268.0	2,801.0
Average annual savings	37,857.5	39,216.0	33,612.4
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**
Yes	10.6	12.0	6.3
No	87.1	85.0	93.8
Went before, not now	2.3	3.0	0.0

Relevance

Ginger cultivation holds significant relevance in Assam’s agrarian economy, serving as a vital cash crop and livelihood source for thousands of small and marginal farmers, particularly in the hilly districts of Karbi Anglong, Dima Hasao and Goalpara. The state’s favorable agro-climatic conditions, fertile soils and predominantly organic farming practices make it ideal for producing high-quality ginger varieties. Beyond its economic value, ginger cultivation contributes to employment generation and women’s participation in agriculture, playing an important socio-cultural role in tribal communities. Beyond its economic value, ginger plays a critical role in soil conservation and sustainable hill farming, particularly in districts with high rainfall and sloping terrains. The intervention Ginger varieties under APART such as Nadia and Rio-de-Geneiro, are recognized for their superior aroma and oleoresin content, which hold strong potential for both domestic processing and export markets. The Karbi Anglong Ginger, which has received a Geographical Indication (GI) tag, symbolizes the region’s unique agro-biodiversity and export potential. The marginal and small farmers mostly (61%) belonging to indigenous groups also cultivates paddy, mustard and other vegetables alongside with ginger.

Efficiency

Ginger cultivation in Assam has emerged as one of the most efficient and profitable agricultural enterprises under the APART project. The widespread adoption of improved seed varieties, scientific cultivation practices and institutional support has significantly enhanced productivity, profitability and resilience of ginger farmers across intervention areas.

Adoption of Improved Varieties: The adoption rate of APART recommended ginger seed varieties has been exceptionally high, with more than 99% of farmers using improved seeds. Two major varieties, ver-Nadia (53%) and Rio-de-Geneiro (46.2%), have been widely cultivated. Gender-wise analysis shows 100% adoption among female farmers and 99% among male farmers, indicating near-universal acceptance and sustained use. Farmers who received APART demonstrations in 2018-19 have continued to cultivate ginger on an average of five successive crop cycles, reinforcing the long-term impact and efficiency of interventions.

Adoption of Package of Practices (PoP): Efficiency is further driven by strong compliance with the recommended Package of Practices. Farming practices like mulching and using vermi-compost was introduced by APART and were very well accepted by the farmers. Among ver-Nadia growers, 80% have fully adopted the PoP (78% males and 87% females), while among Rio-de-Geneiro growers, 88.5% reported complete adherence (93% males and 76.4% females). The gender data also highlights that women farmers have shown higher consistency and precision in following improved agronomic practices.

Input Procurement and Resource Utilization: Farmers procure seeds mainly government agencies, while many have developed self-reliant seed systems, particularly among Ver-Nadia users who retain a larger share of seeds for future use. Fertilizers are primarily sourced from private dealers, with a slightly higher proportion among Rio-de-Geneiro users. The combination of formal input sourcing and on-farm resource retention indicates efficient backward linkages and reduced dependency on external inputs.

The efficiency of ginger cultivation in Assam, driven by the APART interventions, is evidenced through near-universal adoption and sustainability. The combination of improved seed varieties, strong gender participation, adherence to recommended practices and efficient input management together will help position Assam's ginger sector as a model for sustainable and high-efficiency spice cultivation in the North Eastern region.

Effectiveness

Economic Effectiveness: Income, Expenditure, and Savings: Ginger cultivation contributes significantly to household income. On average, farmers earned Rs.1.13 lakh annually from ginger, with women earning slightly more (Rs.1.21 lakh) than men, suggesting strong female involvement in crop management. Women also earned more from other agricultural crops (Rs.53,000 vs. Rs.42,000 for men), highlighting their productive engagement in diversified farming. In terms of expenditure and financial management, women tended to allocate more income to household needs, while men reported higher savings, pointing to gendered differences in financial decision-making. Overall, ginger cultivation provides both direct economic benefits through income and indirect benefits via improved household nutrition and welfare.

Institutional Linkages and Collective Action: About 25.8% of farmers are members of Farmer Producer Companies (FPCs), with most having 3-4 years of membership. Farmers recognize the primary benefit of collective decision-making (94%), with additional advantages including access to credit (14.7%) and price stabilization (11.8%). However, female farmers are entirely absent from FPC membership, highlighting a critical gender gap in access to institutional support. Expanding women's participation in FPCs could improve access to collective bargaining, finance and sustainable agricultural practices, further enhancing the effectiveness of ginger cultivation.

Market Integration: The marketing of ginger shows moderate effectiveness: 72.7% of farmers sell their produce, while 27.3% retain produce for home use or seeds and the majority sell to traders (77.3%) and fewer sell to processors (24.2%) or through FPCs (12.1%). This indicates that while farmers achieve market access and income, they remain heavily dependent on intermediaries, which may limit price realization. Strengthening FPC-based marketing and direct linkages with processors could enhance profitability and stability.

Ginger cultivation in Assam has proven effective under APART interventions, generating substantial economic benefits, improving productivity and fostering skill development among farmers. Women, in particular, demonstrate strong engagement and earnings from ginger, although their exclusion from FPCs limits potential gains from collective action.

Sustainability

APART has played a crucial role in enhancing the sustainability of ginger cultivation across participating districts. The project's interventions have promoted improved production practices, market linkages and gender inclusion, laying the foundation for long-term ecological, economic and social sustainability.

Agronomic and Environmental Sustainability: Through APART, farmers have adopted high-yielding and disease-resistant seed varieties such as *ver-Nadia* and *Rio-de-Geneiro*, resulting in stable productivity of over 11 tons per hectare. The sustainable farming methods learned through demonstrations not only lower production risks but also contribute to the long-term resilience of the agro-ecosystem.

Economic and Market Sustainability: APART interventions have strengthened the market orientation of ginger farmers through improved access to quality inputs, aggregation and market intelligence. Farmers now achieve better price realization (Rs.71-72 per kg on average) and have developed stronger ties with traders and processors. The adoption of improved post-harvest handling, collective marketing and value addition has enhanced profitability, ensuring that ginger remains a viable cash crop for smallholders even in fluctuating market conditions.

As an operational first, Assam Karbi Anglong Ginger (GI-435) sourced from Karbi Anglong hills, was dehydrated in compliance to USDA & EU norms at the district level and forwarded for exports to USA in bulk (120 MT) during 2025.

Fresh Assam ginger has been exported to Dhaka as standardized, washed and pesticide residue free grades from Sadia cluster (Tinsukia district) by interlinking Sadia cluster with Siliguri washing units and dispatch through Petrapole LCS, West Bengal

The APART experience demonstrates that ginger cultivation in Assam has transitioned from subsistence farming to a sustainable, market-driven enterprise. The integration of improved seed varieties, environmentally sound practices, gender inclusion and strong institutional support has made the sector more resilient and equitable. To sustain these gains, continued focus on input access, value addition, climate adaptation and farmer-led market linkages will be essential.

Impact

The analysis of ginger cultivation across 132 sampled units indicates a moderately profitable enterprise with substantial productivity but relatively high input costs. Farmers cultivate an average of **0.295 ha**, producing **3,502.56 kg** of ginger per unit, translating to an impressive **productivity of 11,801.61 kg/ha**. After accounting for home consumption, seed retention and unsold quantity, the **marketable surplus stands at 3,221.91 kg**.

Table 53: *Yield, Revenue and Earnings - Ginger Cultivation*

	Total
N	**132**
Average cultivated area (ha)	0.295
Average Yet to sell/Home consumption /Seeds (Kg)	280.64
Average Production (Kg)	3,502.56
Average Productivity (kg/ha)	**11,867.98**
Average Marketable Surplus (kgs)	3,221.91
Average Market Price (Rs.)	42.69
Average Residue/By-product (Lumpsum Cost) (Rs.)	2555.56
Average Revenue (Rs.)	**1,36,710.91**
Average Input Cost (Rs.)	96,613.64
Average Earnings (Rs.)	**40,097.27**

With an average market price of **Rs.42.69 per kg**, along with an additional **Rs.2,555.56** earned from by-products, the **average revenue generated is Rs.1,36,710.91**. However, ginger cultivation is input-intensive, reflected in the high **average input cost of Rs.96,613.64**. Consequently, farmers earn **Rs.40,097.27** on average from ginger production.

Comparing yield with state averages: According to the Statistical Handbook Assam 2024 (Directorate of Economics and Statistics), the average yield of ginger in the state during 2023-24 is approximately 8,490 kg/ha. In comparison, the average yield recorded among the intervention farmers under APART is 11,867.98 kg/ha, which are significantly higher than the state averages. This substantial improvement clearly indicates enhanced productivity and reflects the effectiveness of the interventions implemented under the project.

Gross Margin Analysis

Table 54: *Gross Margin Analysis: Ginger Cultivation*

	Intervention		
	Total	**Male**	**Female**
N	**132**	**100**	**32**
Average Area (Ha)	0.295	0.29	0.31
Quantity Produced (kg)	**3,502.56**	**3,446.38**	**3,678.12**
Yield (kg/ha)	**11,867.98**	**11,915.61**	**11,730.7**
Average Revenue (Rs.) per ha	4,63,227.72	4,70,265.84	4,42,939.15
Average Input Cost (Rs.) per ha	3,27,363.15	3,20,553.40	3,46,993.42
Gross Margin (Rs/Ha)	**1,35,864.56**	**1,49,712.45**	**95,945.73**
Gross Margin Ratio (%)	**29.32%**	**31.84%**	**21.66%**

Ginger cultivation under the intervention demonstrates high productivity on small landholdings (0.30 ha on average), with yields of nearly 11.8 tons/ha and strong revenue generation (Rs.4.63 lakh per ha). Male and female farmers recorded comparable yields and revenues per hectare, indicating similar production performance. However, cost structures differ notably by gender. Female farmers incur substantially higher input costs per hectare, which compresses their profitability despite slightly higher average revenues. As a result, male farmers achieve higher gross margins per hectare (Rs.1.50 lakh/ha) and a stronger gross margin ratio (31.84%) compared to female farmers (Rs.0.96 lakh/ha; 21.66%). Overall, ginger emerges as a high-value crop under the intervention, though targeted support on input cost optimisation, particularly for women farmers, would further enhance returns.

Comparison with Baseline Study (Independent Samples)

The independent sample comparison reveals that ginger cultivation between 2019 and 2025 witnessed dramatic growth in scale, productivity and profitability. The data suggests that the intervention or external conditions (such as improved inputs, market access or extension services) have substantially enhanced performance in the ginger sector.

Table 55: *Comparison with Baseline Data: Ginger Cultivation*

	Sample	Total area	Total production	Productivity	Significance (Mann-Whitney U test)	Market Price
				Average	*****: p<0.001; **: p<0.05; *: p<0.10**	
Baseline (2019)	19	2.94 ha	13,830 kgs	4,690.17 kg/ha	***	Rs. 18.42
Endline (2025)	132	38.96 ha	4,62,338 kgs	11,867.9 kg/ha		Rs. 42.69

Note: It is important to note that the baseline findings were based on a relatively small sample size, which may have influenced the comparability of results.

Test used: Mann-Whiteney test (non-parametric)
Test statistics value: -5.603
P value: 0.000

Equity

Ginger cultivation has emerged as a **profitable and gender-inclusive enterprise**, where both men and women contribute effectively to production and marketing. While men benefit from scale, women demonstrate efficiency and strong market participation.

About 25.8% of farmers are members of Farmer Producer Companies (FPCs), however, female farmers are entirely absent from FPC membership, highlighting a critical gender gap in access to institutional support. Expanding women's participation in FPCs could improve access to collective bargaining, finance and sustainable agricultural practices, further enhancing the effectiveness of ginger cultivation.

The sustained adoption over multiple cropping cycles since the 2018-19 demonstrations is a strong indicator of institutional and economic sustainability. Farmer's continued use of recommended varieties and practices, without ongoing external support, illustrates a self-reinforcing system of efficiency, where knowledge, inputs and market access are well integrated.

The project has emphasized inclusive participation, with women farmers achieving comparable productivity and earnings to men. This has strengthened gender equity and household income diversification.

Grievance Redressal: More than 55% ginger farmers are aware of the grievance registration process and 40.5% have ever registered their grievances.

Table 56: *Productivity (Kg per Ha) comparison of Agri-Horti commodities*

	Intervention	Control	Remarks

	(all units in kg/ha)				
Commodities	**ETA 2025**	**Baseline 2019**	**ETA 2025**	**Baseline 2019**	
Paddy	5,990.54	4,956.26	4,938.32	3,455.03	The yield of Paddy mentioned in the Baseline Study, both for intervention and control areas, are higher for 2018-19 figures. The yield mentioned in the Statistical Handbook Assam, 2019 is 2,271 kg per hectare in total (across all seasons). Refer Page 109 (Table 20) of this document for details
Maize	9,216.56	2,884.61	-	-	A 3.3-fold rise in productivity, from 2.88 to 9.28 tons/ha. Refer Page 115 (Table 24) of this document for details
Pulses	1,141.85	2,545	-	-	The yield of Pulses mentioned in the Baseline Study is higher for 2018-19 figures. The yield mentioned in the Statistical Handbook Assam, 2019 is 755 kg per hectare. Refer Page 123 (Table 29) of this document for details
Mustard	1773.43	1299.2	1116.18	1295.4	The production data mentioned in baseline study is way above FY 2018-19 averages. Based on the Best Management Practices of Rapeseed - Mustard in Assam, issued by ICAR-Rajasthan states that the yield of mustard-rapeseed for FY 2018-19 was 660 kg/ha. Refer Page 165 (Table 50) of this document for details
Potato (Table)	17,042.5	5,271.9	8,074.1	5,501.50	Productivity has improved significantly, showing better crop performance under the intervention. Refer Page 144 (Table 39) of this document for details
Potato (Processed)	17,676.77	-	-	-	-
Fruits (Banana)	21,791.59	15,122.5	-	-	Improvement in productivity is not significant. Refer Page 132 (Table 34) of this document for details
Vegetables					
Brinjal	16,637.29	10,743.24	-	-	Refer Page 154 (Table 45) of this document for details
Cabbage	17,366.13	18,313.43	-	-	
Cauliflower	19,051.69	7,900.56	-	-	
Pumpkin	16,109.5	6,000	-	-	
Tomato	25,318.5	8,929.41	-	-	

	Intervention		Control		Remarks
	(all units in kg/ha)				
Commodities	**ETA 2025**	**Baseline 2019**	**ETA 2025**	**Baseline 2019**	
Ginger	11,867	4,690.17	-	-	Productivity has improved significantly, showing better crop performance under the intervention. Refer Page 172 (Table 55) of this document for details

3.4.1.2 C1.2: Milk Value Chain

Over the last 7-8 years, Assam's dairy sector has moved from largely informal, small-scale production toward more organized dairying: higher aggregate milk output, faster expansion of processing capacity (cooperatives and private/industrial players), stronger government support (AI, fodder, training, subsidies) and improved market linkages. Based on NDDB's state-wise estimates of Milk Production[18] - Assam has moved from 8,82,000 tons in 2018-19 to 10,92,000 tons in 2023-24.

APART has supported the dairy sector three ways:

- **Milk Value Chain-Formal sector -** The focus of this value chain is productivity enhancement by organizing farmers into Milk Producer's Institutions (MPIs) that eventually will get registered as Dairy Cooperative Societies (DCS) and genetic upgradation of non-descript cows using AI, improved feeding through fodder production demonstrations, bulk supplements provision through DCS and by developing linkages with crop producers (e.g. maize, mustard, legumes for crop residue). A customized ration balancing program involving feed analysis and use of locally available resources would be delivered by mobile AI technicians. This was implemented by WAMUL.
- **Milk value-chain-Informal sector -** Transformation of the informal dairy sector into the formal one through improvement in resilience in production, quality, safety and standards of milk adding value to the produce with particular focus on informal market actors and dairy -entrepreneurs in targeted districts. This was implemented by Directorate of Dairy Development.
- **Cross-cutting areas of formal and informal milk value sectors -** Interventions in formal and informal milk value chains, which are expected to cover a large number of dairy animals, was implemented by the Animal Husbandry and Veterinary Department (AHVD) at state level and ATMAs at district level providing better health care and management to the animals of APART districts, both under formal and informal sector and provide training and information to the farmers under informal sector.

It may be noted that while expenditure against the released amounts is above 98% for each OPIUs, release of funds based on the provisions are lower. Dairy development received 26.5%, AHVD received 39% and WAMUL received 56.5%. It may be noted that NDDB received more funds than provisioned.

Table 57: *Financial Utilization - Milk Value Chain (PMIS)*

OPIU	Provision (AWP 19-20) (*In Lakhs*)	Provision (AWP 20-21) (*In Lakhs*)	Provision (AWP 21-22) (*In Lakhs*)	Provision (AWP 23-24) (*In Lakhs*)	Fund Released (*In Lakhs*)	Expenditure (*In Lakhs*)	Utilization (%age)
Animal Husbandry and Veterinary Department	3,205.25	383.68	0	2,106.86	**2,220.23**	**2,210.11**	**99.54**

[18] https://www.nddb.coop/information/stats/milkprodstate

OPIU	Provision (AWP 19-20) (*In Lakhs*)	Provision (AWP 20-21) (*In Lakhs*)	Provision (AWP 21-22) (*In Lakhs*)	Provision (AWP 23-24) (*In Lakhs*)	Fund Released (*In Lakhs*)	Expenditure (*In Lakhs*)	Utilization (%age)
(AHVD)							
Directorate of Dairy Development (DDD)	1,275.33	61.55	0	558.63	**502.37**	**494.2**	**98.37**
West Assam Milk Producer's Cooperative Union Ltd. (WAMUL)	9,376.67	1,619.89	3,042.6	10,120.68	**13,657.54**	**13,623.61**	**99.75**
National Dairy Development Board (NDDB)	-	766	1,644	375	**4,245.18**	**4,245.18**	**100.00**

Source: PMIS (04th December 2025)

3.4.1.2.1 C1.2.1: Milk Value Chain - Formal Sector

Milk processing in Assam entered a new phase with the **upgradation of WAMUL's milk processing facility from 60 KLPD to a state-of-the-art 150 KLPD plant**. The milk processing plant is licensed by FSSAI and accredited with ISO 22000 and HACCP certifications. It produces a wide range of value-added dairy products including fresh packed milk, paneer, curd, flavored milk, cream and ghee. A Solar Thermal System has been installed, generating 10 lakh Kcal of energy and resulting in direct savings of about Rs.4 lakh per month in fuel costs. The key interventions of WAMUL under APART were (i) breeding, (ii) feeding, (iii) disease control and (iv) dairy management. On the procurement side, volumes have reached 90,000 liters per day, benefitting approximately 50,910 dairy farmers organized into 1,346 dairy cooperative societies across 25 districts. In terms of marketing, WAMUL currently has 160 distributors, 6,500 retailers and 3.5 lakh consumers.

3.4.1.2.2 C1.2.2: Milk Value Chain - Informal Sector

To achieve the project objective, the Directorate of Dairy Development have taken up the following activities with support from knowledge partner, International Livestock Research Institute (ILRI), Kenya:

- **Market assessment** through mapping of market actors of informal Dairy Value Chain through Physical assessment of distribution of market actors in 17 project districts.
- **Assessment of human health risk in Dairy Value Chain** with particular focus on informal sector before and after interventions by assessment of magnitude of risk from Milk and Milk Products, assessment of adulteration, microbial load, antimicrobial residue and aflatoxin, assessment of prevalence of zoonotic pathogens like Brucella, Mycobacterium, etc. and identification of critical control points.
- **Improvement and strengthening of the Lab infrastructure** in dairy plants for checking quality and safety of milk /milk product traded by informal market actors. Improvement in quality in the traditional market will raise the demand and value of the products and thus income and employment. It will also help facilitate the evolution of the traditional market towards the more regulated and organized market.
- **Design, Development and Printing of training manuals** for Informal Milk Market Actors, protocols for Training of Trainers (ToT), capacity building of government officials on Laboratory Technology with support from International Livestock Research Institute (ILRI).
- **Training of milk market actors -** Training of milk market actors in targeted project districts on improved package of practices for quality and hygiene. The milk market actors comprise of Milk Producers, Milk Traders, Sweet Makers and Cottage Processors.

Immediately after each training, a Hygienic Milk Monitoring Committee (HMMC) will be constituted among the trained actors to monitor the adoption of improved practices taught during the training.

- **Formation of DCS among the interested trained Milk Producers -** The transformation is sought to achieve through mobilizing the informal Dairy value chain through strengthening of the existing Dairy Cooperatives Societies, formation of new Dairy Cooperatives Societies wherever feasible and register them under the Assam Cooperatives Registration Act. They will be supported with capacity up gradation, input services, market access and other linkages in the Milk value chain.
- **Linkages and Support to Market actors** to run their business efficiently by providing input support and recognition for adoption of improved practices.
- **Development of Milk Collection Centers** at each DCS for better aggregation of milk produced by each member of the Dairy Cooperative Society (DCS).
- **Assessment of critical need gap of existing DCS** and arrangement for need based support. Need based interventions/ support will be provided for capacity building, value addition, technical up gradation.
- **Demonstration of Mastitis and Reproductive Health Management camp** on pilot basis to create awareness among the dairy farmers regarding diagnosis and management of mastitis and reproductive diseases in targeted clusters.

To strengthen food safety and enhance the functioning of the informal milk value chain, several initiatives were undertaken:

- **Milk Quality Assurance:** Five milk testing laboratories were strengthened, with 12,619 samples tested. Support was also extended for the NABL accreditation process of the Khanapara laboratory.
- **Capacity Building:** A total of 121 training programs were conducted for milk market actors, reaching 3,784 participants (43% women).
- **Institutional Development:** 21 new Dairy Cooperative Societies (DCSs) were formed, while 39 existing DCSs received continued support.
- **Leadership Training:** Presidents and Secretaries of graded DCSs (111 individuals) were provided training.
- **Animal Health & Productivity:** 11 demonstration camps were organized on mastitis control and reproductive health management.

WAMUL emerged as a new leader in the milk sector in Assam with significant growth and transformation through APART. WAMUL underwent a major infrastructure and operational transformation that significantly improved productivity, efficiency and transparency across its dairy value chain, under APART:

1. Infrastructure and Operational Strengthening

- Established a network of **400 trained Mobile AI Technicians (MAITs)** delivering over **11 lakh AI services**, leading to the birth of **5 lakh genetically improved calves**, 50% of which are female.
- Expanded **milk processing capacity** from **60 to 150 TLPD**, with facilities for **value-added products** such as ice cream, flavored milk and traditional sweets.
- Installed **solar-powered Automated Milk Collection Systems (AMCS)** at Dairy Cooperative Societies (DCSs), enabling transparent milk testing and payment systems.
- Set up **70 Bulk Milk Cooling (BMC) units** (2.2 lakh LPD total capacity) and deployed **insulated road milk tankers (RMTs)** to maintain a seamless cold chain.

- Achieved **ISO certification** for both dairy and cattle feed plants, ensuring quality compliance and consumer confidence.

2. Expansion of Coverage and Farmer Reach

- Expanded operations to **24 districts**, covering **3400 villages** and forming **1600 DCSs** with **50,000+ active pourers**.
- Increased daily milk procurement to **1.6 lakh kg**, sourced directly from farmers.
- Distributed **500 MT of cattle feed** under the *Purabi* brand to enhance livestock nutrition.
- Established a retail network of **over 6000 outlets**, strengthening *Purabi*'s market presence across Assam.

3. Animal Health, Nutrition, and Technology Integration

- Introduced **balanced ration feeding**, **silage making**, **urea-treated paddy straw** and **green fodder cultivation** to improve productivity.
- Promoted **Pashu Ayurveda** for preventive and curative animal healthcare, reducing dependence on chemical treatments.
- Adopted **ERP systems** and the **Bharat Pashudhan (INAPH)** digital platform for end-to-end monitoring of breeding and input services.
- Deployed **solar-powered Instant Milk Chilling Units (IMCUs)** to ensure cost-effective milk preservation.

Institutional Strengthening and Capacity Building

- Recruited and trained over **100 technical and operational staff** under APART.
- NDDB and NDDB Dairy Services Ltd. provided **technical, managerial and operational guidance** in all functional areas.
- Conducted **extensive training programs** for dairy farmers, AI technicians and DCS functionaries to enhance skills and promote cooperative engagement.

Key Outcomes and Impacts

- **Over 2 lakh genetically improved female calves** born, ensuring higher future milk productivity.
- **Improved milk price realization** for farmers through enhanced quality and cooperative marketing.
- **Expanded processing and chilling infrastructure**, leading to better milk quality and reduced wastage.
- **Wider farmer inclusion**, encouraging participation in formal milk value chains.
- **Recognition from the Government of Assam**, resulting in the launch of a **milk price support scheme** to incentivize cooperative milk pouring.
- Establishment of a **skilled and dedicated workforce**, now an enduring asset for brand *Purabi*.

Challenges and Learnings

- WAMUL overcame major challenges such as COVID-19 disruptions, recurring floods and shortage of local skilled manpower through adaptive management and resource optimization.

  Key learnings included:

- Importance of **standardized SOPs** and **digital process automation**.
- Adoption of **climate-resilient and sustainable technologies**.
- Strengthened coordination between government, cooperatives and private suppliers.

Sustainability and Way Forward

The gains from APART have been institutionalized within WAMUL's value chain, forming the foundation for Assam's dairy growth roadmap. The **Assam Dairy Development Plan (ADDP)**, approved by the State Government, aims to scale *Purabi*'s milk handling capacity to **10 lakh liters per day within seven years**.

To realize this vision, the Govt. of Assam and NDDB have jointly established **North East Dairy and Foods Limited (NEDFL)**, a new venture that will develop cluster-based cooperatives in:

- **Upper Assam (EAMUL)**
- **Central & Lower Assam (WAMUL)**
- **Barak Valley (through a new producer company)**

This integrated approach positions *Purabi* as a model for cooperative-led, sustainable and inclusive dairy development in Northeast India.

Endline Results: Formal and Informal Sectors

1257 dairy farmers across 17 districts were interviewed. Formal dairy farmers of APART were chosen from WAMUL beneficiaries and informal dairy farmers were selected from Directorate of Dairy Development (DDD). 25.8% of the dairy farmers were females.

***Table 58:** End-line Survey Findings: Formal and Informal Sectors*

Sample			
	Total	**Male**	**Female**
Intervention (Formal)	353	227	126
Intervention (Informal)	350	231	119
Control	554	474	80
Total	**1257**	**932**	**325**

Background Information of Dairy Farmers:

***Table 59:** Background Information - Dairy farmers*

	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**703**	**458**	**245**	**554**	**474**	**80**
Average age	45.2	46.8	42.3	45.0	45.4	43.1
Education Level	%	%	%	%	%	%
Illiterate	4.0	5.2	1.6	2.5	2.5	2.5
Read and write	4.0	4.1	3.7	3.2	3.8	0.0
Class 1-5	15.5	15.5	15.5	17.9	15.2	33.8
Class 6-8	26.0	25.1	27.8	29.2	27.2	41.3
Class 9-12	45.2	43.9	47.8	38.3	41.4	20.0
Graduation	5.0	5.9	3.3	8.8	9.9	2.5
Above Graduation	0.3	0.2	0.4	0.0	0.0	0.0
Social groups	%	%	%	%	%	%

	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**703**	**458**	**245**	**554**	**474**	**80**
Scheduled Caste	20.2	20.7	19.2	20.2	21.7	11.3
Scheduled Tribes	11.9	11.8	12.2	35.2	30.2	65.0
OBC	29.0	27.5	31.8	33.2	36.5	13.8
General	38.8	40.0	36.7	11.4	11.6	10.0
Religion	**%**	**%**	**%**	**%**	**%**	**%**
Hindu	70.7	69.4	73.1	92.2	91.6	96.3
Islam	29.2	30.3	26.9	7.8	8.4	3.8
Christian	0.1	0.2	0.0	0.0	0.0	0.0
Family						
Family size (Nos.)	5.7	5.7	5.7	5.1	5.2	4.8
Average Adult Male (Nos.)	2.2	2.2	2.2	2.1	2.1	1.9
Average Adult Female (Nos.)	1.9	1.9	1.8	1.8	1.9	1.7
Average Children Male (Nos.)	0.9	0.9	0.9	0.7	0.7	0.6
Average Children Female (Nos.)	0.7	0.7	0.8	0.5	0.5	0.6
Cattle owned	**Average**	**Average**	**Average**	**Average**	**Average**	**Average**
Nos of cattle owned	6.5	6.7	6.2	5.2	5.3	4.3
Nos of Descript Cows owned	4.6	4.8	4.3	2.7	2.9	1.4
Nos of Non-Descript Cows owned	1.9	2.0	1.9	2.5	2.4	2.9
Nos of (Descript) Milking cows	2.4	2.5	2.3	2.0	2.1	1.3
Nos of (Non-Descript) Milking cows	1.9	1.9	1.9	2.0	2.0	1.9
Nos of (Descript) Pregnant cows	0.8	0.8	0.7	0.6	0.7	0.4
Nos of (Non-Descript) Pregnant cows	0.6	0.6	0.6	0.5	0.6	0.5
Nos of (Descript) Calves	2.2	2.2	2.1	1.8	1.9	1.1
Nos of (Non-Descript) Calves	1.6	1.6	1.6	1.9	2.0	1.9
Nos of (Descript) cows	4.8	5.0	4.5	2.8	3.0	1.5
Nos of (Non-Descript) cows	2.0	2.0	1.9	2.5	2.5	2.9
Income						
Average income in the last 12 months from dairy	1,75,498.3	1,78,446.2	1,69,987.5	84,553.1	83,958.0	88,079.1
Average income in the last 12 months from agri-horti crop	49,136.2	46,739.1	53,617.5	35,695.8	34,732.1	41,406.3
Average income in the last 12 months from any other sources	44,737.6	44,776.9	44,664.1	38,366.1	38,323.6	38,617.5
Average total HH income	2,69,372.1	2,69,962.1	2,68,269.1	1,58,615.0	1,57,013.7	1,68,102.9
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**	**%**	**%**	**%**
Yes	3.4	4.8	0.8	7.8	8.4	3.8

	Intervention			Control		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**703**	**458**	**245**	**554**	**474**	**80**
No	90.6	87.6	96.3	85.6	83.8	96.3
Went before, not now	6.0	7.6	2.9	6.7	7.8	0.0

Relevance

Dairy farming in Assam has emerged as a crucial component of the rural economy over the last seven to eight years, contributing significantly to income generation, employment and nutritional security. Despite being a largely agrarian state, Assam's dairy sector is characterized by smallholder-based production systems, where small and marginal farmers and landless laborers depend on dairy as a supplementary and often stable source of livelihood. The activity plays an important role in income diversification, especially during lean agricultural periods and offers consistent cash flow to rural households.

The sector has strong socio-economic relevance- providing gainful employment opportunities to both men and women, with women contributing majorly to animal rearing, milking and marketing activities. Dairy farming also supports the broader agricultural system by supplying valuable by-products such as manure for crop cultivation and draught power for field operations. In flood-prone districts, dairying serves as a livelihood buffer, ensuring income continuity even when crops fail.

From a value chain perspective, when APART was being conceived, around 60% of total milk production in the state is consumed at the household level and the remaining 40% constitutes marketable surplus. However, over 90% of this surplus is handled by the informal sector through local aggregators (known as *paikaria*)[19], with formal entities such as WAMUL, Dugdha Utpadak Samabai Samiti (DUSS) and the Directorate of Dairy Development accounting for less than 10%. This underlined both the dominance of informal milk trade and the scope for formal sector expansion to ensure better quality control, farmer remuneration and organized growth.

Currently, in terms of herd composition, farmers associated with formal milk value chains (VCs) tend to keep more productive, descript breeds, averaging 5.9 cattle per household with 2.4 descript milking cows- reflecting greater investment in improved genetics and management practices. Informal VC farmers, although owning larger herds (7.2 cattle), rely more on non-descript breeds, indicating higher herd size but lower productivity. Control group farmers maintain smaller, mixed herds (5.2 cattle) with limited specialization.

Overall, dairy farming in Assam remains highly relevant as a driver of rural economic resilience, women's empowerment and nutritional well-being. APART has been able to provide appropriate support for breed improvement, veterinary services, feed management and market linkages.

Efficiency

Dairy farming in Assam has emerged as an important livelihood source, contributing to nutritional security and rural income diversification. The sector, however, reflects distinct patterns between Formal and Informal Milk Value Chains (VCs) in terms of gender participation, technology adoption and institutional engagement.

Animal Management and Gender Roles - Male dominance persists across most dairy activities- particularly in milking, grass cutting and milk sales. Female members, however, play a more active role within the Informal VC, especially in cleaning, feeding and watering

[19] PIP - APART

tasks. The use of hired labor is notably higher in Control households, suggesting weaker household participation compared to both VCs. Overall, the Formal VC exhibits more male-led specialization, while the Informal VC demonstrates better gender inclusivity in daily dairy management.

Demonstrations and Adoption - Demonstration-based learning has proven highly effective, with 98% of formal and 93% of informal VC farmers finding them useful. Exposure to breeding demonstrations (MAIT, AI) reached 53% in formal and 47% in informal sectors. Similarly, dairy management demonstrations benefited around 25-28% of farmers. Feeding and disease control technologies saw moderate participation (13-19%), with informal VC farmers showing slightly higher uptake of new feeding practices. A strong adoption rate was reported- 76% of formal and 85% of informal VC farmers implemented the practices learned. Fodder cultivation is practiced by 44.5% of formal and 38% of informal farmers, indicating a move toward improved feed self-sufficiency. The Informal VC shows stronger learning gains in feeding, housing and milking practices, while Formal VC farmers benefit more in breeding and animal health management.

Health Orientation Camps - Participation in animal health camps was higher among Formal VC farmers (62.0%) compared to Informal VC farmers (47.7%). Formal VC farmers primarily attended for reproductive health management (55.7%), whereas informal VC farmers focused on mastitis and reproductive health (41.3%). Vaccination services (Brucellosis, FMD, etc.) were slightly more common in the formal VC (17.4% vs. 13.8%). Camps were generally organized within villages (58% Formal, 51.5% Informal), but Informal VC farmers also accessed services at community fields (46.1%) and veterinary establishments (28.7%). Perceived usefulness was very high, 96.3% (Formal) and 94.0% (Informal) participants reported tangible benefits.

Among the surveyed farmers, **346 in Formal VC** and **325 in Informal VC** - a large proportion reported tangible learning outcomes. The highest benefits were in **improved breed knowledge**, with 76.0% of formal and 77.8% of informal farmers reporting gains. **Feeding-related improvements** were more pronounced in the informal VC: 56.6% gained knowledge about feeds and 51.1% about feeding quantity and frequency, compared to 37.6% and 30.9% respectively in the formal VC. Similarly, informal VC farmers exhibited stronger improvements in **milking practices (44.6%)**, **cattle housing (38.2%)** and **feed quality management (37.2%)**. On the other hand, **formal VC farmers** showed relatively higher improvements in **animal health management**, with 34.1% benefiting from disease and vaccination demonstrations compared to 29.2% in the informal VC.

Factors facilitating the efficiency of dairy farming in the state are as follows:

- **High usefulness and adoption of demonstrations**: Nearly all dairy farmers in both formal (98%) and informal (93%) milk value chains found demonstration activities useful. Adoption of practices was strong - about 76% in formal VC and 85% in informal VC farmers implemented what they learned.
- **Productivity-enhancing practices**: Informal VC farmers have significantly improved their knowledge and practices related to feeding (type, quantity, frequency), animal housing and daily milking. Formal VC farmers show stronger gains in areas like breeding and animal health (vaccinations, disease control).
- **Fodder cultivation**: A meaningful proportion of farmers are cultivating fodder-approximately 44.5% in the formal VC and 38% in the informal VC, helping in feed availability and reducing dependence on external or expensive inputs.
- **Gender & labor patterns**: Male members dominate core income-generating dairy tasks (milking, sales, grass cutting), while women have more involvement in cleaning, feeding and watering, especially within informal VCs. Control households rely more heavily on

hired labor, which suggests missed opportunities for household labor utilization and cost savings.

- **Institutional & health outreach**: Participation in animal health camps is higher in formal VCs, especially for reproductive health, while informal VCs have broader interest including mastitis issues. Vaccination services and disease-management are better in formal VCs, but coverage still has gaps.

Overall, the data indicates that **informal VC farmers have translated demonstration learnings into wider practical improvements** across feeding, housing and milking practices, while **formal VC farmers are more efficient in adopting health and breeding-related innovations**. This complementary pattern highlights the importance of tailoring interventions to the specific strengths and needs of each value chain to maximize efficiency and productivity in Assam's dairy sector.

Effectiveness

Income enhancement: Participation in dairy value chains significantly boosts household income. Annual income from milk for the intervention group is around Rs. 1,75,498 while the control dairy farmers earn Rs. 84,553. Milk accounts for about 75% of total income among Formal VC farmers, underscoring dairy's central role in livelihood diversification and economic stability.

Artificial Insemination (AI) and MAIT services:

- AI adoption is widespread across both Formal and Informal VCs - over 90% of farmers have availed AI services.
- Awareness is strong (93.2% in Formal VC; 89.7% in Informal VC) and AI centers are present in most villages.
- Formal VC farmers mainly use doorstep AI through MAITs (73%), while Informal VC farmers depend more on local AI centers (45%).
- Farmers report improved productivity (average 2.1-2.4 calves per year). The duration of MAIT presence is longer in Formal VC villages (7.2 vs 3.8 years).
- Informal VC farmers gain more from improvements in milk quality, ear tagging and pregnancy diagnosis, while Formal VC farmers benefit more from reduced inter-calving intervals and regular follow-up services.
- AI service charges are comparable (Rs.277 in Formal vs Rs.268 in Informal VC).

Institutional linkages (MPI/DCS): Membership in Milk Producer Institutions (MPI) or Dairy Cooperative Societies (DCS) is higher in Formal VC (52.2%) than Informal VC (40.4%). However, Informal VC members derive greater benefits in:

- Dairy management training (51% vs 34%)
- Feed and supplement support (44% vs 26%)
- Proximity to milk collection infrastructure (BMCs within 7.1 km vs 9.2 km).
- Awareness of digital/solar-powered milk collection units (DPMCUs) is equal (78%) and milk procurement coverage (74%) is similar across both groups.
- Dairy farming in Assam has emerged as a profitable and inclusive livelihood activity, with formal and informal value chains each offering distinct advantages.
- Formal VCs provide higher incomes, organized market access and structured AI support.
- Informal VCs demonstrate better accessibility to services, training & localized infrastructure.
- Together, they reinforce dairy's effectiveness in improving income resilience, livestock productivity and institutional participation among rural households.

Sustainability

The dairy sector in Assam has evolved into a critical pillar of rural livelihoods, nutrition and women's empowerment. Over the last decade, sustained government interventions and institutional strengthening have laid the groundwork for a more organized, inclusive and resilient dairy ecosystem. However, long-term sustainability depends on maintaining the balance between economic viability, social equity and environmental stewardship.

1. Institutional and Economic Sustainability

- **Strengthened Cooperative Framework:** The expansion of the cooperative model through WAMUL and other dairy cooperative societies (DCS) has created structured market linkages and assured milk procurement mechanisms. This institutional backbone ensures price stability, reduces market vulnerability and facilitates collective bargaining power for smallholder farmers.
- **Market Access and Value Chain Integration:** Through APART and subsequent programs, dairy farmers have been integrated into the formal value chain, gaining access to improved breeds, feed, veterinary care and organized collection networks. This enhances production efficiency and income diversification, thereby improving economic resilience.
- **WAMUL Expansion and Scaling-up:** The increase in processing capacity from 1.5 to 3 lakh liters per day underlines a sustainable growth trajectory. By strengthening the processing and marketing capacities of WAMUL, the state ensures long-term economic viability and scale economies across the dairy value chain.
- **Financial Viability through Subsidy and Support Schemes:** The Rs.5/liter milk subsidy scheme (2025) and the Assam Dairy Development Plan (2023-2030) will provide policy continuity and financial incentives that encourage farmers to stay engaged with the formal sector, ensuring sustained supply and organized sector growth.

2. Social and Livelihood Sustainability

- **Inclusive Growth and Gender Empowerment:** Dairy farming in Assam remains a household-based enterprise where women play a key role in animal care, milking and marketing. Interventions under APART have enhanced women's technical capacities and decision-making roles in DCSs, contributing to gender equity and inclusive rural development.
- **Employment and Income Stability:** The dairy sector provides steady income flows compared to seasonal agriculture, cushioning rural households against economic shocks. Strengthening of DCSs and regular milk procurement offer predictable cash income, improving livelihood security.
- **Community Institution Building:** The formation and strengthening of MPIs/DCS foster local leadership, peer learning and social capital, reinforcing collective ownership and long-term community participation in sectoral growth.

3. Environmental Sustainability

- **Resource Efficiency and Climate Resilience:** Promoting balanced feeding practices, fodder development and scientific animal husbandry has improved feed efficiency and reduced methane emissions. Training on animal health, waste management and clean milk production contributes to reducing environmental impact.
- **Adaptation to Climate Challenges:** With increasing climatic variability affecting fodder availability and animal health, ongoing efforts under APART and ADDP to promote climate-resilient breeds, fodder diversification and improved veterinary services are vital for long-term adaptability.

4. Policy and Programmatic Sustainability

- **Continuity through ADDP (2023-30):** The Assam Dairy Development Plan ensures that gains from APART are institutionalized and scaled up. By focusing on productivity enhancement, quality improvement and processing capacity, the plan ensures a sustainable policy trajectory for the next decade.
- **Public-Private-DCS Convergence:** Leveraging partnerships among government, NDDB, NEDFi and WAMUL strengthens multi-stakeholder collaboration and reduces dependence on public funds over time, leading to operational self-sufficiency.
- **Data and Quality Systems:** The installation of milk analyzers, testing labs and digital monitoring systems under the National Program for Dairy Development ensures traceability, transparency and long-term quality assurance- cornerstones of sustainable dairy systems.

The sustainability of Assam's dairy sector lies in deepening the reforms initiated under APART, institutionalizing cooperative governance and fostering environmentally responsible production. Continued investment in capacity building, women's empowerment and climate-smart technologies will be essential. With coherent policy backing and an expanding cooperative network, Assam is well-positioned to achieve a self-sustaining, inclusive and climate-resilient dairy economy.

The dairy sector in Assam stands at a pivotal stage of transformation-shifting from fragmented, informal operations to an increasingly organized, technology-enabled and farmer-centric ecosystem. Sustained interventions under the APART, coupled with strong institutional leadership through WAMUL and continued government support via schemes such as the Assam Dairy Development Plan (ADDP) and the milk subsidy initiative, have collectively established a robust foundation for long-term sustainability.

Impact

Dairy farming in Assam, particularly through organized interventions like WAMUL, demonstrates **substantial positive impacts** on productivity, income and livelihood security. The combination of technical support, assured markets, supplementary services and digital payment adoption strengthens both **economic outcomes and farmer participation**, with notable benefits for women. Scaling such models can further enhance **sustainable dairy development** across the state.

Market Access and Institutional Linkages - The intervention has substantially strengthened market integration for dairy farmers, particularly through formal and semi-formal channels. Milk sale to WAMUL is the dominant marketing pathway, with **87.8% of farmers supplying to the cooperative**, reflecting high trust in the institutional arrangement. Women's participation is notably higher, with **90.5% of female farmers** selling to WAMUL compared to **86.3% of male farmers**, highlighting the gender-inclusive nature of the cooperative model.

In intervention areas, **nearly 73% of farmers sell milk through Dairy Cooperative Societies (DCS)**, in stark contrast to only **6% in control areas**. This shift away from traders and informal buyers has reduced farmer's dependence on middlemen and improved price assurance. The DCS channel alone contributes **almost half of total dairy income** in intervention households, underlining its critical role in income stabilisation.

Price Realisation and Farmer Perceptions - Around half of the WAMUL suppliers perceive the milk price as comparable to prevailing market rates, while the remaining farmers are divided between those who consider it higher and those who perceive it as lower. Despite mixed perceptions on price levels, **assured procurement (91%)** emerges as the single most important reason for selling to WAMUL. This underscores that **price stability and certainty**, rather than marginal price differences, drive farmer participation.

Nearly **87% of farmers received Additional Milk Price (AMP)** from WAMUL, reinforcing income security and acting as a key incentive for sustained engagement with the cooperative.

Productivity and Herd Dynamics - Clear productivity differentials were observed across household categories. Informal intervention households maintain the largest herds (3.4 milking cows), followed by WAMUL households (2.7), while control households lag behind (2.4). Despite smaller herds, **WAMUL households achieve the highest productivity (19.4 kg/day)**, outperforming informal intervention and control households. This reflects better breeds, improved feeding regimes and superior herd management practices. Higher numbers of calves in WAMUL (2.5) and informal households (2.9) indicate stronger herd sustainability and future production potential.

Household milk consumption remains low across all groups (1.5-1.8 kg/day), confirming that dairy functions primarily as a **commercial livelihood activity**, with the bulk of production marketed.

Sales Patterns and Revenue Performance - Milk sales are regular and frequent across all household types, with farmers selling milk **almost daily (29-30 days per month)**. While informal intervention households realise slightly higher per-kg prices due to local market dynamics, overall earnings are highest among WAMUL households due to superior productivity and higher marketed volumes.

Annual revenue comparison:

- **WAMUL:** Rs. 2.56 lakh
- **Informal (Intervention):** Rs. 2.07 lakh
- **Control:** Rs.1.62 lakh

WAMUL households earn the highest revenues **despite having fewer cows than informal households**, demonstrating the importance of efficiency rather than herd size alone.

Costs, Returns and Economic Efficiency - WAMUL households incur the highest annual costs (₹78,089), likely due to better quality feed, veterinary care and improved breeds. However, these higher costs are more than offset by enhanced productivity and assured markets.

Net annual returns:

- **WAMUL:** Rs. 1.77 lakh
- **Informal (Intervention):** Rs.1.48 lakh
- **Control:** Rs.1.05 lakh

This clearly indicates that **investment in quality management and organised marketing yields superior economic returns**. Informal households, while maintaining larger herds, do not fully capitalise on productivity potential, whereas control households lag behind on both productivity and profitability dimensions.

Gender Outcomes - Women farmers benefit significantly from structured dairy interventions. Higher participation of women in WAMUL supply chains, coupled with lower average costs and comparable or higher net returns, highlights the **empowering role of cooperatives**. In informal and control settings, women tend to lag behind men, whereas in intervention and WAMUL-linked systems, gender gaps in productivity and income narrow considerably.

Digitalisation and Support Services - WAMUL provides not only assured markets but also critical supplementary services. Over **72% of farmers use digital billing and direct bank transfers**, improving transparency and financial convenience. Adoption of digital systems is higher among men, but uptake among women is also substantial, signalling growing financial inclusion.

Additional services, training (32.9%), veterinary care and vaccination (31.9%), subsidised feed (22.3%) and ration balancing programs (18.1%) - contribute to improved herd health, productivity and long-term sustainability.

The dairy intervention has generated **clear, multi-dimensional impacts**. WAMUL-linked households emerge as the most efficient and profitable, combining higher productivity per cow, assured markets, and strong institutional support. Informal intervention households outperform control households, confirming the positive effects of improved practices and partial market integration. Control households lag significantly, underscoring the opportunity cost of remaining outside organised dairy systems.
Overall, the findings demonstrate that **structured dairy interventions - anchored in cooperatives, quality inputs, and market assurance, deliver higher incomes, greater stability, and more inclusive outcomes**, particularly for women farmers. Dairy thus emerges as a reliable, daily income source with strong potential for livelihood enhancement when supported by organised value-chain interventions.

***Table 60**: Comparison: Milk (Informal) Intervention and Control*

	Milk Informal (Intervention)			Milk (Control)		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**350**	**231**	**119**	**554**	**474**	**80**
Average Nos. of milking cows in the HH	3.40	3.5	3.2	2.39	2.5	2.0
Average Nos. of calves in the HH	2.85	3.0	2.7	2.22	2.3	1.9
Average Nos. of day milk produced in a month	29.28	29.2	29.5	29.54	29.5	29.5
Average quantity of milk is retained at home for household consumption (kgs/day)	1.81	1.7	1.9	1.46	1.5	1.4
Average amount of marketable milk (kgs/day)	14.56	14.5	14.6	12.80	13.4	9.3
Average quantity of milk produced per day (kgs/day)	**16.37**	16.3	16.6	**14.27**	14.9	10.7

	Milk Informal (Intervention)			Milk (Control)		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**
N	**350**	**231**	**119**	**554**	**474**	**80**
Average market price (Rs.)	51.54	51.6	51.4	48.06	47.9	49.0
Average revenue (Rs.)	**2,07,268.49**	2,05,627.65	2,10,453.66	**1,62,351.43**	1,68,566.08	1,25,529.59
Average cost incurred (Rs.)	59,132.91	61,452.94	54,629.33	57,343.58	59,629.31	43,800.68
Average return (Rs.)	**1,48,135.58**	1,44,174.71	1,55,824.34	**1,05,007.84**	1,08,936.78	81,728.91

***Table 61**: Milk (Formal)*

	Milk (Formal) - WAMUL		
	Total	**Male**	**Female**
N	**353**	**227**	**126**
Average Nos. of milking cows in the HH	2.7	2.8	2.7
Average Nos. of calves in the HH	2.5	2.6	2.4
Average Nos. of day milk produced in a month	29.3	29.4	29.1
Average quantity of milk is retained at home for household consumption (kgs/day)	1.7	1.7	1.7
Average amount of marketable milk (kgs/day)	17.7	18.2	16.7
Average quantity of milk produced per day (kgs/day)	**19.4**	**19.9**	**18.4**
Average market price (Rs.)	48.0	48.1	48.0
Average revenue (Rs.)	**2,55,536.12**	**2,64,010.09**	**2,40,269.52**
Average cost incurred (Rs.)	78,088.74	82,177.25	70,722.94
Average return (Rs.)	**1,77,447.38**	**1,81,832.84**	**1,69,546.59**

The intervention households demonstrate markedly stronger dairy performance than the control group. Intervention farmers maintain larger herds, with higher average numbers of milking cows (3.4 vs 2.4) and calves (2.85 vs 2.22), which translates into higher daily milk production (16.37 kg/day compared to 14.27 kg/day). Marketable surplus is also higher under intervention (14.56 kg/day vs 12.80 kg/day), alongside better price realisation (Rs.51.54/litre vs Rs.48.06/litre). These factors together result in substantially higher annual revenues (Rs.2.07 lakh vs Rs.1.62 lakh) and net returns (Rs.1.48 lakh vs Rs.1.05 lakh) for intervention households, despite similar cost levels.

Gender-wise, female farmers under the intervention perform particularly well, achieving slightly higher daily milk production and marketable surplus than male farmers, while also incurring lower average costs. This leads to the highest net returns among all groups (Rs.1.56 lakh per household). In contrast, female farmers in the control group lag significantly behind their male counterparts in production, marketable surplus, and returns. Overall, the results indicate that the intervention has enhanced herd strength, productivity and profitability in informal dairy systems, with especially strong and inclusive gains for women farmers.

Formal dairy farmers supplying to WAMUL exhibit strong and stable production performance. Households maintain moderate herd sizes (2.7 milking cows on average) and produce about 19.4 kg of milk per day, with a high marketable surplus (17.7 kg/day), reflecting reliable offtake through the formal procurement channel. Price realisation is stable at around Rs.48 per litre, resulting in high average annual revenues of Rs.2.56 lakh per household and net returns of Rs.1.77 lakh, despite relatively higher production costs.

Gender-wise, male farmers record slightly higher production volumes and revenues, driven by marginally larger herd sizes and higher marketable surplus. However, female farmers incur significantly lower costs, enabling them to achieve comparable net returns (Rs.1.70 lakh) relative to male farmers (Rs.1.82 lakh). Overall, the results highlight that linkage with WAMUL ensures assured markets, stable prices and attractive net incomes, with both male and female farmers benefiting substantially from participation in the formal dairy value chain.

Table 62: *Comparison (Intervention vs. Control) - Milk Value Chain*

	Informal (Intervention)	Control	Difference	%age	Probability	Significance
	Average	**Average**				****/*** = 1%; * = 5%**
Average Nos. of milking cows in the HH	3.40	2.39	1.01	42.49%	100%	***
Average Nos. of calves in the HH	2.85	2.22	0.63	28.56%	100%	***
Average Nos. of day milk produced in a month	29.28	29.54	-0.26	-0.89%	95%	*
Average quantity of milk is retained at home for household consumption (kgs/day)	1.81	1.46	0.34	23.35%	99%	**
Average amount of marketable milk (kgs/day)	14.56	12.80	1.76	13.74%	99%	**
Average quantity of milk produced per day (kgs/day)	**16.37**	**14.27**	**2.10**	**14.73%**	**99%**	**
Average market price (Rs.)	51.54	48.06	3.48	7.23%	100%	***
Average revenue (Rs.)	**2,07,268.49**	**1,62,351.43**	**44,917.07**	**27.67%**	**99%**	**

	Informal (Intervention)	Control	Difference	%age	Probability	Significance
	Average	Average				**/*** = 1%; * = 5%
Average cost incurred (Rs.)	59,132.91	57,343.58	1,789.33	3.12%	70%	n.s.
Average return (Rs.)	**1,48,135.58**	**1,05,007.84**	**43,127.74**	**41.07%**	**99%**	**

Results of step-wise ordinary least square (OLS) regression models showing effect of explanatory variables on milk productivity (dependent variable logarithm of milk productivity)

The table below reveals estimated regression coefficients of OLS of three models. In unadjusted Model 1, milk producer intervention (DDD) has negative and significant influence ($p<0.001$) on milk productivity, though the effect became insignificant after controlling other potentially confounding socio-demographic variables and district fixed-effects in model 3. Increased number of non-descript cows show negative and significant influence on milk productivity in both unadjusted (model 2) and adjusted model (model 3) ($p<0.001$). Pouring milk to DCS/WAMUL also does not necessarily enhance productivity as observed in model 2 as well as model 3.

Explanatory Variables	Model 1	Model 2	Model 3	P-value	95% CI	
	Coeff	Coeff	Coeff			
Milk intervention and control						
Milk producer control (ref)	….	….	….	….	….	….
Milk producer intervention (DDD)	-0.39***	-0.28	-0.38	0.272	-1.059	0.298
Number of descript cows	….	0.003	0.01	0.804	0.052	0.067
Number of non-descript cows	….	-0.12***	-0.12***	0.001	-0.187	-0.051
Adopted the technology learnt during demonstration	….	0.10	0.09	0.319	-0.085	0.261
Total of calves in farm	….	-0.005	-0.001	0.992	-0.101	0.102
Member of DCS (in months)	….	-0.01*	-0.01	0.142	-0.012	0.002
Farmer pouring milk to DCS/WAMUL						
No (ref)	….	….	….	….	….	….
Yes	….	-0.28*	-0.24*	0.036	-0.456	-0.016
Control variables	No	No	Yes			

Explanatory Variables	Model 1	Model 2	Model 3	P-value	95% CI
	Coeff	Coeff	Coeff		
District fixed effect	No	No	Yes		
Adjusted R square	**0.03**	**0.08**	**0.12**		
Note 1: ***: p<0.001; **: p<0.05; *: p<0.10					
Note 2: Control variables are gender of the farmer, educational qualification, age, religion, social category, logarithm of per capita house hold income.					
Note 3: *Due to multicollinearity between milk intervention and formal & informal control, number of descript and non-descript cows, member of DCS the interaction effect between these four variables has been controlled in Model 2 & Model 3*					
Note 4: P-values and Confidence Interval have been given only for the final adjusted model.					

Distribution used for testing individual coefficient in the model: t-distribution
Distribution used for testing overall model significance: f-distribution

There is a difference between intervention and control dairy farmers in terms of average daily milk production (11.66 kg/day versus 7.11 kg/day). However, this difference is not statistically significant, as the organization of informal dairy farmers into Dairy Cooperative Societies (DCSs) by the Directorate of Dairy Development (DDD) is a relatively recent intervention. Notably, 47% of informal dairy farmers are now supplying milk to DCSs, which represents a significant achievement of the project and the department continues its efforts to further expand inclusion.

Comparison with Baseline Study (Independent Samples)

The dairy sector in Assam has witnessed a significant transformation between the baseline (2019) and endline (2025) periods, driven by interventions promoting improved breeds, better feeding practices and stronger market linkages. The data reveal marked improvements in productivity, marketable surplus and milk sales among intervention households compared to the control group.

Growth in Milk Production: At the intervention sites, average milk production per household increased sharply from **11.66 kg/day** in 2019 to **19.4 kg/day** among farmers engaged in the **formal value chain** and **16.4 kg/day** among those in the **informal chain** by 2025. This reflects a **66-70% rise in production**, underscoring the effectiveness of productivity-enhancing measures such as crossbreeding, improved feed and animal health interventions. In contrast, control households recorded only a modest rise from **7.11 kg/day to 14.3 kg/day**, suggesting that sector-wide improvements may have also benefitted non-intervention farmers, but to a lesser extent.

Increase in Marketable Surplus: The share of marketable milk also rose substantially. Among intervention households, the average marketable milk increased from **10.31 kg/day** at baseline to **17.7 kg/day (formal)** and **14.6 kg/day (informal)** at endline.

This expansion of surplus milk reflects both higher yields and stronger market orientation. The control group improved as well, from **6.11 kg/day** to **12.8 kg/day**, but remained below the intervention levels.

Enhanced Market Participation: The average number of days milk was sold in a year increased dramatically, from **229.6 days** at baseline to around **351-354 days** at endline. This indicates that milk production has shifted from being a seasonal or supplementary activity to a **year-round enterprise**, particularly in intervention areas. Improved chilling and collection infrastructure under the formal network (e.g., WAMUL) likely contributed to this continuity.

Price Realization and Market Linkages: At baseline, the average milk price hovered around **Rs.39 per liter** across both intervention and control farmers. By 2025, prices increased to **Rs.48 per liter in the formal chain** and **Rs.51.5 per liter in the informal chain**, reflecting a **20-30% rise** in realization. Interestingly, while the **informal market offered slightly higher spot prices**, the **formal channel provided assured offtake, regular payments and input support** - factors that make it more stable and sustainable for smallholders.

Between 2019 and 2025, the dairy sector in Assam transitioned from low-yield, semi-subsistence production toward a **commercially viable, market-linked enterprise**. Intervention households, particularly those engaged with organized cooperatives like WAMUL, achieved higher productivity, consistent sales and improved income stability. The comparison between formal and informal chains highlights that **structured institutional engagement remains key to sustaining dairy growth and farmer welfare** in Assam.

Table 63: *Comparison with Baseline Data - Milk Value Chain*

<table>
<tr><th></th><th>Baseline control (2019)</th><th>Endline control (2025)</th><th>P values</th><th>Significance</th><th colspan="2">95% CI</th><th>Baseline Intervention (2019)</th><th>Endline Intervention (Informal) (2025)</th><th>P values</th><th>Significance</th><th colspan="2">95% CI</th></tr>
<tr><td></td><td></td><td></td><td></td><td>***: p<0.001; **: p<0.05; *: p<0.10</td><td></td><td></td><td></td><td></td><td></td><td>***: p<0.001; **: p<0.05; *: p<0.10</td><td></td><td></td></tr>
<tr><td>N</td><td>190</td><td>554</td><td></td><td></td><td></td><td></td><td>405</td><td>350</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Average quantity of milk produced per day (kgs/day)</td><td>7.11</td><td>14.3</td><td>P(T<t)=0.000
P(|T|>|t|) = 0.000
P(T>t) = 1.00</td><td>***</td><td>-8.678</td><td>-5.597</td><td>11.66</td><td>16.4</td><td>P(T<t)=0.000
P(|T|>|t|) = 0.000
P(T>t) = 1.00</td><td>***</td><td>-8.894</td><td>-3.311</td></tr>
</table>

	Baseline control (2019)	Endline control (2025)	P values	Significance	95% CI		Baseline Intervention (2019)	Endline Intervention (Informal) (2025)	P values	Significance	95% CI	
				***: p<0.001; **: p<0.05; *: p<0.10						***: p<0.001; **: p<0.05; *: p<0.10		
N	**190**	**554**					**405**	**350**				
Average amount of marketable milk (kgs/day)	6.11	12.8	P(T<t)=0.000 P(|T|>|t|) = 0.000 P(T>t) = 1.00	***	-10.498	-7.804	10.31	14.6	P(T<t)=0.000 P(|T|>|t|) = 0.000 P(T>t) = 1.00	***	-10.585	-5.512
Average market price (Rs.)	39.33	48.1	P(T<t)=0.000 P(|T|>|t|) = 0.000 P(T>t) = 1.00	***	-10.114	-8.353	39.28	51.5	P(T<t)=0.000 P(|T|>|t|) = 0.000 P(T>t) = 1.00	***	-12.598	-11.365

The impact story of dairy farming can be summed up as:

- **Enhanced Productivity:** Structured interventions lead to higher milk yield per cow.
- **Higher Income and Economic Resilience:** WAMUL households earn the highest revenue and net returns.
- **Efficient Cost Management:** Investment in improved breeds, feed and veterinary care translates into higher profitability.
- **Inclusive Market Participation:** High female engagement and adoption of digital systems strengthen financial access and empowerment.
- **Technical and Service Support:** Training, veterinary care and feed programs enhance farm efficiency and sustainability.
- **Reduced Risk:** Assured market and additional milk incentives (AMP) stabilize farmer income.

Dairy farming in Assam has evolved into a reliable and income-generating livelihood, driven by the structured support of WAMUL and other formal initiatives. The cooperative model has enhanced productivity, ensured assured markets and improved farmer incomes through technical inputs, veterinary care and digital payment systems. With strong participation of women and consistent market linkage, the sector now demonstrates both **economic resilience and social inclusiveness.** Continued investment in breed improvement, feed management and farmer training will be key to sustaining this **growth-oriented and gender-responsive dairy ecosystem** in Assam.

Equity

Gender participation in Assam's dairy sector reflects both traditional household roles and emerging equity through organized value chain engagement. Women are integral to dairy management - leading daily tasks like feeding, cleaning sheds and milking - while men typically handle fodder collection, breeding decisions and marketing.

Data show that in **intervention areas**, both male and female farmers have benefitted, though with varying outcomes. Female farmers report high participation in milk sales, **90.5% supply milk to WAMUL** compared to 86.3% of males. Women's involvement in decision-making and financial transactions has grown alongside increased formal linkages with Dairy Cooperative Societies (DCS).

In terms of income, **households in the formal milk value chain earn Rs.2.90 lakh annually**, with milk contributing nearly three-fourths of total income. This stable and regular income has enhanced women's financial control and household welfare. Women also manage smaller herd sizes more efficiently, maintaining improved breeds and better hygiene, reflecting their growing technical capacity.

However, men still dominate ownership of productive assets and large herd management and fewer women occupy leadership positions in producer organizations. Closing this gap requires gender-responsive training, credit access and inclusion of women in cooperative governance.

The formalization of Assam's dairy sector under cooperative models like WAMUL has enhanced women's roles from unpaid labor to productive contributors and decision-makers. Strengthening asset ownership, financial literacy and leadership among women will further deepen gender equity and ensure the dairy sector's inclusive and sustainable growth.

Grievance Management: Awareness on grievance management is more among informal milk VC (80%) than formal milk VC (74%).

3.4.1.3 C1.3: Milk Value Chain - Cross-cutting areas of Formal and Informal Sectors

The key indicators of the cross-cutting areas of formal and informal milk include the immunization program for the number of animals, animal health camps, reproductive health and Mastitis management camps, training of Gopal Mitras.

The results-based framework indicates that some cross-cutting interventions need attention. While training of DCS members far exceeded targets (167%) and Gopal Mitra training was nearly on target (96%), animal health camps (35%) and reproductive health/mastitis management camps (49%) fell short. Immunization coverage was also very low (10%).

3.4.1.4 C1.4: Fisheries Value Chain

Fish farming (aquaculture and inland fisheries) plays a crucial role in Assam's economy, food systems and livelihoods. Given Assam's rich water resources - rivers, wetlands (beels), ponds, tanks, reservoirs, fisheries are well placed to address multiple goals: ensure nutritional security, generate rural employment, support income for small farmers, reduce import dependence and contribute to sustainable development. Many in Assam derive livelihoods from fishing, fish culture, seed production, processing and trade. Small-scale farmers, fishers in beels, ponds, riverine areas all depend on fisheries. Fisheries provide opportunities for rural incomes, especially where agriculture may be less remunerative.

Fish is a major source of animal protein for a large part of Assam's population (>90%), particularly in rural areas. It helps meet daily dietary needs, complements other sources of protein and supports health. Fish farming helps reduce dependence on fish imports from other states, retaining income within Assam. It contributes to state output, value addition, infrastructure development (hatcheries, rearing ponds, supply chains), use of wetlands, beels and riverine stretches, when managed sustainably, contributes to flood regulation, groundwater recharge, biodiversity and ecosystem services. Fish farming can help restore or maintain wetland habitats.

The Fisheries interventions under APART focused on sustainable fisheries development in Assam. It aimed to increase fish production and productivity through climate-resilient aquaculture and better management practices, while enhancing food security and the livelihoods of smallholder farmers and fishers. The project was implemented by the Department of Fisheries, Assam with technical support from organizations like WorldFish[20] and in coordination with the Assam Rural Infrastructure and Agricultural Services (ARIAS) Society.

APART has been able to reach out to 11,918[21] fish farmers (including Beel members), among which 23.2% are female farmers. Around 10,010 farmers are said to have adopted the technologies, of which 17% are female partners.

	Total Beneficiary (Nos.)	Target Water Area (Ha)	Total Water Area (Ha)	Gender (Nos.)		Caste (Nos.)			
				Male	Female	General	OBC	SC	ST
Demonstration	7,789	2,504	2,652.34	5,998	1,791	4,680	1,126	1,388	589
Adoption	10,010	-	2,964.08	8,313	1,697	6,063	1,580	1,267	968

The APART aquaculture demonstrations (polyculture, paddy-cum-fish, polyculture with freshwater prawns) show a consistent scale-up over six years, covering 7,789 beneficiaries and 2,652.34 ha of water area against a target of 2,504 ha, indicating strong field uptake and participation. Over the six years, male farmers dominate participation (77%), with 5,998 male and 1,791 female beneficiaries. However, women's participation shows a positive trend, growing from 135 in 2018-19 to 428 in 2023–24, indicating strengthening gender inclusion efforts in aquaculture. Across caste categories, the largest share of beneficiaries comes from the General category (4,680 participants), followed by SC (1,388), OBC (1,126) and ST (589) households. The increasing participation of SC/ST groups over time reflects improved outreach and livelihood inclusion in marginalized communities.

The APART project recorded 10,010 adoptions over five years, reflecting strong uptake of aquaculture practices across beneficiary households. Adoption peaked in 2019–20 with 4,570 farmers, and though the numbers gradually declined in later years, the overall trend shows deepening engagement and consolidation of practices rather than expansion-based growth.

	Total Beneficiaries (Nos.)	Target Water Area (Ha)	Total Water Area (Ha)	Total Sanction Amount (Rs.)	Gender (Nos.)		Caste (Nos.)			
					Male	Female	Gen	OBC	SC	ST
Total	68	4,129	1,105.74	14,39,43,173	3,158	971	950	1,353	623	1,201

The Beel Fishery component of the APART project supported **68 beels** across five years, bringing **1,105.74 hectares** of natural water bodies under improved scientific management. With a cumulative **Rs. 143.94 crore** sanctioned, the program significantly strengthened

[20] https://worldfishcenter.org/project/assam-agribusiness-rural-transformation-apart
[21] PMIS, APART

community-owned fisheries and enhanced the productivity and governance of Assam's beel ecosystems.

3,158 male and **971 female** members participated. Overall, women accounted for **23.5% of participation**, reflecting ongoing but promising inclusion in traditionally male-dominated fishery governance systems. Beel fisheries interventions reached **diverse social groups**, with exceptionally strong inclusion of traditional fishing communities comprising mostly ST members.

Around Rs.9,504.72 lakhs were provisioned over the year. Rs.7,015.82 lakhs were released with nearly 96.9% utilization.

Table 64: *Financial Utilization: Fish Value Chain - PMIS*

OPIU	Provision (AWP19-20) (in Lakhs)	Provision (AWP20-21) (in Lakhs)	Provision (AWP21-22) (in Lakhs)	Provision (AWP23-24) (in Lakhs)	Fund Released (in Lakhs)	Expenditure (in Lakhs)	Utilization (%age)
Fishery	2,913.28	2,751.05	0	3,840.39	7,015.82	6,795.91	**96.87**

Source: PMIS (04th December 2025)

Endline Results

A total of **1278 fish farmers** were interviewed from 16 districts, 878 APART fish farmers from 16 districts and 400 fish farmers from 9 districts as Control. 24.3% intervention farmers were females, and 10.4% control farmers were females. Overall, 20% respondents were females.

Table 65: *Sample Size - Fish (Total)*

	Total	Male	Female
Intervention	878	665	213
Control	400	359	41
Total	**1278**	**1024**	**254**

Demonstrations in APART Fisheries VC were conducted to promote four types of fish farming practices. The samples selected for each is detailed below. The female fish farmers selected are - 25% for polyculture, 17% for paddy-cum-fish, 36% for polyculture with prawns and 13% for Beel fisheries. Control farmers were taken for polyculture fish farming only.

Table 66: *Sample Size - Fish (Intervention)*

	Total	Male	Female
Polyculture Fisheries	500	375	125
Paddy-cum-Fish	148	123	25
Polyculture with Prawns	145	93	52
Beel Fisheries	85	74	11
Total	**878**	**665**	**213**

Background Information of fish farmers:

Table 67: *Background information - Fish farmers*

	Intervention			Control		
	Total	Male	Female	Total	Male	Female
N	**878**	**665**	**213**	**400**	**359**	**41**
Average age	44.7	45.9	40.9	44.5	44.8	42.6

	Intervention			Control		
	Total	Male	Female	Total	Male	Female
N	**878**	**665**	**213**	**400**	**359**	**41**
Education Level	%	%	%	%	%	%
Illiterate	1.8	2.1	0.9	2.3	2.2	2.4
Read and write	2.3	2.4	1.9	4.5	3.9	9.8
Class 1-5	11.4	11.7	10.3	13.3	11.4	29.3
Class 6-8	24.0	26.2	17.4	38.8	39.0	36.6
Class 9-12	48.1	46.2	54.0	36.8	38.4	22.0
Graduation	12.2	11.3	15.0	4.5	5.0	0.0
Above Graduation	0.2	0.2	0.5	0.0	0.0	0.0
Social groups	%	%	%	%	%	%
Scheduled Caste	26.1	26.2	25.8	5.5	5.8	2.4
Scheduled Tribes	7.6	6.5	11.3	42.0	39.3	65.9
OBC	17.7	17.6	17.8	37.8	38.7	29.3
General	48.6	49.8	45.1	14.8	16.2	2.4
Religion	%	%	%	%	%	%
Hindu	62.4	60.2	69.5	88.5	87.2	100.0
Islam	37.5	39.7	30.5	11.5	12.8	0.0
Christian	0.0	0.0	0.0	0.0	0.0	0.0
Pond	%	%	%	%	%	%
Own pond (Yes)	99.5	99.4	100.0	98.8	98.9	97.6
Leased pond (Yes)	9.0	9.6	7.0	8.0	8.6	2.4
Ponds (owned + leased) (Yes)	2.0	2.0	1.8	1.3	1.3	1.2
Income						
Average income in the last 12 months from fish farming	252734.6	255356.8	244548.1	137750.9	135824.8	154615.9
Average income in the last 12 months from agri-horti crop	45527.0	47067.3	40718.1	45712.8	45979.4	43378.0
Average income in the last 12 months from any other sources	38514.6	40165.7	33359.5	44495.7	43310.3	54875.6
Average total HH income	3,36,776.2	3,42,589.8	3,18,625.8	2,27,959.3	2,25,114.5	2,52,869.5
Went to other districts / state in search of work during last 3 years	%	%	%	%	%	%
Yes	3.0	3.9	0.0	5.8	6.1	2.4
No	90.0	88.1	95.8	87.0	85.8	97.6
Went before, not now	7.1	8.0	4.2	7.3	8.1	0.0

Relevance

Integrated aqua culture is an approach that combines multiple species and/or agriculture to create a more sustainable and resource-efficient system. It holds high relevance for Assam due to its abundant water resources, agrarian livelihoods and growing demand for fish as a primary source of nutrition. The state's favorable agro-climatic conditions, coupled with extensive networks of ponds, wetlands (*beels*) and floodplain areas, create strong potential for diversified and sustainable fish farming systems.

Integrated aquaculture ensures efficient use of land and water by combining fish culture with other agricultural or livestock activities. In systems like **paddy-cum-fish farming,** the same land supports both rice and fish production, improving overall productivity per unit area. The practice allows nutrient recycling - fish waste enriches soil fertility while paddy fields provide natural feed and habitat for fish. The farmers have been engaged with this activity for an average of 5.7 years. They have an agricultural land of 0.6 ha along with the 0.59 ha of pond area.

By cultivating **multiple species** like Indian Major Carps (rohu, catla, mrigal), **exotic carps** (silver, grass, common carp), **minor carps**, **mola** and even **freshwater prawns**, farmers achieve better feed conversion, ecological balance and risk mitigation. The mixed-species approach optimizes pond ecology and ensures year-round harvests, leading to **higher yields and diversified income sources**.

Fish contributes significantly to dietary protein intake in Assam. The inclusion of **small indigenous species (SIS)** like mola enhances nutritional security, particularly for rural households, due to their richness in micronutrients and essential fatty acids. Integrated systems thus support both **household nutrition** and **livelihood resilience**.

APART has strengthened integrated aquaculture practices by promoting quality fish seed and feed production, genetically improved strains and better management systems. It has also introduced **innovative models** like **carp-mola polyculture** and **prawn-based polyculture**, while building capacities through **Farmer Producer Organizations (FPOs)** and market linkages.

Intervention-supported farmers under APART operate at **larger scales** and report **higher productivity** compared to traditional systems. Integrated aquaculture enhances employment opportunities, promotes women's participation and contributes to rural economic growth.

Integrated aquaculture in Assam represents a **sustainable, profitable and nutrition-sensitive model** of rural development. It aligns with state and national priorities for **blue growth**[22]**, food security and livelihood enhancement**, making it a cornerstone for the future of Assam's fisheries sector. Through initiatives like APART, the approach has evolved from subsistence to a commercially viable and environmentally responsible system.

Efficiency

Fish farming has emerged as a key livelihood and income-generating activity in Assam, supported by the APART project, which emphasizes scientific aquaculture, integrated production systems and sustainable input management. The efficiency of fish farming in the state can be gauged through adoption of improved technologies, quality input procurement and effective feed management practices. The three major culture systems are Polyculture, Paddy-cum-Fish Farming and Polyculture with Freshwater Prawn Farming, reflect varying levels of institutional linkages, technology adoption and input optimization, collectively illustrating the growing maturity of Assam's aquaculture ecosystem.

Adoption and Technology Use: Adoption rates across systems indicate widespread acceptance of modern aquaculture practices:

[22] The **Blue Growth Initiative** is a strategic approach, led by organizations like the Food and Agriculture Organization (FAO), to promote sustainable economic growth in fisheries, aquaculture, and other aquatic sectors. Its primary goal is to increase economic and social benefits while minimizing environmental damage by improving governance, conserving biodiversity, and empowering communities.

- Polyculture has an adoption rate of 98.6%, followed closely by Paddy-cum-Fish (97.3%) and Polyculture with Freshwater Prawn Farming (99.3%).
- The Paddy-cum-Fish farmers are continuing cultivating high-yield paddy variety (90%), high yield fish seed variety (82%) and cultivating small fish varieties like mola (44%).
- Use of recommended fish species remains consistently high across systems (97-98%), reflecting strong adherence to scientifically validated culture compositions.
- However, compliance with recommended seed quantities shows variation - Polyculture (84.5%) lags Paddy-cum-Fish (88.2%) and Prawn-integrated systems (94.4%), suggesting room for improvement in stocking density management.
- On average, 20.7 farmers per village are engaged in fish farming, with 11.8 adopting improved practices, showing positive but uneven diffusion of technology.

This pattern signifies that APART's technical interventions have penetrated well into community practices, though sustained capacity building is required to ensure uniform adoption and efficiency in input application.

Fish Seed Procurement Patterns: Fish seed procurement reveals distinct institutional linkages and self-sufficiency levels across systems:

- **Polyculture Farming:** Farmers rely predominantly on private hatcheries (63.5%) and government hatcheries (40.5%), while own stock (45.2%) indicates partial self-reliance. FPCs (23%) and AFDC (9%) contribute modestly, showing the need to strengthen collective procurement through producer organizations.
- **Paddy-cum-Fish Farming**: Exhibits balanced sourcing - private hatcheries (47.9%) and government hatcheries (44.3%) serve as the main suppliers. The role of FPCs (33.6%), AFDC (20.7%) and peer farmer exchange (35.7%) demonstrates effective networking and local capacity in seed access. Self-maintained brood stock (41.4%) also supports local sustainability.
- **Polyculture with Prawn Farming**: Demonstrates the most organized structure, with strong institutional linkages - FPCs (53.2%), private hatcheries (53.9%) and government hatcheries (47.5%) ensure steady supply of quality fish and prawn seed. The own stock share (41.1%) underscores continuing self-production, while AFDC (14.9%) support reinforces formal institutional presence.

Overall, the prawn-integrated system exhibits higher efficiency through diversified and reliable seed sourcing, enhanced by community-level networks and institutional support.

Feed Procurement and Management

Feed management is central to aquaculture efficiency, influencing both growth performance and profitability. Data show an increasing trend toward formulated pelleted feeds, signifying a shift toward scientific and intensive practices.

- **Polyculture Farming:** Farmers use 1,720.6 kg floating and 1,367.6 kg sinking feeds, indicating a balanced strategy catering to multiple feeding niches. Higher floating feed use implies attention to feed efficiency, water quality and wastage reduction.
- **Paddy-cum-Fish Farming:** Records the highest total feed use, floating (1,546.6 kg) and sinking (1,478.7 kg), in line with its integrated ecosystem where paddy residues and aquatic vegetation complement feed inputs. Slightly greater reliance on sinking feeds aligns with the submerged and benthic feeding nature of this system.
- **Polyculture with Prawn Farming:** Shows lower total feed use, floating (1,330.3 kg) and sinking (1,136.5 kg), reflecting both higher feed conversion efficiency and cost-

conscious practices. Prawn's bottom-dwelling behavior explains continued dependence on sinking feeds.

Feed use efficiency appears highest in prawn-integrated systems, where precision in feed management reduces wastage and optimizes growth performance.

Procurement of Aquaculture Inputs: Input procurement patterns reflect the operational and institutional robustness of each system:

- **Polyculture Farming:** Farmers depend on both institutional and local markets, with moderate reliance on private and government hatcheries. The balanced use of lime (29.9 kg), cow dung (1314.8 kg) and fertilizers (urea, SSP) suggests a cost-effective mix of traditional and modern inputs.
- **Paddy-cum-Fish Farming:** Utilizes higher quantities of lime (33.4 kg) and cow dung (1424.3 kg), pointing to strong pond management practices. Inputs are mainly sourced from government and FPC channels, providing quality assurance and extension support.
- **Polyculture with Prawn Farming:** Characterized by intensive input use, notably mustard oil cake (257 kg) and rice polish (105.1 kg), indicating higher feed input intensity and controlled water quality management. Strong institutional sourcing through FPCs and hatchery networks underscores commercialization and organized input procurement.

FPCs and AFDCs play a progressively important role, especially in prawn and paddy-cum-fish systems, linking smallholders with formal supply chains. The prevalence of own broodstock and local seed exchange strengthens resilience and reduces dependence on external suppliers. Balanced use of traditional manures and commercial feed enhances ecological stability while maintaining productivity. Polyculture with prawn farming represents the most commercial and organized model, integrating scientific feed, quality seed and institutional procurement effectively.

The efficiency of fish farming in Assam is improving steadily, driven by high technology adoption, organized input supply networks and diversified culture systems. While polyculture farming demonstrates widespread participation and resource diversity, paddy-cum-fish systems ensure ecological balance and integration with agriculture. Polyculture with prawn farming, on the other hand, exemplifies market-oriented, institutionally linked aquaculture.

Effectiveness

It is apparent that fish farming, especially where APART-style interventions (polyculture, paddy-cum-fish and polyculture with prawn) have been applied is an effective livelihood enterprise. Households in the intervention group achieve substantially higher fisheries incomes and overall household incomes than control households, while cooperative/Farmer Producer Company (FPC) membership and access to market/training services are important enabling factors. Production and husbandry practices (including high use of organic manure, routine plankton monitoring and targeted prawn husbandry) support productivity.

Income and economic effectiveness

- The strong increase in fisheries income for intervention households is the primary driver of higher total incomes. This suggests that technical or organizational interventions (seed, polyculture systems, prawn integration, extension support) materially increase yields and/or price realization.
- Agricultural income parity indicates interventions were targeted (and effective) specifically for aquaculture rather than cropping.

- Lower “other” income in the intervention group implies a greater household reliance on fisheries as the main income source, a sign of successful specialization but also a potential vulnerability if fish production shocks occur.

Production and practices

Polyculture and integrated practices

- **Adoption of technology:** near-universal adoption of polyculture and paddy-cum-fish approaches, with very high use of recommended fish species.
- **Paddy-cum-fish specifics:** average engagement of 5.7 years, average agricultural land 0.6 ha and pond area 0.59 ha. Last-year average harvests: fish - 1,780.7 kg and paddy - 3,471.6 kg. This demonstrates real integrated production and diversified returns from the same land/pond base.

Polyculture with freshwater prawns

- **Pond depth:** 3.5 ft (suitable for prawn culture in this system).
- **Fertilizer / manure:** 59.3% use chemical fertilizers (Urea 99% of those; SSP 86%) while 92% use organic manure- a mix of organic and chemical inputs.
- **Plankton monitoring:** 77% monitor plankton (good practice linked to better production timing/stocking).
- **Prawn husbandry:** 75.2% provide hiding arrangements during moulting (bamboo, betel-nut leaves, coconut leaves, tree branches, plastic pipes, tyres), indicates awareness of prawn biology and best practice.
- **Stocking & feeding:**
    - **Stock when water turns green:** 99.3% (common ecological indicator).
    - **Mean seed size stocked:** 3.3 cm.
    - **Feed sources:** departmental hatcheries (69%), registered private hatcheries (60%), multiplication centers (20%).
    - 91% use sinking pellets (the dominant feeding practice).

The combination of plankton monitoring, appropriate stocking timing/size, provision of shelters for prawns and high adoption of sinking pellets are indications of maturing husbandry knowledge and practices, which likely contribute to higher yields and more consistent production outcomes in intervention areas. The mixed use of chemical and organic fertilizers suggests room to improve nutrient management (reduce unnecessary chemicals while maintaining productivity).

Collective institutions, markets and value capture

Membership & perceived benefits

- **Cooperative membership:** 54.8% of surveyed fish farmers are members of cooperatives
    - Top cooperative benefits (percent of members citing): better price realization (77%), year-round access to markets (54.4%), elimination of middlemen (51.5%), training/exposure (47.1%).
- **FPC membership rates:** Polyculture 41.8% | Paddy-cum-Fish 41.1% | Polyculture with prawns 69.9%.
    - 75% of FPC members said better prices are the key benefit; year-round markets and elimination of middlemen each cited by 60%.

- **FPC operational indicators:** FPC membership sizes reported (e.g., mean members - around 149-243 across systems) and FSSAI certification held by a minority (22.6-27.5% across systems).
- **Price gains:** High shares of FPC members reported improved prices after joining (Polyculture - 80.7%, Paddy-cum-Fish - 93.5%, Prawn polyculture - 80.4%).
- **Training reported from FPCs:** Technical fishery technology 38-43% across systems, good fishery practice 19-35%, access to credit reported by 11-21% (higher for paddy-cum-fish), good marketing practice lower (4.9-16.1%), while management/accounting training is very low (<5%).
- Input services from cooperatives/FPCs are reported but at much lower levels than market/price benefits.

Cooperatives and FPCs appear to be critical enablers of improved price realization and market access for fish farmers and their presence correlates with the higher incomes observed in intervention groups.

The intervention appears to maintain near-parity in fisheries incomes between men and women within intervention households, which is positive for inclusivity. Despite promising signs, women's absolute representation in FPC/cooperative leadership/training appears lower, targeted measures should ensure equitable access to capacity building, decision-making roles and credit.

Data shows that fish farming in the intervention areas of Assam is effective in increasing household incomes (fisheries incomes - 83.5% higher; total household incomes - 47.7% higher than controls). This effectiveness is driven by improved husbandry (polyculture, prawn management, timely stocking and feeding) and by collective institutions (cooperatives/FPCs) that materially improve market outcomes and prices.

Sustainability

The sustainability of fish farming interventions in Assam depends on the reflection on how far the benefits achieved under APART are likely to endure and scale beyond project support.

The adoption of integrated and polyculture-based systems has promoted efficient resource utilization and ecological balance. Farmers practicing paddy-cum-fish and polyculture with freshwater prawns are optimizing land and water use while maintaining biodiversity. The introduction of Indian Major Carps (rohu, catla, mrigal) and compatible exotic species ensures stable yields without excessive ecological disruption. Additionally, the increasing use of organic pond inputs such as lime and cow dung has reduced dependence on synthetic chemicals, improving water quality and pond health. These measures collectively enhance the resilience of the aquatic ecosystem, making fish farming more climate-adaptive and environmentally responsible.

The marked increase in average income from fisheries - 83% higher in intervention households compared to control groups, demonstrates strong economic viability. Farmers are not only producing more but also earning better due to enhanced productivity, diversification and market linkages. Access to quality inputs, such as certified seeds and feed and the adoption of scientific pond management practices, have lowered mortality rates and improved output consistency. The emergence of collectives, cluster-based operations and market-oriented production is strengthening value chains. These mechanisms enable bulk input procurement, collective marketing and negotiation for better prices which are key drivers for long-term financial stability and scaling of operations.

Institutional mechanisms established under the intervention such as Farmer Producer Groups (FPGs), Fish Farmer Interest Groups (FIGs) and linkages with fisheries cooperatives are critical for continuity. They provide the organizational backbone for input supply, extension services and market facilitation even after project withdrawal. The growing connectivity between producers, hatcheries and traders is fostering a more reliable market ecosystem. The strengthening of cold-chain logistics and transport infrastructure will further enhance the sector's competitiveness and reduce post-harvest losses. These institutional linkages ensure that fish farming remains profitable and integrated with regional and national markets.

Alignment with national programs like **Pradhan Mantri Matsya Sampada Yojana (PMMSY)** will enhance policy-level sustainability. The models promoted under APART are **scalable and replicable** across similar floodplain and wetland ecosystems of Northeast India. The emphasis on capacity building, training and local entrepreneurship creates a strong foundation for long-term continuity.

The fish farming interventions in Assam have demonstrated a balanced model of **economic growth, ecological prudence and social inclusion**. With strong adoption of scientific practices, institutionalized farmer networks and tangible income gains, the system shows high potential for **self-sustaining aquaculture ecosystems**. Continued focus on input quality, capacity building and value-chain development will ensure that the progress achieved remains both resilient and regenerative over time.

Impact

Polyculture records the **higher yield (6,327.39 kg/ha)** followed closely by **Polyculture with Prawns (6,066.49 kg/ha)**. **Paddy-cum-Fish** yield is at **1,968.27 kg/ha**, largely due to its dual-use nature where water depth, duration and stocking intensity are lower as compared to other two.

In revenue terms, both Polyculture models generate substantially higher returns because of higher production volume and strong market prices (around Rs. 208-209/kg). **Polyculture earns Rs. 6.46 lakh**, followed by **Polyculture with Prawns at Rs. 5.39 lakh**.

Paddy-cum-Fish provides ecological and livelihood benefits like soil fertility improvement, reduced pest incidence and dual use of land, making it valuable for integrated, low-input farming households. **Polyculture with Prawns** offers an attractive balance - high yield, good returns and diversified output, making it suitable for farmers with better water control and management capacity.

Table 68: *Production, Revenue and Earnings - Fish*

	Polyculture	Paddy-cum- Fish	Polyculture with Prawns
N	**500**	**148**	**145**
Water area (Ha)	0.503	0.592	0.425
Fish sold to market (Kgs)	3,094.10	1092.02	2,492.76
Home consumption (Kgs)	88.66	68.45	84.69
Total Production (Kgs)	**3,182.76**	**1160.47**	**2,577.45**
Yield (kg/ha)	**6,327.39**	**1,958.54**	**6,066.49**
Market price (Rs per kg)	208.88	207.9	209.17
Revenue (Rs.)	**6,46,295.61**	**2,41,261.71**	**5,39,125.22**
Total Input Cost (Rs.)	71,615.57	29,407.43	59,281.30
Earnings (Rs.)	**5,74,680.04**	**2,11,854.28**	**4,79,843.91**
Gross Margin Ratio (%)	**88.92%**	**87.81%**	**89.00%**

Gross Margin Analysis

Polyculture records the gross margin of Rs. 11,42,505.05 per ha with the gross margin ratio of 88.92%, reflecting efficient cost management. Polyculture with Prawns follows closely with a per ha gross margin of Rs. 11,29,044.5 with similarly strong margin ratio of 89%, supported by its high-value species mix.

Table 69: *Gross Margin Analysis - Fish*

	Polyculture Fisheries					
	Intervention			Control		
	Total	Male	Female	Total	Male	Female
N	**500**	**375**	**125**	**400**	**359**	**41**
Water area (Ha)	0.503	0.512	0.475	0.27	0.26	0.29
Yield (kg/ha)	**6,327.39**	**6,318.73**	**6,355.40**	**4,499.50**	**4,495.35**	**4,531.95**
Revenue (Rs/ha)	12,84,881.92	12,82,209.62	12,93,134.65	8,65,658.74	8,64,006.44	8,78,797.83
Input Cost (Rs/ha)	1,42,376.88	1,43,301.92	1,39,369.72	2,03,748.09	2,07,803.89	1,71,984.34
Gross Margin per ha	**11,42,505.05**	**11,38,907.70**	**11,53,764.93**	**6,61,910.64**	**6,56,202.55**	**7,06,813.49**
Gross Margin Ratio	**88.92%**	**88.82%**	**89.22%**	**76.46%**	**75.95%**	**80.43%**

Polyculture fisheries under the intervention significantly outperform the control group across all economic indicators. Intervention farmers operate on larger water areas (0.50 ha vs 0.27 ha) and generate substantially higher revenues (Rs. 6.46 lakh vs Rs. 2.33 lakh), translating into markedly superior revenue efficiency per hectare (Rs. 12.84 lakh/ha compared to Rs. 8.65 lakh/ha). Although input costs per hectare are higher under intervention, returns far outweigh costs, resulting in very high gross margins (Rs. 11.42 lakh vs Rs. 6.61 lakh) and an exceptional gross margin ratio of 88.92%. Gender-wise, female farmers under intervention achieve outcomes comparable to male farmers, indicating inclusive adoption of improved practices, while female farmers in control areas lag. Overall, the intervention has transformed polyculture fisheries into a highly profitable and efficient livelihood activity, with clear gains in productivity, profitability, and economic resilience.

The profitability, efficiency and resource use in the three aquaculture systems are:

- **Polyculture**, with a water area of 0.503 ha, generates the revenue of Rs. 6.46 lakh due to its significantly higher fish production and better utilization of pond space. Even though its input cost is the highest (Rs. 71,615), its gross margin reaches an impressive Rs. 5.74 lakh, supported by a strong gross margin ratio of **88.92%**, indicating that most of the revenue is retained as profit.

- **Polyculture with Prawns**, though slightly smaller in area (0.425 ha), generates a revenue of Rs. 5.39 lakh, also performs exceptionally well, achieving a gross margin of Rs. 4.79 lakh and a high gross margin ratio of **89%**. The earnings from prawns would further increase the gross margin for this aquaculture system.
- **Paddy-cum-Fish**, with largest water area (0.592 ha), brings in the revenue of Rs. 2.41 lakhs. Its input cost is relatively low (Rs. 29,407), yet the gross margin ratio is strong at **87.81%**. The earnings from paddy would further increase the gross margin for paddy-cum-fish.

Overall, all systems emerged as **highly efficient, profitable and resource-productive**, offering strong financial returns per hectare. Polyculture with Prawns provides the advantage of species diversification and high market value, while Paddy-cum-Fish is more valuable for integrated farming, ecological benefits and suitability for farmers with limited input capacity. Due to the ability to produce two crops, paddy and fish, from a single cultivable area, this technique is both profitable and sustainable.

Comparison Intervention and Control Farmers

Intervention farms recorded a 40.6% improvement in **yield per hectare**, driven by better feed management, improved seed quality and scientific practices.

Table 70: *Comparison Intervention and Control Farmers - Fish*

	Intervention	Control	Difference	%	Probability	Significance
N	500	400				
	Average	Average				**/*** = 1%; * = 5%
Water Area (Ha)	0.503	0.27				
Quantity Produced (kg)	3,182.76	1,216.08	1,966.68	161.72%	100%	***
Yield (kg/ha)	**6,327.39**	**4,499.50**	**1,827.90**	**40.62%**	**100%**	***
Home Consumption (kg)	88.66	99.85	-11.19	-11.21%	99%	**
Marketable surplus (kg)	3,094.10	1,116.23	1,977.87	177.19%	100%	***
Market price (Rs)	208.88	209.6	-0.72	-0.34%	100%	***
Revenue (Rs)	6,46,577.80	2,33,787.25	4,12,790.55	176.57%	100%	***
Revenue (Rs/ha)	**12,84,849.23**	**8,65,658.74**	**4,19,190.49**	**48.42%**	**100%**	***
Input Cost (Rs.)	71,615.57	55,066.80	16,548.77	30.05%	100%	***
Input Cost (Rs/ha)	**1,42,373.25**	**2,03,748.09**	**-61,374.84**	**-30.12%**	**100%**	***
Earnings (Rs.)	5,74,962.23	1,78,720.45	3,96,241.78	221.71%	100%	***

	Intervention	Control	Difference	%	Probability	Significance
N	500	400				
	Average	Average				**/*** = 1%; * = 5%
Earnings (Rs/ha)	11,42,475.98	6,61,910.64	4,80,565.33	72.60%	100%	***
Gross Margin Ratio (%)	88.92%	76.00%				

Revenue per ha under intervention is significantly higher **(Rs. 12,84,849.23 vs Rs. 8,65,658.74),** mainly due to higher production and better utilization of pond area. **Net earnings per ha increased by over 72%,** showcasing strong economic efficiency.

Home consumption was marginally lower for intervention farmers, as a higher proportion of produce entered the market, indicating greater market orientation.

Gross Margin: Intervention - 88.9%; Control - 76.0%. An increase of 12.92 percentage points, reflecting much better returns on investment.

Per Hectare Earnings: Intervention - 11.42 lakh/ha; Control - Rs. 6.61 lakh/ha. 73% higher profitability per hectare for intervention farmers.

- The intervention has substantially enhanced productivity, income and efficiency across all parameters.
- Higher returns per hectare and greater marketable surplus highlight the transformation toward commercial aquaculture.
- While input costs rose slightly, they were far outweighed by gains in output and income.
- Control farmers remain limited by traditional practices and lower input use.

Intervention in polyculture farming has led to major improvements in yield (+48%), income and profitability (+73% per ha), confirming the effectiveness and sustainability of project-supported practices under APART. The approach is both economically rewarding and scalable, positioning it as a model for inclusive aquaculture development in Assam.

Results of step-wise ordinary least square (OLS) regression models showing effect of explanatory variables on fish productivity (dependent variable logarithm of fish productivity)

The table below presents estimated regression coefficients of OLS of six models. In the unadjusted model 1, it has been observed that fish production in the intervention, irrespective of varieties of fish, has positive and significant influence on fish productivity ($p<0.001$) and continue to remain significant in model 5 i.e. even after controlling other explanatory variables, as well as in model 6 after controlling all other potential confounders and district fixed-effects ($p<0.001$). A closer look also reveals that all varieties of fish produced in the control areas has negative and significant effect on fish productivity in models 5 and 6 ($p<0.10$ in model 5; $p<0.001$ in adjusted model 6). Becoming a member of FPC enhances fish productivity significantly in unadjusted model 2 ($p<0.001$), such effect diminishes in model 4 and 5. Number of fish seed though does not have significant positive influence on fish productivity, such effect found to be positive and significant in models 5 and 6 ($p<0.001$) implying number of fish seeds increases fish productivity to a significant extent after controlling other explanatory and control variables including district-fixed effects. Amount of fish feed (in kg) although found to have positive significant influence on fish productivity in unadjusted model 3 (P<0.05), such effect has not been observed in the model 4 and model 5. Similarly, adoption of technologies learnt during demonstration significantly enhances fish productivity independently in model 4 (p<0.001), such effect became insignificant in models 5 and 6.

Explanatory Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	P-value	95% CI	
	Coeff	Coeff	Coeff	Coeff	Coeff	Coeff			
Types of fish production in intervention and control									
Fish production of not all types in control (ref)	….	….	….	….	….	….	….	….	….
Fish production of all types in control	-0.16**	….	….	….	-0.16**	-0.28**	0.002	-0.463	-0.106
Fish production of not all types in intervention	0.62***	….	….	….	0.62***	0.80***	0.000	0.491	1.088
Fish production of all types in intervention	0.56***	….	….	….	0.47***	0.66***	0.000	0.317	1.002
Member of FPC									
No (ref)	….	….	….	….	….	….	….	….	….
Yes	….	0.40***	….	….	0.10	0.13	0.152	-0.047	0.303
Number of fish seed	….	….	-0.01	….	0.03***	0.04***	0.000	0.028	0.054
Amount of fish feed (in kg)	….	….	0.01**	….	-0.01	-0.01	0.580	-0.006	0.003
Increased adopted demonstrated technology	….	….	….	0.34***	0.05	-0.01	0.854	-0.157	0.130
Control variables	No	No	No	No	No	Yes			
District fixed effect	No	No	No	No	No	Yes			
Adjusted R square	**0.15**	**0.04**	**0.01**	**0.13**	**0.17**	**0.24**			
Note 1: ***: p<0.001; **: p<0.05; *: p<0.10									
Note 2: Control variables are gender of the farmer, educational qualification, age, religion, social category.									
Note 3: P-values and Confidence Interval have been given only for the final adjusted model.									

Distribution used for testing individual coefficient in the model: t-distribution
Distribution used for testing overall model significance: f-distribution

Comparison with Baseline Study (Independent Samples)

The analysis compares average performance indicators of **Intervention** and **Control** farmers between **2019 (Baseline)** and **2025 (Endline)** to measure the net program impact under the APART project. Since the samples are independent, changes represent differences in group averages rather than matched respondents.

Table 71: *Differences in Mean: Fish*

<table>
<tr><th>Parameter</th><th>Intervention 2019</th><th>Intervention 2025</th><th>P values</th><th>Significance (t-test)</th><th colspan="2">95% CI</th><th>Control 2019</th><th>Control 2025</th><th>P values</th><th>Significance (t-test)</th><th colspan="2">95% CI</th><th>Effect</th></tr>
<tr><td></td><td>Average</td><td>Average</td><td></td><td>***: p<0.001; **: p<0.05; *: p<0.10</td><td></td><td></td><td>Average</td><td>Average</td><td></td><td>***: p<0.001; **: p<0.05; *: p<0.10</td><td></td><td></td><td></td></tr>
<tr><td>Base</td><td>407</td><td>500</td><td></td><td></td><td></td><td></td><td>157</td><td>400</td><td></td><td></td><td></td><td></td><td>-</td></tr>
<tr><td>Water Area (Ha)</td><td>0.59</td><td>0.503</td><td></td><td></td><td></td><td></td><td>0.333</td><td>0.270</td><td></td><td></td><td></td><td></td><td>-</td></tr>
<tr><td>Production (kg)</td><td>1901.71</td><td>3182.76</td><td></td><td></td><td></td><td></td><td>1127.07</td><td>1216.07</td><td></td><td></td><td></td><td></td><td>+1192.04</td></tr>
<tr><td rowspan="3">Yield (kg/ha)</td><td rowspan="3">3223.23</td><td rowspan="3">6,327.39</td><td>P(T<t) = 0.000</td><td rowspan="3">***</td><td rowspan="3">-1,138.77</td><td rowspan="3">-1,011.893</td><td rowspan="3">3384.59</td><td rowspan="3">4,499.50</td><td>P(T<t) = 0.000</td><td rowspan="3">***</td><td rowspan="3">-3,136.82</td><td rowspan="3">-3,041.58</td><td rowspan="3">+1,989.35</td></tr>
<tr><td>P(|T|>|t|) = 0.000</td><td>P(|T|>|t|) = 0.000</td></tr>
<tr><td>P(T>t) = 1.00</td><td>P(T>t) = 1.00</td></tr>
<tr><td>Market Price (Rs)</td><td>153.77</td><td>208.88</td><td></td><td></td><td></td><td></td><td>180.85</td><td>209.6</td><td></td><td></td><td></td><td></td><td>+26.36</td></tr>
</table>

- **Production:** Intervention farmers increased average production by **1,281 kg**, compared to only **89 kg** among control farmers. The difference **(+1,192 kg)** signifies a strong project-attributable gain in output levels.
- **Productivity:** Yield improved by **+3,104 kg/ha** in the intervention group versus **+1,114 kg/ha** in control. The difference of **+1,989 kg/ha** confirms significant efficiency gains due to improved inputs, feed management and technical support.
- Both groups benefited from higher prices, but intervention farmers achieved a **greater improvement (+26 Rs/kg)**, likely due to enhanced quality, size and better market linkages.

These results highlight the **strong positive impact** of project interventions in improving productivity, efficiency and market competitiveness in Assam's aquaculture sector.

Equity

Gender equity is a cornerstone of sustainable and inclusive development within the fisheries and aquaculture sector. In Assam, where fish farming plays a central role in rural livelihoods, interventions under the ongoing aquaculture development programs have actively sought to enhance women's participation, decision-making and economic empowerment. The gender equity outcomes reflect encouraging progress; women are not only emerging as active contributors to household aquaculture but also as agents of change within community-based fisheries systems.

While participation rates among women have improved, **representation in leadership and decision-making roles** remains limited.

- **FPC Membership:** Female membership has increased, though **absolute numbers remain lower** than male counterparts.
- **Leadership and Governance:** Women are **underrepresented in executive positions**, often restricted to supportive roles rather than key decision-making functions.
- **Training and Capacity Building:** Fewer women attend **technical and managerial trainings**, often due to **mobility constraints, time poverty and socio-cultural barriers**.

Addressing these disparities is crucial for ensuring that women not only participate but also **influence governance and benefit distribution mechanisms.**

The fish farming interventions in Assam have made commendable progress in promoting **gender equity and inclusive growth**. Women are now recognized as co-farmers, not just helpers, in aquaculture systems- actively contributing to production, management and marketing. The narrowing gender income gap and increasing visibility of women in collective structures underscore a positive transformation.

Beel Fisheries

APART has worked in 68 Beels and has for the first time facilitated the formation of Beel Development Management Committees (BDMC).

Relevance

Beel fisheries are a cornerstone of Assam's inland fishery sector, providing ecological, economic and social benefits. These natural floodplain wetlands sustain a rich diversity of fish species and offer vital ecosystem services such as flood regulation, groundwater recharge and habitat for aquatic biodiversity. They are an important livelihood source for thousands of traditional fishing households and contribute to local food and nutrition security. The beel's integration of capture and culture-based systems ensures sustainable utilization of water resources while promoting inclusive rural growth.

Efficiency

Beel fishery practices in Assam exhibit high operational efficiency due to strong community participation and adoption of improved practices.

- **Adoption Rate**: 100% of fishers reported adopting modern technology and improved management practices.
- **Input Use and Cost Efficiency**: The total input cost averaged Rs. 4,35,702.87 per unit, with fish feed accounting for over 70% of total expenditure.

- **Production and Returns**: With an average production of 14,127.67 kg and revenue of Rs. 37.42 lakh, the average unit cost is Rs. 271.47/kg, generating net earnings of Rs.33.06 lakh, indicating high profitability and cost efficiency.
- **Species Composition**: Farmers maintain a balanced polyculture system with Indian Major Carps (Rohu 25.4%, Catla 20.9%, Mrigal 16%) as dominant species, supplemented by Silver, Grass, and Common Carp, enhancing productivity and resource use efficiency.
- **Community Organization**: 100% membership in Beel Development and Management Committees (BDMCs) reflects effective collective governance, facilitating input procurement, pond management and equitable benefit-sharing.

Effectiveness

The Beel fishery intervention has shown strong effectiveness in improving productivity, income and community well-being.

- **Productivity**: Average monthly fish capture is high (170-190 kg per species category), with premium prices for larger species such as Catla (Rs.213.4/kg) and Magur/Singhi (Rs.343.2/kg).
- **Community Benefits:** 83.5% of respondents reported income generation for community members, 55.3% acknowledged employment opportunities and 43.5% noted better household access to fish for consumption.
- **Perceived Outcomes:** More than half (52.9%) viewed beel fisheries as more productive and 80% felt the fish from beels have higher market demand, demonstrating improved local market integration and consumer preference.

Table 72: *Effectiveness of Beel Fishery in Assam*

	Cultivated last year	% Fish Composition	Nos of fingerlings	Size of fingerlings (cm)	Fish capture per month (kg)	Price per kg
Rohu	100	25.4	1252.9	5.4	171.8	189.1
Catla	100	20.9	1577.6	5.5	181.6	213.4
Mrigal	100	16	1385.9	5.2	173.8	170.6
Silver Carp	100	12.3	1341.8	5.0	166.7	163.2
Grass Carp	97.6	10	1440	5.2	187.6	160.7
Common Carp	92.9	7.9	1351.9	4.8	170.5	155.6
Magur / Singhi	25.9	7.7	468.2	3.5	124.5	343.2
Java Puthi	25.9	14.3	300	3.7	110	188.6
Minor Carps	41.2	10.3	1309.8	4.6	184.6	174.9
Others (Seni Puthi)	2.4	1.7	800	3.3	16.7	333.3

Sustainability

Sustainability is central to the Beel Fishery model. The Sustainable Wetlands and Integrated Fisheries Transformation (SWIFT) project, supported by the Asian Development Bank, strengthens institutional frameworks for ecosystem conservation while improving the beel fishery value chain. The technological learning, community mobilization and organization support rendered by APART will the corner-stone for this project, being implemented by ARIAS Society.

Impact

Beel fisheries demonstrate strong economic potential due to their extensive water spread, natural productivity and low input dependence. The analysis indicates that an average water area of **15.4 hectares** yields a total production of **14,127.67 kg**, with a healthy productivity level of **916.01 kg/ha**. The production system remains largely efficient as only a small share (**342.35 kg**) is retained for home consumption, allowing a significant **marketable surplus of 13,785.32 kg**.

Financially, beel fisheries show **exceptional profitability**. With total revenues of **Rs. 37.42 lakh** against input costs of just **Rs. 4.36 lakh**, the system generates substantial **earnings of Rs. 33.06 lakh**. The resulting **Gross Margin Ratio of 88.4%** highlights very high returns over operational costs, making beel-based aquaculture a highly attractive livelihood option. Additionally, the **Gross Margin per hectare (Rs. 2.14 lakh/ha)** demonstrates efficient utilization of the water area and strong cost-to-output performance.

Overall, the data underscores that beel fisheries operate as a **high-yield, low-cost and high-return production system**, driven by natural resource advantages and minimal input requirements. Strengthening management practices, ensuring sustainable harvesting and improving market linkages could further enhance productivity and long-term ecological health of beel ecosystems.

Table 73: *Production, Revenue and Earnings - Beel Fisheries*

Indicators	Average
N	**85**
Average water area (Ha)	15.4
Quantity produced last FY (kg)	14,127.67
Yield (kg/ha)	**916.01**
Unit cost (Rs. / kg)	271.47
Home consumption (kg)	342.35
Marketable surplus (kg)	13785.32
Revenue (Rs.)	**37,42,300.82**
Input Costs (Rs.)	4,35,702.87
Gross Margin (Rs.)	**33,06,597.95**
Gross Margin Ratio (%)	**88.4%**

Equity

Beel fisheries have evolved as a collective and socially embedded livelihood model. The strong community orientation of BDMCs ensures inclusive participation and equitable benefit-sharing.

- **Membership:** Each beel supports an average of 51.3 active members (35 male, 16 female).
- **Participation:** Out of 4,129 total members, 971 are women - 23.5% participation.
- **Perception of Social Value:** 23.5% of respondents acknowledged broader community benefits, while 27.1% reported skill enhancement through capacity-building activities.

The collective management structure has strengthened social cohesion, local governance and community resilience while reducing dependence on external markets.

However, women's access to leadership, ownership of resources and formal representation in governance remains limited.

Beel Fisheries in Assam represent a model of eco-livelihood integration, balancing wetland conservation with socio-economic development. The initiative demonstrates strong performance, where ecological stewardship, efficient production, social inclusiveness and gender empowerment converge. Sustaining these gains through policy support, climate resilience measures and greater women's leadership in fishery governance will be key to ensuring the long-term transformation of Assam's wetland-based livelihoods.

Grievance Management: 72% were aware of APART's grievance mechanism and 30% had reported their grievances about APART activities to the Grievance Redressal Cell.

3.4.1.5 C1.5: Sericulture and Handloom Value Chain

Assam's humid subtropical climate, abundant rainfall, and rich biodiversity provide ideal conditions for sericulture, especially for muga and eri silk cultivation. Sericulture is an eco-friendly, low-input and non-polluting activity, suitable for marginal and degraded lands. It helps promote agro-forestry and soil conservation by encouraging plantation of host plants like *Som*, *Kessaru* and *Castor*.

Sericulture provides sustainable, year-round income opportunities for rural households, especially women. The activity involves multiple stages (host-plant cultivation, silkworm rearing, reeling, spinning, weaving and dyeing), each supporting livelihood diversification.

Assam's muga silk, known as the "Golden Silk of Assam," is the only natural golden silk in the world and holds a Geographical Indication (GI) tag. Eri silk, also "Ahimsa Silk" for its non-violent production process, is gaining global attraction in eco-fashion and ethical textile markets.

Sericulture is integral to Assamese identity. Muga and eri textiles are essential for traditional attire (e.g., *mekhela chador*), festive occasions and customary exchanges. A large proportion of sericulture workers in Assam are women, especially from Scheduled Tribes (STs) and Other Backward Classes. The activity offers home-based employment compatible with household responsibilities, contributing to economic independence and gender equity. Traditional rearing and weaving practices, often passed down through generations, preserve local craftsmanship and biodiversity-based knowledge systems. Assam accounts for over 90% of India's muga silk and is a major eri silk producer, contributing significantly to the region's rural economy.

APART has supported the eri and muga silk farmers through plantation support, providing training and exposure visits, providing rearing houses, spinning and reeling machines and market linkages like fairs and reshom haat. Since, sericulture activities are inherently home-based, it was an unorganized sector APART through the Department of Sericulture facilitated the formation of Farmer Interest Groups (FIGs) and FPCs for the first time in Assam. Reelers and spinners were incorporated in the FIGs, 1 machine for 3 muga silk reelers and 1 machine for 2 eri silk spinners were provided. Rearing capacity for eri silk was expanded. Plantation activities both in government land and private land was promoted. The rearing cost for muga thereby reduced. Eri farmers systematically cultivated and cared their plantations. Thereby reducing the workload of women rearers (eri). The quality of reeling and spinning improved with the available machines. Skill development training was provided to nearly all farmers.

Table 74: *Beneficiaries of Sericulture (PMIS)*

Eri Silk		Muga Silk	
District	Farmers	District	Farmers
Biswanath	315	Charaideo	6
Bongaigaon	99	Dhemaji	25
Charaideo	38	Jorhat	51

Eri Silk		Muga Silk	
District	**Farmers**	**District**	**Farmers**
Darrang	100	Kamrup	159
Dhemaji	50	Lakhimpur	289
Jorhat	74	Sivasagar	149
Kamrup	384		
Lakhimpur	133		
Majuli	132		
Sivasagar	208		
	1,533		**679**

Table 75: *Number of Activities - Sericulture (PMIS)*

Activities	Nos
Private Graneur	103
Reelers	428
Reelers Training	107
Adopted Seed Rearer	256
Spinners	281
Spinners Training	128
Kessaru Plantation	427
ERI Rearing House and Kessaru Plantation	230
Som Plantation	388
Total	**2348**

Source: PMIS

Financial utilization is around 86.7%.

Table 76: *Financial Utilization - Sericulture (PMIS)*

OPIU	Fund Released (in Lakhs)	Expenditure (in Lakhs)	Utilization %
Sericulture	1885.82	1635.94	86.75%
Handloom and Textiles	737.15	713.39	96.78%

Source: PMIS

Endline Results

3.4.1.5.1 Eri Silk

A sample of 128 eri silk farmers participating in the APART program was interviewed from four districts (Biswanath, Golaghat, Jorhat and Morigaon). In the sample, 47% are Planters/ Rearers and 53% are Spinners and 87.5% are females, indicating that women dominate Eri cultivation in Assam. The social category representation comprised 50.78% from the Scheduled Tribes (ST), 20.31% from the Scheduled Caste (SC), and rest from the Other Backwards Classes (OBC).

Background Information of Eri Silk farmers:

Table 77*: Background information - Eri Silk farmers*

	Eri Silk

	Total	Male	Female
N	**128**	**16**	**112**
Average age	41.9	46.9	41.2
Education Level	**%**	**%**	**%**
Illiterate	3.91	12.50	2.68
Read and write	5.47	18.75	3.57
Class 1-5	3.91	6.25	3.57
Class 6-8	25.78	12.5%	27.68
Class 9-12	59.38	50.00	60.71
Graduation	1.56	0.00	1.79
Above Graduation	0.00	0.00	0.00
Social groups	**%**	**%**	**%**
Scheduled Caste	20.31	37.50	17.86
Scheduled Tribes	50.78	62.50	49.11
OBC	28.91	0.00	33.04
General	0.00	0.00	0.00
Religion	**%**	**%**	**%**
Hindu	100.00	100.00	100.00
Islam	0.00	0.00	0.00
Christian	0.00	0.00	0.00
Family			
Family size (Nos.)	4.8	6.0	4.6
Average Adult Male (Nos.)	1.8	2.6	1.7
Average Adult Female (Nos.)	1.7	1.9	1.7
Average Children Male (Nos.)	0.8	1.1	0.7
Average Children Female (Nos.)	0.5	0.5	0.5
Income			
Average income in the last 12 months from the selected activity	38,437.6	43,437.5	37,723.3
Average income in the last 12 months from agriculture	43,364.1	35,937.5	44,425.0
Average income in the last 12 months from any other sources	64,156.3	39,375.0	67,696.4
Average total HH income	1,47,562.4	1,20,000.0	1,51,426.2
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**
Yes	5.47	25.00	2.68
No	92.19	68.75	95.54
Went before, not now	2.34	6.25	1.79

Planters and Rearer:

98% are planters and 2% rearers in the sample. The average area under the Eri food plant plantation is 0.18 ha of land. 30% said that they source Eri cocoon from the sericulture department, 52% source it privately and 18% said that they use both sources. 38% rear the silkworm in living houses, 50% in rearing houses made by themselves, and 12% in rearing houses received from APART.

	Production		Increase (%age)	Current price	Sale
	Before APART	Current			
Seed Cocoon	1170 kg	1503 kg	28.46%	Rs. 608 per kg	Rs 913,824.00
Cut / Commercial Cocoon	596 kg	795 kg	33.39%	Rs. 738 per kg	Rs 586,710.00
Pupa	493 kg	650 kg	31.85%	Rs. 535 per kg	Rs 347,750.00
Dfls	3100 grams	6135 grams	97.90%	Rs. 9.2 per grams	Rs 56,442.00

93.3% have rearing appliances. Rearing appliances for Eri silkworms include a rearing house with good ventilation and fly-proofing, trays for young worms (tray rearing), bamboo or plastic mountages for spinning, bamboo poles for hanging leaf bunches (bunch rearing) and containers with water for feeding.

They sourced the disease-free lays (dfls) - 77% through their own production, 11.7% said that they purchase and another 11.7% said that they do both.

48% farmers have their own machines, 32% share machines with neighbors, 6% with FIG/FPCs and 13% hire machines.

Spinners:

The spinners source their cocoons- 64.7% from their own production, 16.2% purchase, 14.7% said that they have their own production as well as they purchase, while only 4.4% obtain from the sericulture department.

They spin with the help of Takuri (the Spindle, a spinning tool used to prepare the fibers, as they are loose and coarse), which is a popular method (40%), Spinning Machine (13%) and 47 % depending on both the methods.

Among the ones who use spinning machines (N=41) - 46.3% have their own machines, 7.3% hire machines, 36.6% share machines with neighbors and 9.8% share machines with FIG members. Out of 22 respondents who hire and share machines, 16 got support from APART, 5 from FPCs and one from Sericulture Department.

	Average Production		Increase	Amount sold	Current price
	Before APART	Current			
Eri Silk Yarn produced annually	10.81 kg	16.43 kg	5.62 kg	13.84 kg	Rs 1472.58/ kg

Out of 128 Eri Cultivators, only 48% mentioned receiving a rearing house.

28% of the respondents had been to exposure visits. The respondents mentioned they learnt about Technology (22%), Production (14%), Marketing (11%), Management (6%), and Others (47%). 84% of the respondents (N=128) mentioned receiving training.

Table 78: *Respondents had been to training - Sericulture (Eri)*

Training Type	Yes (%)	Average No. of days of training	Useful (out of those who attended) (%)
Plantation	36	15.1	95%
Rearing	65	10.0	82%
Spinning	60	5.9	80%

FIG and FPC: 70% of the respondents are members of FIG. Out of those who are part of FIG, 75% of them mentioned that the FIG was a part of FPC too. 41% are members of FPC. 22% marketed through FPC.

Grievance management: More than 70% eri silk farmers are aware of the grievance registration process and only 16.4% have ever registered their grievances.

3.4.1.5.2 Muga Silk

The study included 133 respondents from four districts- Jorhat, Kamrup, Lakhimpur and Sivasagar; amongst them 27% are Commercial Muga Rearers, 26% are Adopted Seed Rearers, 19% are Private Graineurs, and 28% are Reelers. All the reelers are females. In the sample, 78 (59%) respondents were male and 55 (41%) were female.

Background Information of Muga Silk Farmers:

Table 79: *Background information - Muga Silk Farmers*

	Muga Silk		
	Total	**Male**	**Female**
N	**133**	**78**	**55**
Average age	45.2	51.0	37.0
Education Level	**%**	**%**	**%**
Illiterate	3.76	1.28	7.27
Read and write	0.00	0.00	0.00
Class 1-5	4.51	5.13	3.64
Class 6-8	16.54	12.82	21.82
Class 9-12	69.92	75.64	61.82
Graduation	5.26	5.13	5.45
Above Graduation	0.00	0.00	0.00
Social groups	**%**	**%**	**%**
Scheduled Caste	22.56	11.54	38.18
Scheduled Tribes	13.53	14.10	12.73
OBC	60.15	70.51	45.45
General	3.76	3.85	3.64
Religion	**%**	**%**	**%**
Hindu	100.0	100.0	100.0
Islam	0.0	0.0	0.0
Christian	0.0	0.0	0.0
Family			
Family size (Nos.)	6.1	7.1	4.8
Average Adult Male (Nos.)	2.0	2.4	1.4
Average Adult Female (Nos.)	1.8	2.2	1.3
Average Children Male (Nos.)	1.2	1.3	1.1
Average Children Female (Nos.)	1.1	1.2	1.1
Income			
Average income in the last 12 months from the selected activity	1,52,676.7	2,01,910.3	82,854.5

	Muga Silk		
	Total	**Male**	**Female**
N	**133**	**78**	**55**
Average income in the last 12 months from agriculture	92,048.9	1,16,929.5	56,763.6
Average income in the last 12 months from any other sources	88,022.6	89,551.3	85,854.5
Average total HH income	3,32,748.1	4,08,391.0	2,25,472.7
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**
Yes	0.00	0.00	0.00
No	93.23	88.46	100.00
Went before, not now	6.77	11.54	0.00

86% said that their income increased after being associated with APART, with 55% stating that increase was 25%-50%.

Support received: Fifty-six percent have received rearing houses from APART. Out of all, 35% went for exposure visits. Out of those reelers who had gone for exposure visits, 48% mentioned gaining knowledge on Technology for Muga activities, 34% on Muga Production, 28% on Marketing of the produced Muga and 20% on Management of the trade /business and others (28%).

Table 80: *Respondents had been to training - Sericulture (Muga)*

Training attended	Yes (%)	Average number of days	Useful -Yes
Commercial Muga Rearers	32%	11.2 (Median =7.0)	84%
Muga Adopted Seed Rearers	24%	7.9 (Median =2.0)	88%
Private Graineurs	27%	7.2 (Median =6.0)	93%
Reelers	29%	7.3 (median =6.0)	100%

FIG /FPC: 46% are members of FIGs, 89% said that their FIGs are part of an FPC. 66% are members of FPCs and 53% are marketing through FPCs.

Table 81: *Benefits of joining FPC - Muga*

Benefits of joining FPC	Total	Male	Female
N	**87**	**57**	**30**
Food plant raising	71%	65%	83%
Supply of Sapling for plantation	49%	60%	30%
Assistance for Silk worm rearing for cocoon production	46%	58%	23%
Supply of Muga Seeds/dfls	40%	49%	23%
Financial management	36%	51%	7%
Organized marketing of the products	25%	33%	10%
Community procurement	24%	30%	13%
Training	24%	26%	20%
Fertilizers & manures	18%	23%	10%
Cocoon drying machine	18%	18%	20%
Spinning/reeling machine	17%	14%	23%
Preprocessing activities in weaving	8%	11%	3%

Commercial Muga Rearers- Among the commercial Muga rearers, all respondents are planter-cum-rearers and 44% are also planter-cum-reelers, all of whom are men. On average, the Som plantation area maintained by each farmer is about 0.5 hectares. For seed/egg procurement, 97% source from the Sericulture Department, 53% from other government agencies, 56% from their own sources, and only 3% from private suppliers. In terms of feed, 72% of the respondents procure Som or other host plants from government sericulture farms, 58% from private sources, 56% through APART, 19% from SERI VGR farms, and another 19% from their own sources. The average number of Muga-Polu crops reared per year is 576.9, with an average seed/DFLs output of 2,343.1 grams annually. Regarding cocoon stifling, 75% of respondents undertake the process, using traditional hot-air drying (63%) and sun drying (37%). Weather continues to be a challenge, with 39% identifying extreme heat as a key risk in the last year. Losses from pests and diseases were reported as heavy by 14% of farmers and moderate by 53%.

	Production		Increase	Selling price (Rs.)	Sale (Rs.)
	Before APART	Current			
Commercial (Reeling) Muga Cocoons produced per year	3522.2 Nos.	5141.7 Nos.	1619.5	23,055.6 per 1000 Nos	1,18,544.98
Pupa (edible) produced per year	4.4 kgs	7.6 kgs	3.2	2,244.4 per kg	17,057.44

Muga Adopted Seed Rearers- Among the respondents, 35 farmers (26.3%), are engaged as adopted seed rearers, with a majority (27) being men. All of them source seed/eggs from the Sericulture Department, while 54% also rely on their own sources. Number of crops (MUGA-Rearing) done per year is 4002.9. Every farmer has a Jali house for cocoon spinning, produces seed cocoons and sells them, with all rearing activities carried out in their own plantations. Despite these practices, 83% reported experiencing moderate losses of Muga silkworms due to pests and diseases.

	Production		Increase	Selling price (Rs.)	Sale (Rs.)
	Before APART	Current			
Seed/dfls reared/cropped per year	3543 gms	4,760 gms	1217 gms	-	-
Seed cocoons produced per year	4057 (Nos)	7,343 (Nos)	3286 (Nos)	9,014 per 1000 Nos	66,189.80

Private Graineurs- 18.8% are private graineurs, of which 18 are male. All of them produce dfls/seeds, with production increasing from 3,720 earlier to 5,880 at present; however, none of them sell DFLs. All produce seed cocoons, and the selling price of cut cocoons is Rs. 5,240. None of the respondents are engaged in spinning Muga cut cocoons. While 76% have a grainage facility, only 20% sell Muga spun silk to others, at an average price of Rs. 7,448.

	Production		Increase	Selling price (Rs.)	Sale (Rs.)
	Before APART	Current			
dfls/seeds produced per year	3,720	5,880	2,160	-	-
Cut cocoon				5,240	
Muga spun silk/Kg	-	-	-	7,448	-

Reelers- Out of 133 farmers surveyed, 37 (27.8%) are reelers, all of whom are female. All reelers reported stifling their cocoons by sun drying, and 97% use traditional reeling or spinning equipment. About 57% of the reelers mentioned that they receive support from the Sericulture Department. Using BHIR, they produce on an average 2,739.2 grams of yarn per year.

	Production		Increase	Selling price (Rs.)	Sale (Rs.)
	Before APART	Current			
Raw silk produced per year in kgs	2.4 kgs	4.1 kgs	1.7	-	-
Muga Reeled Silk/ kg				11,632.4	
Muga Spun Silk/ kg	-	-	-	8,156.5	-

Grievance Management- 74% are aware of the grievance mechanism of APART.

3.4.1.5.3 Handlooms and Textiles

Silk Rearing and Weaving are the second most important source of livelihood for the rural population of Assam while agriculture remains the first. Both Eri and Muga Silk are indigenous to Assam, and they have a long history of contribution to rural economy of the region. Golden (Muga) silk occupies a very important place in the life and culture of Assamese people. Among all the silk fabrics, Muga silk is supposed to be one of the costliest fabrics in the textile world and it has huge potential in the global market. Similarly, Eri silk which is also termed as Ahimsa Silk has also a huge demand in the global market.

The OPIU - Directorate of Handloom & Textiles implemented project interventions in 11 districts of Assam (Kamrup, Sonitpur, Biswanath, Jorhat, Majuli, Sibsagar, Charaideo, Lakhimpur, Dhemaji, Morigaon, Darrang) to enable entrepreneurs and weavers of the Handloom value chain with Muga and Eri Silk commodities in the targeted clusters to take advantage of the rapidly changing market demand, and enhance resilience of for increasing production and support end to end interventions of Silk Value Chain and strengthen the Silk sector in Assam.

The major interventions planned under Handloom Value Chain were: (i) organizing producers into producer groups, (ii) technical assistance for improved skill and design development, (iii) facilitating technology upgradation and access to finance for value chain stakeholders and (iv) upgrading existing marketing outlets, developing market channels and launching branding campaigns.

Major activities undertaken include (i) market assessment, (ii) intensive awareness programs, (iii) training and capacity building of staff, (iv) cross-learning workshops, (v) skill upgradation training for weavers, (vi) exposure visits for weavers and officers, (vii) marketing linkages with ARTFED and AGMC, (viii) organizing trade fairs and buyer-seller meets, (ix) provisioning improvised looms, accessories and jacquards and (x) branding campaigns, new designs and value-additions.

Significant progress was made in increasing Muga and Eri silk fabric production, formation and registration of Farmer Producer Companies (FPCs), constructing Common Service Centers (CSCs) covering a substantial number of beneficiaries. Through APART, the Directorate of Handloom & Textiles have worked with 7000 weavers of which 99% are women, 33.7% belonging to indigenous groups. 12 Farmer Producer Companies (FPCs) have been successfully registered to strengthen farmer collectives and streamline production and marketing and 4 Common Service Centers (CSCs) have been established to support the operations and provide shared facilities to the stakeholders involved.

Endline Results

A sample of 133 weavers participating in the APART program was interviewed from six districts (Biswanath, Jorhat, Kamrup, Lakhimpur, Sivasagar and Sonitpur). In the sample 100% respondents are females, indicating that women dominate the home-based weaving sector of Assam. 29.3% belonged to indigenous groups.

Background Information of Weavers:

***Table 82**: Background information - Weavers*

	Handloom		
	Total	**Male**	**Female**
N	**133**	**0.0**	**133**
Average age	40.9	0.0	40.9
Education Level	**%**	**%**	**%**
Illiterate	9.77	0.0	9.77
Read and write	6.02	0.0	6.02
Class 1-5	6.77	0.0	6.77
Class 6-8	24.81	0.0	24.81
Class 9-12	47.37	0.0	47.37
Graduation	5.26	0.0	5.26
Above Graduation	0.00	0.0	0.00
Social groups	**%**	**%**	**%**
Scheduled Caste	30.08	0.0	30.08
Scheduled Tribes	29.32	0.0	29.32
OBC	36.09	0.0	36.09
General	4.51	0.0	4.51
Religion	**%**	**%**	**%**
Hindu	100.0	0.0	100.0
Islam	0.0	0.0	0.0
Christian	0.0	0.0	0.0
Family			
Family size (Nos.)	4.7	0.0	4.7
Average Adult Male (Nos.)	1.8	0.0	1.8
Average Adult Female (Nos.)	1.7	0.0	1.7
Average Children Male (Nos.)	0.7	0.0	0.7
Average Children Female (Nos.)	0.5	0.0	0.5
Income			
Average income in the last 12 months from the selected activity	35,782.0	0.0	35,782.0
Average income in the last 12 months from agriculture	40,195.5	0.0	40,195.5
Average income in the last 12 months from any other sources	36,311.3	0.0	36,311.3
Average total HH income	1,12,288.7	0.0	1,12,288.7

	Handloom		
	Total	**Male**	**Female**
N	**133**	**0.0**	**133**
Went to other districts / state in search of work during last 3 years	**%**	**%**	**%**
Yes	4.51	0.0	4.51
No	94.74	0.0	94.74
Went before, not now	0.75	0.0	0.75

Looms: On an average the households have 1.2 looms which are traditional ones. 96% uses simple frames, 6% uses pit looms and only 1% uses wooden fly shuttle frames.

Designing: In terms of designing, 97% uses traditional designs and 3% uses jacquard draw buoy. 8% said that they have jacquard with them. A whopping 82% said they use CATD software.

Raw materials: The primary raw materials used by the weavers are - eri (8%) and cotton (92%).

Training: 62% received training on weaving, 60% on awareness, 13% on market linkages, 12% on use of new accessories, 10% on designing. Only 1% undertook exposure visits.

	Production		Increase	Selling price (Rs. Per m)	Sale (Rs.)
	Before APART	Current			
Length of fabric produced in last 1 year	8 meters	9 meters	1 meter	250	2,250

Types of garments produced: 100% weavers produce mekhla-chador and 95% produce gamusas. Some number of sarees and stoles are also weaved.

Marketing: 87% sell through private traders, 16% through FPCs, 5% through Reshom Haat and 3% through fairs and exhibitions. The weavers have attended an average of 1.8 exhibitions in the last one year.

FPC: Only 33% are members of FPCs for more than 4 years.

Table 83: *Benefits of joining FPC - Handloom*

Benefits of joining FPC	Percentage
Improved collective decision-making	85
Stabilize prices by reducing mediators	45
Access to credit and insurance	28
Access to newer markets by pooling resources	19
Opportunities for cross-learning	2

Half of the respondents reported an increase in their income after being associated with APART. Of these, 68% experienced an increase of less than 25%, while 12% reported an increase of more than 50%.

The two departments sericulture and handloom and textiles have not worked in tandem. The beneficiaries received training on dyeing and designing, which they found very useful but the training to use the machines were lacking. The weavers mostly work with cotton and few with tussar textiles. The use of eri and muga silk is hardly there. Moreover, there the marketing channel needs to be improved and more varied products to be introduced.

Grievance management: 68% are aware of the grievance redressal mechanism of APART.

3.4.2 C2: Product aggregation and Sale through Producer Associations and setting up market intelligence

The objective of this sub-component is to organize the producers' groups into farmer producer organizations (FPOs), and develop and strengthen their capacity and skills to more effectively link to input and output markets. The FPOs will be provided investment support by establishing common service Centers (CSCs).

3.4.2.1 C2.1: Product aggregation and sale through Producer Associations

There are **125 FPCs** (Agri & Horti: 88, Fish: 26, Silk: 11) registered under APART with 60,573 shareholders (33% women). These are being formed and supported by different agencies.

- **37 CSCs functional** (Agri-horti: 10, Fishery: 22, Silk: 5)
- Equipped with need-based infrastructure and machinery/ equipment
- Facilitated for aggregation, post-harvest handling, value addition etc.
- Fully women operated 4 FPCs/CSCs *(2 on Silk Sector and 2 on Agri/Horti.)*

3.4.2.1.1 Farmer Producer Company (FPC)

Farmer Producer Companies (FPCs) are important in Assam for empowering small and marginal farmers by providing collective market access, improved bargaining power and better access to inputs, knowledge, technology and financial services. They achieve this by forming a formal, collective entity that helps farmers overcome challenges like high production costs and weak market links, thereby boosting their incomes and overall livelihoods through shared resources and business development.

APART has initiated the process to mitigate the constraints faced by farmers by strengthening backward and forward linkages to integrate producers and markets and make the value chains compact and efficient. To achieve this goal, APART has promoted 125 FPCs across three significant value chains, namely Agri-Horti, Fishery and Silk, which are owned and managed by farmers. Through this FPC intervention, APART has also given importance to developing the capacity and skills of FPC members in post-harvest management, governance, value addition and marketing of the produce for better price realization of FPC products. The business development support extended from APART is multi-pronged for the overall growth and sustainability of the FPCs.

As part of the endline assessment of APART, a comprehensive survey was conducted to assess the status of FPCs supported by the project. The study covered 100 FPCs across 15 districts of Assam - namely Barpeta, Biswanath, Cachar, Darrang, Goalpara, Golaghat, Jorhat, Kamrup, Kokrajhar, Lakhimpur, Morigaon, Nagaon, Nalbari, Sivasagar and Sonitpur.

Relevance

The establishment of Farmer Producer Companies (FPCs) under the Assam Agribusiness and Rural Transformation Project (APART) marks a critical step toward enhancing the collective strength and competitiveness of small and marginal farmers. By bringing together fragmented producers under a formal institutional framework, FPCs have addressed long-standing challenges of weak market linkages, high transaction costs and limited access to technology, finance and inputs.

Across 15 districts, 100 surveyed FPCs represented an extensive outreach, covering an average of 18.67 villages and 502 members per company, of whom about 33% were women - a noteworthy gender inclusion outcome. The average age of the FPC was 4.13 years indicates that these are young but rapidly institutionalizing collectives formed largely during or immediately after the COVID-19 disruptions.

Socially, the member composition -61 SC, 91 ST, 175 OBC/MOBC and 174 General members per FPC reflects inclusive participation across communities, ensuring equitable access to collective benefits. The average pooled landholding of 309.46 hectares per FPC represents significant aggregation of small and marginal farmers (average individual holding: 0.66 ha), thereby achieving economies of scale in input procurement and marketing.

In terms of focus commodities, the FPC portfolio demonstrates strategic diversification: Rice (35%), Fishery (26%), Mustard (13%) and Maize (7%) dominate, alongside niche sectors like Muga (5%) and Eri (4%) silk, banana, potato and ginger. This commodity mix reflects APART's focus on resilience-building through diversified value chains that integrate food security, traditional livelihoods and market-oriented agribusiness.

Efficiency

The FPCs have demonstrated moderate efficiency in institutional functioning and statutory compliance but still face constraints in capitalization and grassroots engagement.

- **Capital structure**: Average authorized capital stood at Rs. 11.09 lakh, while paid-up capital was Rs. 4.52 lakh, indicating undercapitalization that limits investment and access to credit.
- **Governance:** Boards averaged 5.93 members, of which only 1.25 were women, showing a gender imbalance in leadership. Representation of SC/ST groups was limited, with less than two members from these categories on average.
- **Compliance:** Governance and documentation practices were generally strong 100% of FPCs had PAN, 99% GST registration, and nearly all maintained mandatory records (board minutes, cash books, passbooks, etc.). However, secondary documentation like asset registers (51%) and incorporation documents (50%) require strengthening.
- **FIG engagement**: Weak member-level interaction remains a concern - 92% of FIGs meet less than monthly, indicating limited grassroots participation.
- **Social audits and grievance systems**: Encouragingly, 95% have Social Audit Committees and 100% have Grievance Committees, though grievance redressal remains low (only 7% reported complaints). 85% have Internal Complaints Committees (ICC), signaling progress in gender-sensitive governance.

While internal controls are improving, there is a need for enhanced financial planning, participatory decision-making, and stronger capitalization for long-term operational efficiency.

Effectiveness

The FPCs have begun to show tangible improvements in business operations, market access, and income generation, although disparities in scale and institutional maturity persist.

- **Financial trajectory:** Average turnover grew from Rs. 14.88 lakh (2022-23) to Rs.17.53 lakh (2024-25), marking a 17.8% increase, while profits rose by 15.3%, reflecting better market linkages and operational learning.
- **Market access:** 63% of FPCs have accessed new markets, including online platforms; 48% improved credit access, a key step toward business expansion.
- **Institutional capacity:** Training coverage was high for operational skills (95% trained in machinery management) and governance (85% in FPC management and finance). However, only 7% of members underwent formal training, suggesting limited outreach.

- **Financial literacy:** 75% organized KCC awareness camps, but only 55 members per FPC on average accessed Kisan Credit Cards, showing underutilization of institutional credit.
- **Business planning:** Only 8% of FPCs set revenue targets, signaling weak financial goal-setting and monitoring mechanisms.

Overall, FPCs have effectively increased market participation and financial turnover, though broader institutionalization and systematic financial planning are necessary to sustain performance.

Sustainability

Sustainability of FPCs hinges on continued capacity-building, market integration and policy support. The APART project has facilitated ecosystem strengthening through initiatives like FPC Conclaves and linkage with state schemes such as the MMIU’s grading and incentive scheme (Rs. 15 lakh support).

FPCs’ growing compliance with MSME registration (90%) and FSSAI certification (98%) suggests deepening formalization, positioning them for sustainable agribusiness engagement.

FPCs have the potential to function as procurement Centers, with required machineries FPCs can effectively function as a procurement Centers.

However, for long-term sustainability, FPCs require:

- Strengthened backward linkages with suppliers and credit institutions;
- Forward linkages with processors and exporters;
- Diversified revenue streams from value addition, branding and aggregation services;
- Inclusion in digital market ecosystems and e-trading platforms.

Impact

The APART-supported FPCs have generated measurable livelihood and productivity gains among members.

- **Price realization:** Nearly 69% of farmers cited better price realization as the key benefit, followed by 19% improved market access and 11% reduced middlemen dependency.
- **Income trajectory:** Rising turnover and profitability trends point toward a cumulative income uplift among participating farmers.
- **Institutional development:** Establishment of robust systems for compliance, financial reporting, and social accountability indicates enhanced organizational maturity.

These outcomes align strongly with APART’s objectives of integrating producers into efficient value chains, promoting inclusive agribusiness, and building resilient rural economies.

Equity

FPCs under APART have made notable strides in inclusion, particularly of women and marginalized groups.

- **Women’s participation:** Women constitute roughly one-third of total membership and several women-led FPCs such as *Srijoni* and *Jaymoti* demonstrate successful leadership models.
- **Social inclusion:** Active participation from SC, ST and OBC farmers (collectively 65% of members) reinforces the equity focus.

- **First-time inclusion:** Many eri and muga silk producers traditionally small, unorganized artisans were mobilized into FPCs for the first time, ensuring equitable integration of indigenous livelihoods into formal markets.
- **Gender-responsive governance:** The presence of ICC in 85% of FPCs reflects institutionalization of gender safeguards, though women's representation at the Board level (21%) remains limited.

The FPC model thus contributes not only to economic empowerment but also to social equity and gender mainstreaming in rural enterprise development.

The FPC intervention under APART has successfully laid the foundation for a vibrant ecosystem of farmer-owned agribusinesses in Assam. While the institutions are still young, they have achieved notable progress in collective marketing, financial compliance and member benefits. To consolidate gains, future efforts should emphasize:

- Deepening of financial and digital literacy
- Expanding credit and investment access
- Strengthening the functionality of CSCs
- Enhancing women's leadership representation and
- Promoting stronger value chain integration

FPCs have been able to mobilize resources from other sources quite effectively. For instance, 22 FPCs have received village-level farm machines support from the Central Government scheme, 5 fish FPCs have received solar-aerators from Assam Energy Development Agency, one FPC dealing with rice-milling has received support from Selco Foundation and has connected itself to the solar grid, thereby largely thereby reducing electricity costs. The FPCs have received input licenses from the Directorate of Agriculture. Sericulture FPCs have received marketing support like fairs, export opportunities from the Directorate.

FPCs under APART have successfully institutionalized collective agribusinesses, improving price realization, compliance and inclusivity. To consolidate gains, future focus should be on capacity-building, financial planning, digital integration, CSC functionality and women's leadership. FPCs now form a strong foundation for inclusive, market-oriented and sustainable rural enterprise development in Assam.

3.4.2.1.2 Common Service Center (CSC)

A total of **20 Common Service Centers (CSCs)** across 10 districts were covered under the survey.

On average, each CSC/FPC had around 445 member farmers. The average landholding of member farmers under each FPC is 308.23 hectares. Each CSC is established on an average area of 1,095 sq ft.

Activities performed by FPC through CSC- The assessment found that the FPCs undertake a range of activities through their respective CSCs. Among these, market linkage emerged as the most common activity, reported by 16 FPCs, followed by aggregation (16) and value addition through primary processing (10). Activities such as input–output marketing were undertaken by 8 FPCs, while a smaller number were involved in facilitating credit linkage (5), training (4), and insurance services (3). This indicates that while market-oriented and aggregation-related functions are relatively well established, financial and capacity-building activities through CSCs remain limited and could benefit from further strengthening.

Focus commodities of FPC/ CSCs- The analysis of focus commodities reveals that the activities of the FPCs and their respective CSCs are primarily centered around fish, which serves as the key commodity for 12 FPCs. This is followed by rice, identified as the focus commodity for 4 FPCs. A smaller number of FPCs are engaged in commodities such as banana (2), mustard (1), and muga (1). This distribution indicates a stronger orientation of FPC operations toward fisheries and paddy-based value chains, reflecting the regional production patterns and market potential.

Table 84: *Focus commodity and other commodities of CSCs*

Focused commodities	Number of CSCs
Rice	4
Mustard	1
Banana	2
Fish	12
Silk (Muga)	1
Other commodities of FPC	**Number**
Agri (Rice, Maize, Mustard)	21
Pulses (Black gram, Pea, Lentil, Rajma)	6
Fruits (Banana)	2
Vegetables (Brinjal, Cabbage, Cauliflower, Potato, Pumpkin, Tomato)	18
Spices (Ginger and Turmeric)	3
Fish	2
Pig	1

Table 85: *Processed/ semi-processed products handled by the CSCs*

Processed/ semi processed products	Number of CSCs
Rice Mill	7
Mustard Mill	8
Fish Feed Mill	9
Fish Seed Bank	6
Silk Production unit	1
Others	1

Services provided by CSCs and benefits to member farmers- The survey highlights both the range of services offered by CSCs and the tangible benefits accrued by member farmers.

All 20 CSCs reported supporting farmers in **selling their produce in rural haats or other suitable markets**, indicating strong engagement in local market facilitation. Additionally, 18 CSCs enable farmers to sell directly to marketing license holders, traders, exporters, processors, or retail chain operators, thereby opening avenues to organized and higher-value markets. Correspondingly, 15 CSCs noted that farmers have benefited from improved market linkages, enabling access to better prices and more stable marketing opportunities.

Ten CSCs are engaged in **input marketing or supply of inputs**, enabling farmers to access quality inputs locally. Of these, nine CSCs reported that farmers have started using improved seed varieties and higher-quality inputs, while five CSCs noted a corresponding reduction in input costs, reflecting more efficient and cost-effective farming practices.

12 CSCs undertake **value addition** through primary processing, contributing to enhanced product quality and better price realization. Of these, 11 CSCs suggested an upward shift in post-harvest handling and processing.

Furthermore, in terms of benefits, all 20 CSCs reported that farmers had **learnt new production technologies**, reflecting improved awareness and adoption of modern farming methods. In addition, six CSCs noted that farmers were able to **secure better price premiums** for their produce, indicating improved market outcomes and income potential.

Overall, the services provided by CSCs demonstrate a strong focus on enhancing market linkages, facilitating access to quality inputs, and supporting value addition through processing, all aimed at improving farmer incomes and long-term sustainability. Collectively, these outcomes suggest that CSC interventions have not only strengthened farmer capacity and promoted the adoption of modern technologies but also enhanced market access and generated tangible economic benefits for the farming community.

Procurement and Sales through CSCs in FY 2024-25 - The 7 Agri-horti CSCs collectively reported an annual sale of 350 MT of focus commodities such as rice, mustard, and banana, generating a revenue of approximately Rs 86.9 lakhs. In addition, the CSCs sold 245 MT of processed/ semi-processed products, by-products, other commodities, etc. generating an additional revenue of Rs 97.5 lakhs. Together, these accounted for a cumulative sale of 595 metric tons and a total revenue of about Rs 1.84 Crore during 2024-25.

The 12 Fish CSCs collectively reported sales of 555 tons of fish during the year 2024-25, generating a total revenue of approximately Rs 5.28 Crore. In addition to fish, these CSCs also engage in trading other commodities such as paddy, maize, mustard, potato, cabbage, cauliflower, black gram, turmeric with a combined sales volume of about 238 tons and revenue of Rs 80.9 lakhs.

The surveyed Silk CSC sold 200 pieces of Eri Gamusa, 21 sets of Mekhala Chadar, 25 pieces of Eri Shawl, 25 pieces of Eri Scarves, 215 pieces of Eri Stole and 200 kgs of Eri raw silk, generating an income of Rs 16 lakhs.

Table 86: *Commodity-wise Production and Sales through CSCs*

Focused Commodities	Amount (Tones)	Amount sold (Tones)	Total price (Rs in lakhs)
Rice	290	270	62.1
Banana	65	65	16.5
Mustard	20	15	8.3
Fish	555	555	528
Muga	30	30	0.6
Total	**960**	**935**	**615.5**
Processed Commodities	**Amount (Tones)**	**Amount sold (Tones)**	**Total price (Rs in lakhs)**
Processed rice	20	15	4.5
Rice polish		5	0.5
Mustard oil	5	2	2.4
Total	**25**	**22**	**7.4**
By-Products	**Amount (Tones)**	**Amount sold (Tones)**	**Total price (Rs in lakhs)**
Mustard cake		3	0.3
Total		**3**	**0.3**

Focused Commodities	Amount (Tones)	Amount sold (Tones)	Total price (Rs in lakhs)
Other commodities	**Amount (Tones)**	**Amount sold (Tones)**	**Total price (Rs in lakhs)**
Paddy	110	25	25.3
Rice	166	166	39
Maize	20	20	8.6
Mustard	66	66	36.4
Black gram	27	27	13.9
Brinjal	5	5	0.5
Cabbage	45	45	2.3
Cauliflower	45	45	2.4
Potato	47	47	6.7
Pumpkin	12	12	1.8
Turmeric	5	5	1
Fish	20	20	40
Total	**568**	**483**	**177.9**
Grand Total	**1553**	**1443**	**801.1**

3.4.2.1.3 Custom Hiring Center (CHC)

A Custom Hiring Center (CHC) under APART is a facility that provides farm machinery and equipment on a rental basis to farmers, especially small and marginal ones. These Centers are run by Farmer Producer Organizations (FPOs) and provide access to expensive machinery that individual farmers cannot afford. They are established to promote farm mechanization and can also offer training on machinery repair, financial management and post-harvest management to FPO members. APART has facilitated 46 such CHCs. APART had provided a range of 8-10 machines to the CHCs namely, Rotavator, Electric Power Tiller/Weeder (MP), Drum Seeder, Transplanter, Electric Battery-Operated weeder, Reaper, Multi-Crop combine harvester with straw management system, Pulverize and Rice Mill.

Access to Custom Hiring Centers (CHCs) remains limited for most farmers despite their potential to enhance mechanization and reduce production costs. The primary difficulty lies in distance and location - many CHCs are not situated close to farming communities, making it hard for farmers to reach them, particularly during peak seasons. Vegetable farmers (24%) and paddy farmers (21%) said that there is a CHC available nearby. Even where CHCs exist, machine availability is often inadequate or mismatched with crop-specific needs.

Additionally, high local rental charges, transportation costs and limited awareness or coordination mechanisms further restrict usage. As a result, small and marginal farmers, who could benefit most from shared machinery access, continue to face barriers in adopting mechanized practices efficiently and cost-effectively.

Table 87: *Custom Hiring Center - Issues and Key Observations*

Issue	Key Observations
Difficult to access from community	Most reported in *Pulses (50%)* and *Fruits (59.8%),* likely due to distance or limited awareness.
High price charged locally	Prominent for *Maize (46.2%)* and *Fruits (32.2%)*, showing higher private rental costs.
CHCs not close by	A dominant constraint, especially *Potato (60%)*, and *Mustard (57.7%)*.

Issue	Key Observations
Machines not available in CHCs	Common across commodities - around *20–22%* reported this problem, peaking at *Pulses (22.5%)*.
High transportation cost	Less severe overall, but still relevant for *Maize (15.9%)* and *Fruits (12.2%)*.

3.4.2.2 C2.2: Setting-up Market Intelligence Cell

Agricultural Market Intelligence Unit (AMIU) was established at Assam Agricultural University, Jorhat in January, 2021. AMIU collects market information from 91 markets of Assam for 89 commodities with the help of Field Data Enumerators (FDEs) deputed in 17 APART districts of Assam on the day of the market and updates on the website on the same day.

To enable farmers, get real time information on prevailing prices, a backend mobile application was developed, which is connected to AMIU website. The price information collected is entered by FDEs onto backend application and the data gets uploaded into the portal without any time lag. FDEs from each district submit a weekly report that includes price trends, arrival trends, and key insights on market conditions.

With the introduction of the AMIU, the market data collection in 17 districts of Assam has become a lot more efficient, timely and precise. The valuable market data set derived daily price information for the farmers and traders has helped them in taking informed decision on sale and procurement of various agricultural commodities. Satisfied with data quality, the AGMARKET even synchronized the AMIU market data into their portal and are available daily. The farmers have received information on the same day. Though this service has discontinued with the end of the project.

Advantages of AMIU information- The primary objective of this AMIU is to establish a standard process of collecting and disseminating agricultural market data to ensure timely, accurate, and relevant information dissemination to all stakeholders. By facilitating data-driven decision-making, the Agricultural Market Intelligence Unit (AMIU) aims to:

- Assist farmers in securing better prices by identifying profitable markets.
- Enable farmers and other stakeholders to make informed decisions based on real-time market trends.
- Availability of prices regularly prevents exploitation of farmers by middlemen, and it also improves bargaining power of the farmers.
- Provide policymakers with the necessary insights to support agricultural marketing and agricultural planning.
- AMIU seeks to fill information gaps in market systems, reduce asymmetric information, and strengthen the transparency and competitiveness of agricultural markets.

The market information is being disseminated using:

1. Official website
2. Mobile App for Farmers
3. SMS Alerts
4. Linking with AGMARKNET Portal of Govt. of India
5. WhatsApp Groups
6. Social media platforms
7. Market Black boards
8. Ticker Boards
9. Doordarshan Broadcasts

The end-line study attempted to collect information on MSP from the farmers across different commodities.

***Table 88:** Knowledge about MSPs*

SN	Commodities	Knowledge about MSP (INR/ kg)
1	Paddy	22.8
2	Maize	19.3
3	Mustard	60.3

***Table 89:** Sources of information on MSPs*

SN	Mediums	Paddy (%)	Maize (%)	Mustard (%)
1	Bulletin Boards	57.9	38.6	73.2
2	Notices in Government Offices	53.7	26.5	47.0
3	Word of mouth	68.6	88.6	69.0
4	News Papers	15.8	0.0	21.4
5	TV channels	15.8	6.1	10.7
6	Radio	4.7	0.0	3.6
7	SMS	1.4	1.5	4.2
8	Voice mails through mobile phones	11.6	11.4	14.3

3.4.3 C3: Facilitating access to and responsible use of financial services

3.4.3.1 C3.1: Information and Counselling on Financial Services

'Krisarthak' designed and delivered Financial Education and Counselling (FEC) services to facilitate access to and responsible use of financial services by the farm community in Assam under the APART initiative. The objective of the assignment was to develop and implement an ICT-based FEC program for target beneficiaries to contribute to enhancing their financial inclusion, defined as their access to and prudential use of appropriate financial services.

The desired outcome was that the beneficiaries of the FEC program have improved understanding of financial services that they have access to and have strengthened capability to, better access and use these services responsibly. 129,470 farmers were reached out, 51,506 (40%) were women. 58,268 farmers were registered through Bittiya Sakhi chatbot and Kobo App (for base phone users) in 21 districts. 25,420 (43.6%) male farmers, 32,848 (56.4%) female farmers were registered. 52,240 (89.65%) smartphone users and 6028 (10.34%) base phone users. 5 value-chains (Agri/Horti, Fishery, Handloom, Sericulture and Dairy) were covered. APART supported 143 FPCs and 64 DCS were reached out. 411 Bittiya Sahayaks and 6 Zonal Heads were onboarded. Although with the end of the project this support has been withdrawn.

52,240 farmers were registered in the Bittiya Sakhi Chatbot till January 2024. These farmers accessed the video content related to Financial Products and Services. Out of these 48,217 (92.3%) farmers and downloaded the certificates. 6028 base-phone farmers were registered digitally through a separate Kobo app. All these numbers were delivered SMS modules containing FE contents.

By Oct 2024, a total of 21,093 Farmer's Financial Health Survey (FFHS) forms had been filled, with 31,997 counselling calls made (including follow-ups). Of these, 9,581 farmers received first-level counselling, while 547 farmers progressed to second-level counselling. Women farmers accounted for most participants, comprising approximately 81% (7,798) of those counselled, compared to 19% (1,783) male farmers. The outreach spanned across multiple districts, expanding from just 5 districts during the pilot to 16 districts by Cycle 5.

Counselling intensity varied across cycles, with significant peaks in Cycles 4 and 5, where around 4,000 farmers received first-level counselling in each phase.

3.4.3.2 C3.2: Assam Challenge Fund for Innovative Finance in Agriculture

Xamahar, also known as the **Assam Challenge Fund for Innovative Finance in Agriculture (ACFIFA)**, was envisaged to support tested innovations by financial service providers such as banks, MFIs, value-chain financiers, insurance companies and payment service providers that can increase access to financial services, including savings, payments, insurance and credit, for farmers and enterprises engaged in agriculture value chains in Assam.

The program fosters innovative approaches to deliver financial products such as loans, insurance and other financial services to underserved agricultural stakeholders, with a focus on supporting scalable solutions for farmers, FPOs and FPCs. Assam Rural Infrastructure and Agricultural Services (ARIAS) Society is the apex coordinating and monitoring agency for the project.

The goal of the program is to enhance access to financial products and services for farmers, with a specific emphasis on increasing the participation of women in agriculture value chains, targeting at least 30 percent women beneficiaries. The program also aims to improve access to financial products and services for MSME units operating within the agriculture and allied sectors. Additionally, the initiative seeks to support the scaling up of sustainable and commercially viable sub-projects to ensure long-term impact and financial sustainability.

The farmers covered under the Xamahar component were primarily selected from APART-supported Farmer Producer Companies (FPCs).

Under the Xamahar component, eight sub-projects were designed with defined targets for the number of farmers benefiting from access to financial products and services. These sub-projects introduced a range of innovative financial solutions including low-cost peer-to-peer (P2P) lending for potato farmers, parametric insurance for seed germination (mustard seeds), Hospicash insurance, and parametric insurance products for fisheries, among others. There is also evidence of few farmers availing insurance benefits (parametric insurance and death claim).

Across most sub-projects, access to credit emerged as a significant challenge, primarily due to poor credit bureau (CIBIL) scores among beneficiaries, largely resulting from past defaults on microfinance loans. This constrained the ability of financial institutions to undertake credit underwriting, as credit history remains a key criterion for lending decisions. In addition to weak credit bureau scores, another common concern was the creditworthiness of APART-promoted FPOs and FPCs. These institutions were at varying stages of development and required capacity building, improved documentation practices and enhanced awareness among functionaries to enable responsible utilization of financial resources and to strengthen their eligibility for formal finance.

Continuation of certain financial products by farmers beyond the project period has been limited.

Sub-project wise performance of Assam AgriFin- Xamahar on the key indicators is given below.

1. **Number of farmers benefitting from financial products:** The aggregate achievement stands at only 27% of the overall target (62,143 against 2,27,569), indicating significant shortfall.

Table 90: *Farmers benefiting from financial products*

SN	Sub-Project	Number of farmers benefiting from financial products	Number of women farmers benefiting from financial products

		Cumulative Target	Cumulative Achievement	Cumulative Target	Cumulative Achievement
1	DeHaat	950	1212	285	741
2	ESAF	27,090	5522	17,761	2193
3	FIA	1,39,388	24206	59,516	13386
4	MBS	6,000	7724	1,800	3082
5	Rangde	1,050	978	200	287
6	Vimo Sewa	9,500	5648	2,850	4934
7	Samunnati	300	252	98	149
8	ECSO	15,000	15930	3,000	4791
9	Integra	1621	671	480	399
10	Go green	26,670	0	23,012	0
	Total	**2,27,569**	**62,143**	**1,09,002**	**29,962**

2. **Grant Disbursement:** Grant approved and disbursed to different organizations under the project is given in table below:

Table 91: *Grant approved and disbursed to various sub-projects*

SN	Name of Sub Projects	Project Share /Grant Amount (80% of total Project cost) (Rs in Lakh)	Sub Project's Contribution (20% of total Project cost) (Rs in Lakh)
1	RangDe	235.00	61.23
2	Manipal Business Solutions	500.00	125.00
3	Vimo Sewa	160.00	40.00
4	Samunnati	500.00	133.20
5	FIA	220.00	58.76
6	Dehaat	391.00	101.62
7	Go green	286.00	71.50
8	ESAF	500.00	260.00
9	ECSO	400.00	120.48
10	Integra	326.00	81.66
	Total	**3518.00**	**1053.45**

The **endline study** covered a total of 46 FPCs and Village Level Entrepreneurs (VLEs) across five districts - Barpeta (35%), Darrang (22%), Goalpara (11%), Kamrup (R) (11%) and Nalbari (22%).

Sub-Projects- The highest proportion of respondents (22% each) mentioned receiving support from ESAF and Vimo Sewa, followed by Rang De (13%). Equal shares of respondents (11% each) indicated support from Dehaat, Samunnati, ECSO and Integra.

Thematic support- An overwhelming majority of respondents (98%) reported receiving support related to insurance services. A smaller share of respondents (4% each) benefited from credit support for production and investment purposes and from savings and digitization of banking services. Only 2% of respondents indicated receiving support in terms of access to pension schemes. This indicates that the Challenge Fund's interventions have been predominantly focused on strengthening risk mitigation through insurance coverage, with relatively limited engagement in credit, savings, and other areas.

Vimo Sewa, Dehaat and ECSO

Insurance- A total of 20 respondents was interviewed, all of whom had received insurance-related services. Among them, 75% availed Crop Insurance (General), while 50% were covered under Wage-Loss Insurance (Hospi-Cash Insurance). Additionally, 25% reported receiving QR-based Parametric Crop Insurance (Seed germination of mustard) and a smaller share (5%) received QR-based Parametric Fish Insurance.

For the QR-based Parametric Crop Insurance, a one-time premium of Rs 1,000 is paid, providing 12 months of coverage, whereas for the other insurance products, a one-time premium of Rs 10,000 is paid, offering 24 months of coverage.

For 75% of the respondents, the insurance scheme provided family coverage, while 25% were insured only for themselves. So far, only 5% (n=1) of respondents have filed an insurance claim. Additionally, one respondent mentioned that a death claim component is linked to the insurance product, though they have not yet made any claim under it.

When asked about their level of satisfaction with the support received (on a 5-point scale), half of the respondents (50%) reported being neutral, while 35% expressed that they were satisfied and 5% were extremely satisfied. Meanwhile, 10% of respondents indicated that they were dissatisfied with the support provided.

Out of all these respondents (N = 20), 80% are aware of the process of availing insurance and its related documentation.

Samunnati, RangDe, ESAF and Integra

Loan - A total of 26 respondents was interviewed, all of whom had availed working capital loans. The average principal amount was Rs.47,884.62, with an average loan tenure of 24 months at an interest rate of 4%. All respondents reported that they were required to provide collateral at the time of loan issuance.

96% mentioned satisfactory documentation support from the sub-project while accessing the loan.

On a 5-point satisfaction scale, a vast majority of respondents (85%) reported being satisfied with the support received, while 4% were extremely satisfied. About 12% of respondents remained neutral, indicating neither satisfaction nor dissatisfaction.

85% indicated that currently they have the imbibed the skills and expertise from the support received to prepare documents and supporting for availing credit loans.

FIA and MBS

Based on the secondary data, MBS had covered DCS and onboarded them as Sahipay and FIA had helped in setting up savings bank account through banking outlets, also provided insurance, pension products (APY), etc. to farmers, including women. The FIA and MBS beneficiaries could not be included in the endline study as no beneficiaries were found during the data collection phase. Hence, these sub-projects were excluded from the study.

Advantages Gained After Participating in Xamahar- Respondents reported several benefits from their participation in the Xamahar initiative. Half of the respondents (50%) mentioned that they received credit support, which helped them improve their businesses, while 48% each highlighted that they got exposed to better markets and that risks were averted through insurance coverage. Additionally, 33% of respondents noted that they were able to expand their businesses, and 15% reported earning better profits. A smaller proportion indicated having more marketable surplus (9%) and established linkages with financial institutions (2%). Overall, the findings indicate that Xamahar has been instrumental in improving financial access, market exposure, and risk management for participating enterprises.

Officials highlighted during qualitative discussions that most claims were made under the Parametric Insurance scheme. While they viewed the initiative positively, it was closed prematurely for unspecified reasons. They recommended that the scheme be revived or considered in future project designs.

3.5 Component D: Project Management, Monitoring and Learning

This component will ensure effective implementation of the project activities and monitor and evaluate project implementation progress, outputs and outcomes, building on the implementation experience of Assam Agricultural Competitiveness Project (AACP). The component inter alia will support:

(i) Establishment and operations of a Project Coordination Unit (PCU), which will oversee and coordinate activities of the implementing agencies of the project.
(ii) Establishment and operations of Project Implementation Units in the respective implementing agencies; and
(iii) Setting up a monitoring and evaluation (M&E) system for the project, including a project management information system and contracting an external M&E agency to monitor project activities and impact.

Component D: Project Management, Monitoring and Learning			
Intermediate Results Indicators & Output Indicators	**Target**	**Achievement**	**Achievement %**
Grievances registered related to the delivery of project benefits that are actually addressed (Percentage, Key Project Indicator) (CRI)	100	**100**	100

Source: PMIS (Dated 4th December 2025)

The indicator on grievance redressal has fulfilled the target.

3.5.1 Project Coordination and Implementation

The project is being implemented by the Assam Rural Infrastructure and Agricultural Services Society (ARIASS), which is an autonomous body of the Government of Assam (GoA).

- **Assam Rural Infrastructure and Agriculture Services (ARIAS) Society** is responsible for the overall management and coordination of the project and is headed by the Chief Secretary of the state.
    - **The Project Coordination Unit (PCU)** - is located at the headquarter of ARIAS Society, and is headed by a State Project Director (SPD). Coordination of the day-to-day project implementation, planning, and scheduling, procurement management, financial control, as well as reporting and monitoring is the responsibility of the PCU. All the core staff of the PCU are in place. State Project Coordination Committee (SPCC) meetings are conducted every month under the SPD.
    - The M&E Consulting Team is an extended arm of the Project Coordination Unit for APART.
- State-level Advisory bodies - **Project Guidance Council** and **Governing Body**. Project Guidance Council meetings are conducted annually under the Chief Secretary and the Governing Body meetings take place quarterly under Additional Chief Secretary.
- **Project Implementing Agencies (PIA)** include the Department of Agriculture, Industries and Commerce, Fishery, Animal Husbandry, and Veterinary, Public Works (Roads), Cooperation, Handloom, Textiles and Sericulture, Panchayat and Rural Development and Assam Agricultural University.
- Eight **Core Project Implementation Units (CPIU):** have been established at the secretariat level in each of the eight line departments relevant to APART along with their

respective Commissionerate /Directorates/Agencies and are involved in project implementation.

- **Operational PIUs (OPIUs)** have been set up at each of the Directorate / HOD levels including the public agencies under them involved in the project. All OPIUs meet quarterly.

At the District level, (i) a **District Level Coordination Committee (DLCC)** headed by the Deputy Commissioner and comprising all district-level implementing departments and agencies, is vested with the responsibility to ensure coordination and review of the Project progress; (ii) the **Agricultural Technology Management Agency (ATMA)** vested with the responsibility of implementation of Project activities at the District level, in collaboration with participating district offices of the implementing agencies, producer communities and entrepreneurs, NGOs and private sector entities.

The following **International Agencies** and **National Knowledge partners** had been also engaged for providing technical support to the project.

International Knowledge Partners:

- World Fish Center, Malaysia
- World Vegetable Center, Taiwan
- International Rice Research Institute, Philippines
- International Livestock Research Institute, Kenya
- The International Fertilizer Development Center (IFDC), Muscle Shoals, Alabama, USA
- International Crop Research Institute for the Semi-Arid Tropics (ICRISAT)- for millets VCs

National Knowledge partners:

- ICAR National Research Center of Pig
- ICAR Indian Institute of Maize Research (IIMR)
- ICAR Directorate of Rapeseed and Mustard Research

3.5.2 Monitoring and Learning

Monitoring and Evaluation (M&E) formed an integral part of the project cycle to ensure accountability, track progress and facilitate learning. The project adopted a results-based monitoring framework aligned with the Logical Framework (Logframe) developed at the inception stage.

The Monitoring and Evaluation (M&E) represents a core component in the implementation of the project. Given the crosscutting and interconnected nature of the project, the project team has developed a comprehensive M&E framework which is used to inform physical progress and financial disbursement and has developed a project baseline to review project implementation and to measure outcomes and impacts aligned to the project development objectives.

M&E Cell - The project team has established a M&E cell at the Project Coordination Unit (PCU). The PCU focuses on supporting the implementation of the M&E structures across APART (e.g., standardized guidelines, processes and workflows) to allow Project Implementing Units (PIUs) to monitor and report on the project's physical progress and financial disbursements.

APART PIUs - The project has identified and assigned nodal officers in each PIU to be responsible for monitoring the implementation of the activities under each sub-component assigned to the respective department. Through the project, information captured is cascaded from the block to the district office, aligning to the overall implementation structure of the project, with the PIU consolidating, reviewing and analyzing the data reported.

Ongoing monitoring was carried out (a) internally by the Project Coordination Unit (PCU) and periodic monitoring (b) by independent external agencies engaged at different stages of the project as listed below to ensure objectivity and transparency.

1. Sutra Consulting Pvt Ltd was engaged to conduct the baseline study and two numbers of half yearly progress monitoring studies around 2028-19.
2. NABCONS was engaged to do mid-term assessment study of a few APART interventions during 2021-22.
3. Vision EIS Consulting Pvt. Ltd in joint venture with Rashtriya Grameen Vikas Nidhi for four numbers of half yearly progress monitoring studies and the endline study from January 2022 onwards.

The project's monitoring framework was based on a set of Key Performance Indicators (KPIs) covering inputs, outputs and outcomes. Progress was measured against baseline values and annual targets.

3.5.3 Project Management Information System (P-MIS)

The **Project Management Information System (PMIS)** developed and deployed under the Assam Agribusiness and Rural Transformation Project (APART) has played a pivotal role in ensuring effective planning, monitoring and reporting throughout the project lifecycle. The PMIS was conceptualized as a centralized, web-based digital platform designed to integrate data from multiple implementing agencies, project districts and thematic components. The Project MIS portal captures the Result indicator as well as value-chain-based activities. Financial data (by OPIUs) based on AWP is also available.

Its primary objective was to provide real-time, reliable and comprehensive information to aid evidence-based decision-making and enhance accountability. The APART PMIS is *beneficiary-centric* and *project-centric* at the same time.

Key features and functions of the PMIS:

1. **Planning and Target Setting:** Component-wise, activity-wise and district-wise physical and financial targets were captured and monitored against annual work plans.
2. **Data Capture and Reporting:** Field-level progress was entered by implementation units on a periodic basis, which enabled aggregation of data at state, district and component levels.
3. **Monitoring & Evaluation (M&E):** The system was linked to the project's Results Framework and Key Performance Indicators (KPIs), allowing tracking of outputs and outcomes against baselines and targets.
4. **Financial Monitoring:** Integration of fund flow and expenditure data ensured close alignment of physical progress with financial performance.
5. **Dashboards & Analytics:** Interactive dashboards provided real-time visualization of progress across components such as agriculture, horticulture, livestock, fisheries, value chains and enterprise development.
6. **Document & Knowledge Management:** Reports, guidelines, manuals and key communications were archived systematically, creating an institutional memory for future projects.
7. **Grievance Redressal & Feedback:** The PMIS was linked with beneficiary feedback mechanisms to strengthen transparency and citizen engagement.

Impact of PMIS on Project Implementation:

1. Enhanced transparency and accountability by making progress data available to stakeholders at different levels.
2. Improved efficiency in monitoring field activities and resolving implementation bottlenecks.
3. Provided a strong evidence base for mid-course corrections, strategic decisions and adaptive management.
4. Facilitated timely preparation of reports for the World Bank, Government of Assam and other stakeholders.

The P-MIS envisages to serve as a citizen engagement platform including as an interface to the public as a project website providing updates on activities supported by the project alongside information on Grievance Redressal Mechanism (GRM).

It is a robust initiative to bring each and every beneficiary detail of such a big program under one umbrella.

3.5.4 Environment Management/ Environmental Safeguards

The Assam Agribusiness and Rural Transformation Project (APART) established a strong environmental safeguard framework that ensured project interventions were sustainable, compliant and aligned with national and World Bank policies. The project's Environmental Management Framework (EMF) guided all activities, from screening and categorization to mitigation planning, monitoring and capacity building.

The Project Coordination Unit (PCU) at ARIAS Society had monitored the environmental performance of all project components through regular environmental monitoring and audits. Project functionaries had conducted environmental screenings for all proposed interventions. Necessary clearances had been obtained from competent authorities before initiating activities near environmentally sensitive areas and site-specific EMPs had been implemented. Environmental Screening, site-specific Environmental Management Plans (295 EMPs) and regular monitoring ensured compliance with regulatory requirements.

The Key environmental achievements include:

Agriculture and Horticulture Value Chain

- **Promoting Stress-Tolerant Rice Varieties (STRVs) of Rice:** In recent years, IRRI has developed rice with better tolerance to drought, submergence, cold, salinity and sodality. The selected varieties which survive under stress and retain desirable grain qualities are being promoted under the project. In the fourth PMS round, 23% of the beneficiary paddy farmers participated in the ICMD-STRV demonstrations. Of the farmers chosen for the ICMD STRV Demonstration, 64% adopted most of what they learnt and 33% mentioned adopting all the practices and seed varieties.

  In the ETA**,** 81% of the paddy farmers (N=627) used the recommended seed varieties: Sali Season - Ranjit-Sub1, Bahadur-Sub1, Swarna-Sub1, BINA Dhan 11, BINA Dhan 17 and DRR 44. Among them, N=508, the adoption (completely and most) is 78%.
- **Alternate wetting and drying (AWD) in Paddy:** The APART project has demonstrated AWD during summer-season (Boro) rice along with other best management practices, including site and field-specific fertilizer management practices. The application of balanced fertilizers at the right time and in the right amount not only increases productivity and profitability but also helps increase grain quality.
- **Direct Seeding of Paddy:** The APART project has encouraged Direct seeding of rice, which refers to cultivating a rice crop from seeds sown in the field rather than by transplanting seedlings from the nursery. The project has demonstrated direct

seeding of pre-germinated seeds by broadcasting, dibbling, or drilling. Drum seeder has also been shown for this technique. Direct seeding is beneficial due to its low input requirement and lesser maturity duration.

- **Soil & Water Conservation Practices-** Sprinkler and drip irrigation methods are limited in the intervention area, although they differ between different value chains. Of the 27.8% of paddy farmers needing irrigation for their crops, 8.3% used drip/sprinklers. Of the 41.9% of pulse farmers requiring irrigation, 31.8% use drip/sprinkler irrigation. 48% of potato farmers reported that they require irrigation; among these, 22.4% specifically mentioned this requirement. **Sixty-five percent of vegetable farmers reported that their vegetables require irrigation. Among them, 16.8% use drip/sprinkler irrigation.**
- **Zero Tillage-** Zero tillage refers to the arable land on which no-tillage is applied between harvest and sowing. Zero tillage is a minimum tillage practice in which the crop is sown directly into the soil, not tilled since the harvest of the previous crop. It is the technique for growing crops or pastures without disturbing the soil through tillage
- **Integrated Pest Management (IPM)-** The new concept or approach of IPM is based on managing pests rather than eradicating them. The IPM packages include cultural practices for preventing pest incidences, regular monitoring of crops and mechanical and biological controls (including pheromone traps) to minimize synthetic pesticide usage. During the PMS-4 round, the demonstration, "a superimposed demonstration on Integrated Pest Management (IPM)," was attended by 39% of paddy farmers. Of those who stated that the demonstration was a superimposed demonstration on IPM, 59% admitted to following the practice entirely, while the rest followed it partially.
- **Pest Management- Reduction in Inorganic pesticide use:** Demonstrations across 1,728 ha in agriculture and 195 ha in horticulture led to a significant reduction in pesticide use (from 34.24 kg/ha to 11.83 kg/ha for paddy during PMS-4). For mustard, through this assessment, it was observed that pesticide use decreased from 29.73 kg/ha to 15.73 Kg/ha. For potatoes, it reduced from 24.19 kg/Ha to 11.64 kg/Ha. Banned pesticide use drastically declined. In the ETA, it shows that the use of inorganic pesticides has further reduced.

SN	Commodity	Sample Size	Use of Inorganic Pesticides	
			kg/Ha	l/Ha
			Average	Average
1	Paddy	627	4.2	3.11
2	Mustard	499	0.51	0.18
3	Potato	603	5.73	2.58
4	Maize	132	1	0.99
5	Pulses	387	1.83	0.33
6	Fruits	164	2.18	0.72
7	Vegetables	736	5.91	2.45
8	Ginger	132	1	0.458

- **Climate-Smart Agriculture**: Climate-resilient rice varieties expanded from 50,961 ha to nearly 5,00,000 ha, enhancing yields and farmer incomes.
- The **Custom Hiring Center (CHC)** interviews revealed that all CHCs interviewed have functional drum seeders that are rented to farmers. These Centers are run by Farmer-Producer Organizations (FPOs) and provide access to expensive machinery that individual farmers cannot afford. They are established to promote farm

mechanization and can also offer training on machinery repair, financial management and post-harvest management to FPO members.

Milk Value Chain-

- **Use of solar energy and environmentally friendly mechanisms-** WAMUL has installed A Solar Thermal System, generating 10 lakh Kcal of energy, resulting in direct savings of about Rs 4 lakh per month in fuel costs. It has also installed solar-powered Automated Milk Collection Systems (AMCS) at Dairy Cooperative Societies (DCSs), enabling transparent milk supply and payment systems. Set up 70 Bulk Milk Cooling (BMC) units (2.2 lakh LPD total capacity) and deployed insulated road milk tankers (RMTs) to maintain a seamless cold chain. These are operated and maintained by WAMUL. These Coolers run on solar energy (a renewable source), are more efficient and highly reliable in areas where electricity is a problem or power shortages are frequent.
- **Ration Balancing Program:** A customized ration-balancing program involving feed analysis and the use of locally available resources would be delivered by mobile AI technicians (MAITs). The Ration Balancing Program is a software application that enables farmers to formulate balanced rations for their dairy animals. Changing nutrition through balanced feeding can help improve feed conversion efficiency, milk production and microbial protein synthesis, while also reducing methane emissions in cows and buffaloes under field conditions.
- **Artificial Insemination:** The project has facilitated Artificial Insemination across the project districts. Insemination is focused on improving the genetic potential of the animals.

Fisheries Value Chain-

- The project encourages **Paddy fish farming, Beel Fishery and Freshwater Prawn cum Polyculture farming**, which are environment-friendly techniques.
- **Paddy cum Fish farming:** Paddy Cum Fish farming is the combination of paddy and fish cultivation. Due to the ability to produce two crops, paddy and fish, from a single cultivable area, this technique is both profitable and sustainable. The development of this method of fish cultivation can be accomplished in paddy fields where surface and groundwater are adequately available. There are many benefits, including better resource utilization, the use of readily available paddy fields, fish as an excellent instrument for integrated pest management (IPM), fish culture increasing soil productivity and paddy production, productivity and income from the unit area and lower fish production costs.
- **Beel Fishery:** In the availability of abundant nutrients from natural sources, the beel ecosystem, which is very prolific, can efficiently transform solar energy into organic carbon. Fish farming in the Beels is therefore a practical method for closing the gap between fish supply and demand.
- **Freshwater Prawn cum Polyculture:** Composite fishing benefits the ecology.
- **Feed Pellets:** High-quality feed pellets are used in the project's demonstrations. High levels of wasted nutrients end up in the fish's feces when low-grade feed pellets with an overly high protein content are used to feed them, contaminating the water they inhabit.
- **Fisheries:** Adoption of polyculture, indigenous species (Jayanti Rohu) and integrated fish-paddy systems improved productivity and raised incomes by up to Rs.2.3 lakh/ha/year.

Infrastructure: 213.5 km of climate-resilient roads, 96 markets and 37 warehouses were constructed with green features, including solar lighting, waste management systems, rainwater harvesting and fire safety infrastructure.

Environmental Audits

Environmental audits reaffirmed strong due diligence- the Final External Audit (2025) reported a 92% compliance rate across both pre- and post-construction stages.

Institutional Systems & Capacity Building

APART strengthened state systems by deploying District Environment Coordinators, departmental focal officers and providing continuous training. Over **8,191 training programs** reached **2,63,000+ participants**, integrating safeguards into day-to-day operations and creating long-term capacity within departments.

Way Forward

The project offers a model for integrating environmental compliance with livelihood development. The recommended way forward includes institutionalizing monitoring systems, embedding successful interventions in government schemes, strengthening knowledge transfer and promoting eco-certification to drive sustainable, market-linked growth.

3.5.5 Social Management/ Social Safeguards

Social safeguard compliances are being duly taken care of in construction/ renovation activity adhering to the social safeguard measures as laid down in Social Management Framework (SMF).

To ensure social inclusion, participation and transparency in establishing a modern supply chain under APART, the Project has included the affected groups right from the initiation and due diligence reports are being prepared as per the framework.

The following activities are being carried on regularly:

a. Social screening of all roads/markets/warehouses/FPC
b. Public/ Stakeholder consultation
c. Preparation of Social Management Plan (SMP) for the proposed road, market and warehouse
d. Social audits and labor law compliance audits
e. Labor Influx Assessment
f. Preparation of Labor Management Plan
g. Preparation of Resettlement Action Plan

The Social Safeguard personnel from the district APART office visits work sites and ensures the availability of the following:

- First-aid kits
- PPE Kit
- Fire Extinguisher
- Drinking water and sanitation facilities
- Proper waste disposal mechanisms
- Labor camps

FPCs: In the End-line assessment, out of the 100 FPCs surveyed, 95% of FPCs reported establishing Social Audit Committees. Among these, 96% had conducted an audit, with 79% performing the audit on a six-monthly basis. This reflects relatively robust adoption of participatory audit mechanisms, though regularity and follow-up actions may require strengthening.

Warehouses: All 20 warehouses reported providing facilities and services to ensure a safe and supportive work environment for laborers. Drinking water, adequate toilet facilities and first aid are available at all warehouses. Security measures to prevent unauthorized entry and safety from visitors are in place across all facilities. Additionally, rules and policies against sexual harassment have been formally adopted in 12 out of 20 warehouses, reflecting efforts to promote a safe and inclusive workplace.

Markets: Out of the 20 markets surveyed, new community toilet blocks were constructed in 10 markets. Seven markets reported having resting rooms for farmers, while only two market complexes had a guest house within their premises, as required. Drinking water facilities were available in 8 markets.

Market users- A total of 60 marketplace users were interviewed (three from each market) about their experiences. Among them, 40 respondents stated that public consultations were held on the temporary relocation issue. 31 respondents confirmed that their relocation suggestions were considered. However, only 12 respondents felt they were adequately relocated and 34 expressed satisfactions with the temporary relocation arrangements.

Those who were dissatisfied with the relocation process cited several reasons: 12 felt the process was unfair, 14 considered the compensation amount too low, and another 9 found the new space provided to be unsuitable. Of those dissatisfied with either the compensation or relocation arrangements (or both), only 9 reported having formally registered complaints. Awareness of the new rules and guidelines of the market was reported by 36 out of 60 respondents.

Access roads: In the study, 20 roads which were taken up for upgradation under the project were considered. Out of these, 15 have formed the Road Management Committees and all 15 respondents mentioned that they were part of the Committee.

3.5.6 Gender and Indigenous People

30.5% women farmers have been reached out in APART. There are 125 FPCs registered under APART with 60,573 shareholders (33% women).

The project has had potentially significant impact on promoting gender inclusiveness through the engagement of women in post-harvest management and processing which traditionally employ a higher proportion of female labor. Substantial engagement of women has been observed in agriculture, sericulture, handloom and textile, fisheries and food processing sector. Thus, the engagement of women in the project activities is crucial.

In the End-Term Assessment, 7512 sample was achieved across the value-chains. Around 25% female respondents were contacted, the largest group as expected was from Sericulture and Handloom.

Table 92: *End-Term Assessment Respondent Profile by Gender and Social Category*

Value Chains	Total	Male	Female	SC	ST	OBC	General
Paddy	1127	908	219	32.7%	30%	12.2%	25.1%
Maize	132	112	20	-	20.5%	-	79.5%
Pulses	387	276	111	11.4%	5.7%	35.1%	47.5%
Fruits	164	149	15	20.1%	19.5%	26.2%	34.1%
Vegetables	736	599	137	17.4%	10.1%	15.6%	56.9%
Potato	906	703	203	16.0%	22.0%	32.7%	29.3%
Ginger	132	100	32	12.1%	60.6%	13.6%	13.6%
Mustard	999	769	230	20.3%	32.8%	23.7%	23.1%

Value Chains	Total	Male	Female	SC	ST	OBC	General
Milk	1257	932	325	20.2%	22.2%	30.9%	26.7%
Fish	1278	1024	254	19.6%	18.4%	23.9%	38.1%
Eri Silk	128	16	112	20.31%	50.78%	28.91%	-
Muga Silk	133	78	55	23.0%	13.0%	60.0%	4%
Handloom	133	-	133	30.0%	29.0%	41.0%	-
Total	**7512**	**5666**	**1846**				

The participation and engagement of women vary across commodities and interventions.

- **Industry Association-** In the General Body, 38% are females and there are 44% females in Executive Body. STs comprise 25% of the General Body and 22% of the Executive Body.
- **CFC-** The CFCs interviewed had on an average 16.71 male members and 7.29 female members (30%).
- **AAGL-** Across the 30 enterprises surveyed, about 40% of the enterprises are owned by females. The number of employees engaged, on average, comprises of 6.13 males and 4.47 females.
- **Kshyamata-** 53% of the enterprises have female owners, and the rest male owners. On average, each enterprise employs 7.23 workers, comprising approximately 2.77 males and 4.50 females, indicating a relatively higher engagement of women in the workforce.
- **FPC-** The membership of farmers in the FPCs was significant, with an average of 502 members per FPC out of which 33% are females. Per FPC, an average of 91 members belong to Scheduled Tribes (ST). On average, the Board of Directors (BoDs) of the FPCs consisted of 5.93 members, including 4.68 male and 1.25 female members. This data revealed that women remain under-represented in leadership positions, limiting inclusivity at the decision-making level.
- **DCSs:** Around 43% of DCS members are females. Five (5) all-women DCSs have been formed.
- **BDMCs:** 65 BDMCs were formed across 18 districts. A total of 6750 fishery farmers mobilized to be part of the BDMC, of which 45% were women.
- **IAs:** 18 Industry Associations (IA) were formed during the project period, comprising a total of 2830+ entrepreneurs/ MSMEs, including 34% women and 12% Scheduled Tribes.

Adoption of climate resilient technology: 22% women, 15% ST and 9.5% SC.

Table 93: *Sector wise Adoption details of Climate resilient technologies demonstration, APART*

Sector	Adoption										
	Total	Male	Female	% of Women	Gen	% of Gen	SC	% of SC	ST	% of ST	OBC	% of OBC
Agriculture	2,04,818	1,70,614	34,204	16.70	88,051	42.99%	18,541	9.05%	33,884	16.54%	64,342	31.41%
Horticulture	10,602	8,761	1,841	17.36	4,291	40.47 %	1,393	13.14 %	2,190	20.66 %	2,728	25.73 %
Fishery	10,010	8,361	1,649	16.47	6,063	60.57 %	1,367	13.66 %	968	9.67%	1612	16.10 %

Sector	Adoption											
	Total	Male	Female	% of Women	Gen	% of Gen	SC	% of SC	ST	% of ST	OBC	% of OBC
Formal Milk-WAMUL	49,681	28,355	21,326	42.93	24,668	49.65 %	4,775	9.61%	4,055	8.16%	16,183	32.57 %
Informal Milk- Dairy	6,669	4,778	1,891	28.36	3,247	48.69 %	573	8.59%	478	7.17%	2371	35.55 %
Total	**2,81,780**	**2,20,869**	**60,911**	**21.62**	**1,26,320**	**44.83%**	**26,649**	**9.46%**	**41,575**	**14.75%**	**87,236**	**30.96%**

Source: P-MIS

Training to women farmers: The table shows that more than 80,000 women have been trained in APART.

Table 94: *Total Females Trained (Cumulative), APART*

Sector	Total Participants	Female Participants	% of female
Agriculture	1,88,846	38,989	20.65
Horticulture	83,540	20,423	24.45
Fishery	5,308	1,624	30.60
Sericulture	649	625	96.30
Handloom & Textiles	1,657	1,473	88.90
Industries & Association	352	148	42.05
WAMUL	20,559	9,275	45.11
Dairy	4,091	1,511	36.93
Assam Agri University	30,326	8,279	27.30
PWD	348	22	6.32
AH & VD	3,314	1,478	44.60
Total	**3,38,990**	**83,847**	**24.73**

Source: Project in-house data

APART: Changing the lives of women

"I am proud to call myself a female farmer. I have been guiding more than 650 women for almost four years and there will be more female farmers joining Joymoti in the future. APART has played a great role in building this institution. Even if APART ends, you can always come back and see Joymoti FPC functioning." – **Kamal Kumari Boro** – Chairperson, Joymoti FPC, Sonitpur District.

Ms. Boro, a woman farmer from an indigenous group has won number of block, district, state and national level awards for her role as a leader and facilitator. She is a true believer and practitioner of equal rights of men and women. Joymoti FPC formed in October 2021 focusses on agri-horti commodities like paddy, mustard, pumpkin, potato and black gram, with 32 FIGs. In January 2025 they have formed the mustard oil expeller unit, thereby expanding their scope from producers to entrepreneurs.

3.5.7 Grievance Redressal Mechanism (GRM)

In the processing of all grievances, APART follows international best practices including the adoption of basic procedures such as acknowledging all grievances and assigning a central tracking number/ID for all grievances alongside basic service standards for the response. APART has also established an operating procedure for the handling of unresolved grievances through a process of escalation - where unresolved grievances are transmitted to the next higher level - to OPIUs and then PCU. The PCU aggregates all grievances into a consolidated single database to monitor the performance of PIUs with service standards and generate aggregated statistics on performance to be disclosed on the project's web platform for the public.

A comprehensive set of trainings on the GRM has been undertaken covering the PCU and PIUs at the State and District. The training was designed as cascading from the PCU that trains State Level PIU officials as part of the Social Safeguards Training. The PCU and State Officials joined the training sessions for the District Level PIUs conducted by DLCC. Service providers and ATMAs also received training on the GRM.

The tollfree helpline number is functional.

Table 95: *End-Term Assessment Findings on Grievance Redressal*

Segments	Percentage of respondents who are aware of APART's GRM process	Percentage of respondents who have ever lodged a formal complaint	Whether the lodged grievance was addressed (Y/N)
Paddy	77	24	Yes
Maize	42	3	Yes
Pulses	87	21	Yes
Fruits	89	21	Yes
Potato	48	14	Yes
Other Vegetables	75	25	Yes
Ginger	55	23	Yes
Mustard	65	18	Yes
Milk (formal) DCS	74	23	Yes
Milk (informal) DCS	79	18	Yes
Fisheries (Polyculture)	76	23	Yes
Fisheries (Paddy cum Fish)	66	4	Yes
Beel Fishing	14	9	Yes
Polyculture with freshwater prawns	71	25	Yes
Silk (Muga)	74	38	Yes
Silk (Eri)	68	14	Yes
Handloom	68	14	Yes
AAGL	67	3	Yes
Kshyamata	37	27	Yes
Xamahar	13	0	-
Industry Associations	35	6	Yes

Segments	Percentage of respondents who are aware of APART's GRM process	Percentage of respondents who have ever lodged a formal complaint	Whether the lodged grievance was addressed (Y/N)
CFC	43	0	-
FPC	15	7	Yes
CSC	55	0	-
Roads	80	10	Yes
Markets	55	10	Yes
Warehouse	55	15	Yes

The assessment of APART's Grievance Redress Mechanism (GRM) indicates that while the system is responsive and effective for those who use it, awareness and uptake vary significantly across beneficiary segments. Awareness is highest among respondents in the Roads (80%), Milk (77%), Sericulture & Handloom (70%) and Agri-Horti (67%) sectors, whereas segments such as Industry Associations & CFC (39%), FPCs & CSCs (35%) and particularly Xamahar (13%) exhibit very low awareness levels.

The proportion of respondents who have ever lodged a formal grievance remains low overall, with only a few segments, Sericulture & Handloom (22%), Milk (21%), Agri-Horti (19%) and Warehouses (15%), showing relatively higher engagement. Notably, all respondents who lodged grievances confirmed that their issues were addressed, reflecting a functional and responsive GRM system.

The findings suggest a need for strengthened communication and outreach efforts, especially in low-performing segments, to ensure equitable access and improved utilization of the GRM across all APART-supported groups.

3.5.8 Procurement Management

Procurement under the project has been undertaken by the PCU and 15 Project Implementation Units (PIUs) in line with the World Bank's Procurement Regulations for IPF Borrowers. At the OPIU level, procurements were carried out as per the Delegated Procurement Guidelines approved by the World Bank, while community-level procurements were implemented by FPCs/IAs under APART following the Community Procurement Guidelines. The project has successfully completed all planned procurements, with no major issues or red flags reported throughout the implementation period.

3.5.9 Financial Management

The financial status of APART is provided in the table below:

Table 96: *Department-wise Fund Utilization under the Project (in Lakhs)*

SN	Department	Fund Released	Expenditure	Utilization (%)
1	Agriculture	19,137.50	18,691.81	97.7
2	Horticulture & Food Processing	8,763.37	8,658.66	98.8
3	Sericulture	1,885.82	1,635.94	86.7
4	Handloom & Textiles	737.15	713.39	96.8
5	Assam State Agricultural Marketing Board	478.29	478.29	100.0
6	Assam State Warehousing Corporation	113.27	113.27	100.0
7	WAMUL	13,657.54	13,623.61	99.8

SN	Department	Fund Released	Expenditure	Utilization (%)
8	Public Works Road Dept.	53,603.83	53,367.75	99.6
9	Industries & Commerce	6,421.71	5,355.73	83.4
10	Assam Agricultural University	9,988.50	9,880.48	98.9
11	Fishery	7,015.82	6,795.91	96.9
12	Animal Husbandry & Veterinary	2,220.23	2,210.11	99.5
13	Dairy Development	502.37	494.2	98.4
14	PCU	32,710.28	32,710.28	100.0
15	National Dairy Development Board	4,245.18	4,245.18	100.0
	Total	**1,61,480.86**	**1,58,974.61**	**98.4**

Source: P-MIS (Dated 04th December 2025)

A total of Rs 1,61,480.86 lakh was released across departments, of which Rs 1,58,974.61 lakh has been utilized, reflecting an overall utilization of 98.4%.

4. Conclusion

Assam Agribusiness and Rural Transformation (APART) is an eight-year (*October 2018 - September 2025*) World Bank-assisted project in Assam. The project is managed and coordinated by Assam Rural Infrastructure and Agricultural Services (ARIAS) Society, which acts as the Project Coordination Unit (PCU), implemented by nine Core Project Implementation Units (CPIU) at the Secretariat level and sixteen Operational PIU (OPIUs) at the Directorate/HOD level.

The **Project Development Object (PDO)** is to add value and improve resilience of selected agriculture value chains, focusing on smallholder farmers & agro entrepreneurs and to advance Assam's COVID-19 response. The key beneficiaries are Farmers, FPOs & entrepreneurs especially MSMEs.

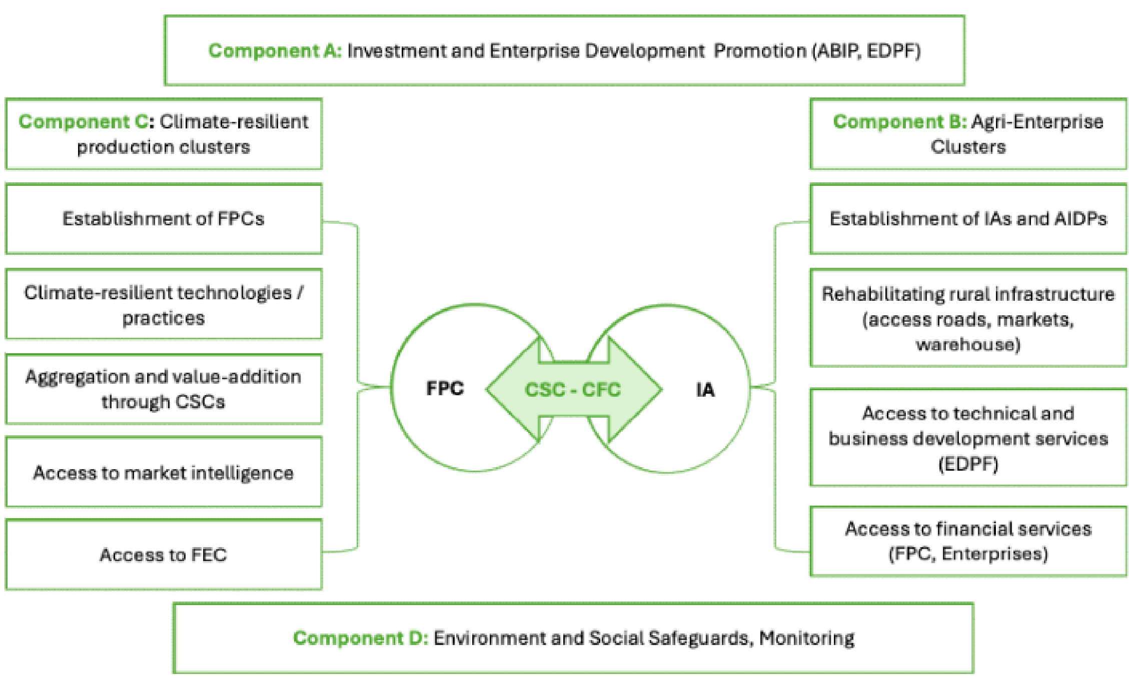
The **Key Performance Indicators** (KPIs) are:

- Farmers reached with agricultural assets or services (no.), of which female (no.)
- Increase in price premium of commodities sold by beneficiaries in the selected value chains
- Share of selected commodities sold through new marketing channels (percent)
- Farmers adopting improved agricultural technology (no.), of which female (no.)

APART supported value addition in production and post-harvest segments of selected agriculture and horticulture value chains (cereals, pulses, fruits and vegetables), milk value chain fisheries value chain, sericulture and handloom value chain; stimulated establishment of new small and medium agri-enterprises; facilitated agribusiness investments through inclusive business models that provided opportunities to small holder farmers to actively participate in the value chains and supported resilience of agriculture production systems in order to better manage increasing production and commercial risks associated with climate change in the project districts.

APART's objectives can be broadly understood from the figure below (adapted from the Project Appraisal Document, PAD).

Figure 2: *APART's objectives - Broad Perspective*



The **four components** of APART are as follows:

- Component A: Enabling Agri Enterprise Development
- Component B: Facilitating Agro Cluster Development
- Component C: Fostering Market-led Production and Resilience Enhancement
- Component D: Project Management, Monitoring and Learning

Component A:

EDPF: More than 1800 agri-based enterprises have been brought under the fold of Enterprise Development and Promotion Facility (EDPF). Schemes like Kshyamata and Assam Agri-business Growth Laboratory (AAGL) have provided business development support (BDS), light touch-up support, access to finance and other national schemes like PMFME, PMEGP etc. Few enterprises also received incubation support. The enterprises who were a little matured could take-up the support and move forward, a few new ones needed some more hand-holding support particularly related to document preparation and access to credit and finance.

ABIP and related: The business facilitation aspect of the component received support from 65 investors for nearly 4,399 crores, covering 45 agri-based sectors (2,541 crore) along with others. Numbers of G2B meetings and lead generation events were organized to invite investors in this sector.

Component B:

Infrastructure: 213.5 kms of rural access roads were rehabilitated, it was ensured that these roads were connected either to a market, a FPC or a cluster to ease movements and facilitate market linkages. 96 wholesale agricultural markets were modernized and improved. The best thing about these markets were construction of (a) a drainage system, (b) internal road ways, (c) sheds and (d) basic facilities like toilets and drinking water. Some of the markets would stay inundated during the rainy seasons with knee-deep mud sludge, thus impeding business. The buyers and the sellers are happy with the works undertaken and feel that this has helped increase in business. 37 warehouses have been upgraded to WDRA standards. Again, the internal roads, drainage, etc. have played a crucial part in the infrastructural development process. Access of vehicles inside the warehouses have eased and there has been an increase in private players availing the services.

IA: APART has been able to organize agri-enterprises into district Industry Associations (IA) for the first time. 18 Industry Associations comprising 2,845 individual entrepreneurs representing various agricultural sectors and value chains were established. 18 Agro-industrial Development Plans were developed and approved. Although all IAs could not move ahead with forming business companies but 8 Common Facility Centers (CFC) comprising 204 firms could be established. The focused commodities being Rice, Mustard Oil, Food Processing and Silk. Additional support like financial linkages with commercial banks, marketing support, convergence support with other existing schemes and raw material procurement from FPCs were provided.

Component C:

FPC and CSC: APART facilitated the formation of 125 Farmer Producer Companies particularly dealing with (a) agri-horti commodities, (b) fisheries and (c) silk value chain. It needs a mention that it was through APART's efforts that the unorganized, home-based silk farmers of Assam were organized into FIGs and FPCs. The process was time-intensive and the hand-holding support of APART would be missed. But the Sericulture Department and the Government of Assam through its various FPC promotion schemes would surely keep the momentum alive. Some of the agri-horti FPCs managed by only women are doing commendable work. The successful and confident faces of these female farmers who are now turning agri-entrepreneurs are the real success stories of APART. Fisheries FPCs have been able to source genetically improved fish seeds and locally processed fish seeds to the members farmers along with training on PoP etc. But there are challenges too, for instance the fish feed produced by the FPC follows the exact proportions of vitamins and proteins as recommended in the APART PoP and locally procuring the raw materials becomes expensive. The market variety of fish feeds available is cheaper, but it does not contain the recommended composition. The acceptance and marketing of the product become difficult in that case. These are challenges that the CSCs must overcome when APART support ends. The project has been able to facilitate around 37 CSCs only. Some of the major challenges were obtaining land, electrical connection. Construction works at the community level sometimes impedes timely completion. Convergence with GoI schemes will facilitate the sustenance of the CSCs.

If we reflect on the figure above, the final mile of CSCs aggregating raw materials, processed commodities and by-products so that the CFCs can procure directly from the FPC/CSCs could not been achieved as expected.

Climate-resilient technologies and practices: this is APART's core area and this enabled a direct interaction with the beneficiaries. The farmers received demonstration support along with training, monitoring, farmer field days, buyer-sellers meets, exposure visits and were organized into groups like FIGs and organizations like FPCs. The farmers were exposed to improved, quality seed varieties and learned climate-resilient farm practices which helped them to see improvement in productivity and therefore in income. Stress-Tolerant Rice Varieties (STRVs) like Ranjit Sub-1 and Bahadur Sub-1 and others have gained well acceptance by the paddy farmers in a state where 50 lakh hectares of land remains submerged annually. The area expansion of toria and mustard has emerged as an important Rabi crop for the state. Processed potatoes were introduced in the Assam horticulture scenario by APART and it immediately had good acceptance from the farmers as well as private players. FPCs directly drawing deals of contract farming with industries and Pepsico setting up a 75,000 MT plant in Nalbari can substantiate the claim. Similarly, commercialization of Ginger and Pineapple farming with market linkages for export promotion has also been observed. The promotion of Maize has contributed in generating raw materials for the feed industry.

This report has deliberated in detail about the adoption of Assam's farmers in terms of seed varieties and package of practices. New technologies and species were introduced for the fishery sector like mola-carp integrated farming and poly culture with freshwater prawns, which was welcomed and accepted by the farmers. Production of good quality Fish seed and feed by the FPCs is a step forward to self-reliance for farmers. For the first time, Beel fish farmers were organized into Beel Development Management Committees for better management, sharing and increased productivity. Milk Value chain both (formal and informal sectors) have seen a good boost. WAMUL has developed as a big player in the milk sector of Assam. It reaches to 1600 village based dairy cooperative societies (DCS) across 24 districts in Assam that are having over 50,000 functional pourers. The expansion of the milk processing capacity from 60 TLPD to 150 TLPD along with manufacturing of value-added products such as ice cream, flavored milk and indigenous sweets was also facilitated by APART. The informal milk sector has been able to provide milk testing facilities, knowledge products (training manuals etc.) and formation of DCSs. Under the Assam Dairy Development Plan, NEDFL - a company has been formed aiming to process 10 lakh liters of milk per day. Sericulture mostly concentrated in providing training to the farmers so that the traditional silk farming practices may improve. Delays in fund disbursements at district levels and lack of knowledge (of support partners) on the specialty value-chain slowed down the formation and functioning of the FPCs and CSCs.

Overall, APART has been able to usher in a change in the agricultural, horticultural, milk and fisheries sectors in Assam. The climate resilient technologies and practices promoted and recommended by the project is not limited to the beneficiaries alone. The availability of the new varieties and farm inputs at local levels show that farmers and traders are aware of the improved practices and are adopting those.

Farmer Producer Companies (FPCs): APART has been able to facilitate around 125 FPCs and 37 Common Service Centers (CSCs) with focused commodities like paddy, mustard, fruits, vegetables, fisheries, silk and weaving. The landholding profile of farmers enrolled in FPCs under APART shows a predominance of marginal farmers, with an average of 349 members per FPC holding less than 1 hectare. The findings indicated that 63% of the FPCs have successfully accessed newer markets, including digital and online marketing platforms, thereby expanding their avenues for sales and improving market outreach. In parallel, 48% of the FPCs reported improved access to loans and credit facilities, which is critical for meeting working capital requirements and scaling production.

Access to market intelligence: Agricultural Market Intelligence Unit (AMIU) an initiative of Assam Agricultural University, collects market information from 91 markets of Assam for 89 commodities with the help of Field Data Enumerators (FDEs) deputed in 17 APART districts of Assam. The FDEs feed real-time data through a backend mobile application. Also, the FDEs from each district submit a weekly report that includes price trends, arrival trends and key insights on market conditions. This has helped in getting timely, efficient and accurate market data. Satisfied with data quality, the AGMARKET even synchronized the AMIU market data in to their portal and are available daily. Among the agri farmers, bulletin boards, notices in government offices and word-of-mouth are the main sources of information. The valuable market data set derived daily price information for the farmers and traders has helped them in taking informed decision on sale and procurement of various agricultural commodities.

Access to Financial Education and Counselling (FEC): The initiative was named Krisarthak, delivering financial education & counseling to farmers digitally. All APART FPCs were covered along with 64 DCS- training 2,01,811 beneficiaries (47% women). The reach-out programs comprised (i) radio program on financial schemes, (ii) residential training, (iii) miking activity, (iv) special outreach workshops and through, (vi) *Bittiya Sakhi* Chatbot (886 BSs).

Xamahar is a Challenge Agriculture Fund designed to provide financial support and innovative solutions to improve access to financial services for farmers and agribusinesses in Assam. Financial service providers such as insurers banks, MFIs, etc. reached out to 62,143 farmers (48% women). As a result, 17,740 savings accounts opened, with online transactions totaling Rs.109 Cr, Credit disbursed Rs. 71 Cr were undertaken and 4 financial products were deployed.

Xamahar and Krisarthak were introduced in the later stages of the project.

Component D:

Grievance Redressal Mechanism (GRM): Awareness of APART's GRM is generally moderate across all sectors. Despite low grievance-lodging rates across most segments, all respondents who filed complaints reported that their issues were addressed, indicating an effective system.

Environmental Safeguards measures like exclusion of harmful activities (hazardous chemicals, wetlands, forests, sensitive areas), environmental screening of DPRs & integration of mitigation measures, capacity building & awareness for partners and communities and monitoring soil health & surface water were undertaken. Green Practices like (i) optimal resource use for polyculture, paddy-fish farming; (ii) low external input farming like IPM, INM, organic practices; (iii) biodiversity conservation through resilient crops, native fish species; (iv) renewable energy & waste management in markets/warehouses and (v) slope stabilization & tree plantation were promoted.

Social Safeguards: Almost 30.5% women farmers were reached out through various services. Adoption of climate resilient technologies are high among women participants. Due diligence for land use was conducted for more than 400 sub projects; no land acquisition happened. Resettlement Policy framework was implemented in 14 roads and 55 markets, no livelihood loss reported. All grievances were timely and adequately resolved. Community consultations and stakeholder disseminations were conducted prior to infrastructure development works and social audits and labor law compliance audits conducted. Institutions like FPC, IAs etc. have their own GRM and ICC mechanisms FPCs regularly conduct social audits. Citizen Feedback was obtained with good rating.

PMIS: The Project Management Information System (PMIS) developed and deployed under the Assam Agribusiness and Rural Transformation Project (APART) has played a pivotal role in ensuring effective planning, monitoring and reporting throughout the project lifecycle. The PMIS was conceptualized as a centralized, web-based digital platform designed to integrate data from multiple implementing agencies, project districts and thematic components. The Project MIS portal captures the Result indicator as well as value-chain-based activities. Financial data (by OPIUs) based on AWP is also available. Its primary objective was to provide real-time, reliable and comprehensive information to aid evidence-based decision-making and enhance accountability. The APART PMIS is *beneficiary-centric* and *project-centric* at the same time.

5. Annexure - I

Survey Details

Qualitative survey

To get a better insight into the ETA, to know about the strengths and weaknesses of the project and the challenging and deterring factors, qualitative research methods were applied such as focus group discussion (FGDs) and Key informant interviews (KIIs).

Detailed discussions with the OPIUs and PCU Coordinators have been conducted at the state level and their views on the functioning, benefits and challenges of APART were gathered.

Table 97: *Date of Meetings with OPIUs*

Operational PIUs (OPIUs) in Commissionerate / Directorates / Agencies	Date of Meeting
Directorate of Agriculture Directorate of Horticulture & Food Processing Assam State Agricultural Marketing Board (ASAMB), Guwahati	19th June 2025 20th June 2025 20th June 2025
Directorate of Dairy Development	19th June 2025
West Assam Milk Producers Cooperative Union Limited (WAMUL), Guwahati	19th June 2025
Directorate of Fisheries	21st June 2025
Directorate of Sericulture	21st June 2025
Chief Engineer (Externally Aided Projects), Public Works, Roads Department	20th June 2025

Interactions were also held with the APART officials, technical leads during the study.

Table 98: *Meeting Details with PCU Coordinators (APART)*

PCU Coordinator	Date of Meeting
Sreemant Phukan, Monitoring and Evaluation Specialist	19th June 2025
Baljeet Singh, Market Analyst cum Operations Specialist	21st June 2025
Dr Sanjay Sarma, Fishery Coordinator	20th June 2025
Asif Bin Qutub, Horticulture Coordinator	19th June 2025
Atanu Chatterjee, Environment Management Specialist	20th June 2025
Sheetal Sharma, Social Sector Management Specialist	19th May 2025
Amarendra Deka, Procurement Engineer cum Road Coordinator	20th June 2025
Devaroon Sabhapandit, Private Sector Development Specialist	12th June 2025
Probin Bharali, Cluster Development Specialist	21st June 2025
Peenaaz Kashyap Das, Enterprise Development Coordinator (EDC)/ Business Analyst	19th June 2025

Senior M&E Team members also visited 7 districts- Goalpara, Kamrup (M), Kamrup (R), Lakhimpur, Biswanath, Sonitpur, Darrang and the following establishments/offices have been covered to understand their experiences of implementation and challenges of the APART project:

- Farmer Producers Company (FPC)/ CSC related to Agri-Horti, Fisheries and Silk
- CFC
- Infrastructure- Roads, Market, Warehouse

Table 99: *District Level Meetings*

District	Sectors covered	Dates

District	Sectors covered	Dates
Goalpara	Srijoni FPC, Amijonga Weekly Market	10th July 2025
Kamrup (M)	Amingaon Warehouse	6th September 2025
Kamrup (R)	Uttaran FPC, Mapakkai Agro Producers Company Ltd, Bondapara Weekly Market	10th July 2025 4th to 6th Sept. 2025
Lakhimpur	CFC- M/S Subansiri Enterprises Pvt. Ltd, Upgraded Road from Singia Govindapur PWD to No. 1 Thekeraguri Gaon in Machkhowa Mouza	1st September 2025
Biswanath	Gohpur Fish FPC, Upgraded Road from Ghimorujan to Jokapara via Ghehua	2nd September 2025
Sonitpur	Joymoti FPC, Mojiya FPC, Ketkibari bi-weekly market, Upgraded Road from Borakota Chapori to Sharani Tinikhria in Bordubia Village	2nd to 4th September 2025
Darrang	CFC- Brahmaputra Rice Cluster Pvt Ltd., Kharupetia Warehouse	4th September 2025

Development of Study Tools

The study tools used during the baseline and progress monitoring phases have been reviewed and research tools have been developed for the end-term assessment of APART, after discussion with OPIUs and departmental functionaries. Each Interview Schedule has been reviewed by concerned APART officials and was finalized after receiving their approval.

A total of 15 questionnaires were developed. CAPI tools have been developed for the segments: Agri-Horti, Fish, Milk, Eri Muga, Handloom, and FPC. At the same time, the PAPI is conducted for the segments: AAGL, Kshyamata, Xamahar, Industry Associations (IA), CFC, CSC, Roads, Markets and Warehouse.

Discussion guidelines for qualitative study have also been designed.

The research instruments were translated into Assamese and the team has obtained approval for the translated questionnaires.

Field Team Deployment

The field manager is responsible for monitoring the field operation in Assam. The following categories of manpower were deployed for data collection.

i) Quantitative Team

- Seven teams with five enumerators and one supervisor in each team. Hence, a total of 35 enumerators and 7 supervisors were deployed for the field data collection.
- For the enterprise sections - AAGL, Kshyamata, Xamahar, Industry Associations, CFC, FPC, CSC, Roads, Markets and Warehouse - 310 samples were assigned. Five senior investigators were deployed for this section.

ii) Qualitative Team

- The qualitative team comprises of Senior M&E team members.

Pilot Testing of Tools and Finalization

Pilot testing was crucial for implementing the study. The pilot testing was done for the segments covered. The pilot testing was carried out in the non-sampled blocks/villages in the Kamrup district.

The core team members, the field manager and the supervisors conducted the pilot testing in several villages and administered around 2-3 questionnaires of each type to different respondents. Since several segments were included in the pilot testing exercise, 10 data collectors were deployed, who completed the task within 2 days.

The 10-member team were thoroughly trained before they were launched for pilot testing. After training, the data collectors (senior Enumerators and Supervisors) completed the pilot study work within 2 days. A CAPI User Acceptance Testing was carried out prior to the full survey rollout to validate the questionnaire flow, check system functionalities and ensure error-free data collection.

The pilot testing helped fine-tune the questionnaire and determined the flow of questions. Based on the feedback from the APART team, tools were finalized and submitted to APART for approval.

Training of the Enumerators and Supervisors

The team leader, core team member and field manager provided the enumerators and supervisors with intensive five-day training in the local language (Assamese). The training covered interviewing techniques and rapport building with respondents, as well as thoroughly explaining all questions, completing schedules, correcting errors and handling non-response cases. It included 4 days of classroom training and one day of mock interviews.

The residential training was conducted from 15th to 19th of July 2025 at Hotel Fortune located Opp. Apsara Cinema/Volvo point G.S. Road Ulubari, Guwahati. The number of investigators were 15% more than that stipulated and after complete review of the abilities of the interviewers, the best 42 were recruited for the survey. All the investigators underwent mock calls to have more clarity on the tools. In the course of the training exercise, the questions, translations and skips were looked into thoroughly and the tools were finalized.

Implementation of survey

The data collection for the quantitative survey took place in the selected 18 districts from 26th July 2025 to 10th September 2025.

RebusCloud software was used for conducting the CAPI survey.

The data quality was being monitored through accompanying calls and spot checks. Aside from the supervisors, a field manager was deployed to monitor the fieldwork closely. The supervisors also conducted spot checks in 10 percent of the sample.

Data Analysis

Data Management

Data was extracted from the server for the quantitative questionnaire and the following steps have been undertaken.

- Check the actual count of records against the extraction count.
- Check for data consistency based on the checklist provided by the core research team.
- Share erroneous records/data with the core and field teams for suspected anomalies. Core indicators were validated as per set procedures.
- Periodic extraction of data was done from the CAPI application to check for data quality, consistency, and completeness.
- Generate outputs based on the program developed for the tabulation plan provided by the core research team.

FGDs and KIIs were conducted and relevant information summarized and compiled for reporting.

Data Extraction and Data Checking

Data flowed straight from the devices to the quantitative survey server. If internet connectivity was available, data was uploaded once a day. If connectivity was poor, the data upload protocol was once every two days. Data was centrally extracted from the server on every alternate day. The frequency tables were generated and checked.

Data Entry for PAPI Survey

Data from those surveys conducted on pen and paper was entered into a template prepared by the data manager. After data entry, it was checked thoroughly by the data manager and the necessary rectifications were made.

Data Processing

The quantitative data from the field was converted into SPSS data format/STATA format for storage and processing. The field and analysis teams cleaned and validated the data together.

Preparation of Report

The core research team members will prepare and share the report with ARIAS.

The findings section of the ETA report, particularly for the value chains, will follow five criteria **relevance, effectiveness, efficiency, impact and sustainability** drawing from the OECD-DAC Network on Development Evaluation (EvalNet) for reporting. In addition to these five criteria, we will also use **Equity** as a criterion to see whether disadvantaged social groups and women have adequately benefitted from the project.

R	**Relevance**	Is the intervention doing the right things?
E	**Efficiency**	How well are the resources being used?
E	**Effectiveness**	Is the intervention achieving its objectives?
I	**Impact**	What difference does the intervention make?
S	**Sustainability**	Will the benefits last?
E	**Equity**	Is the intervention available and accessible to different social groups?

Quality Control Measures

'Quality Assurance' was considered a continuous process during all study phases. The quality of translated questionnaires, recruitment of the interviewers and supervisors, training imparted to the interviewers and supervisors, quality of the briefing note and field methodology instructions note determine the quality of the data to a great extent. However, specific measures were taken to control the quality, the details of which are given below.

- A competent project team was involved. All the team members had extensive experience conducting research in relevant fields. The tasks given to the team members were well-defined and they worked under the overall guidance of the project leader. The field executives regularly monitored the data collection activities and recommended corrective actions in case of any deviations or non-conformities from the defined methodology.
- Customized intensive and detailed training of field team members for hands-on experience and understanding was held.
- A three-tier field monitoring system was followed by the Team Leader/Senior Researcher at the top, the field manager in the middle and the field executive at the bottom level of the monitoring ladder.
- **Accompanied check and spot check of the questionnaires:** The Supervisor would be responsible for conducting 10% accompanied and spot checks of the completed interviews. The supervisor would also brief the team on the problems daily.

- **Refusals and Non-response:** To ensure that fieldwork meets quality standards, the records of all non-response, refusals and incomplete interviews were documented. The total number of interviews achieved does not include the refusals and incomplete interviews. The response rate in the survey was universal.
- **Involvement of researcher:** The researchers were involved during the fieldwork of all phases and interacted with interviewers, supervisors and the field executives to obtain a detailed account of how the quality was being monitored. A feedback session was also conducted by the researcher with all the field teams to gather insights on the actual field situation, share experiences/problems and arrive at solutions.

Quality Control During Data Processing

The following quality control measures were adopted while data processing:

- **Completeness:** The Field Supervisors scrutinised and edited all questionnaires daily for completeness and consistency, then uploaded them to ensure that all required data fields were filled in for each survey response. If data was missing due to the improper selection of options in skip questions, it was provided through the re-collection of data.
- **Accuracy:** The data was verified to ensure that the data entered was error-free and accurately reflected the information collected during the survey. End-user details, addresses, locations, financial information and numeric data were verified in the field and reaffirmed in the downloaded data.
- **Consistency:** The consistency check was critically carried out to ensure that responses were logical and coherent across all survey sections. The digital platform had proper mechanisms to ensure data consistency.
- **Validity:** Confirmation was made that the collected data aligned with predefined criteria.
- **Reliability:** The reliability of the collected data was assessed by cross-checking responses and ensuring consistency in reporting.
- **Data Entry Errors:** Errors that may have occurred during data entry processes were identified and corrected to maintain data accuracy.
- **Outliers:** Data points significantly deviating from the norm or expected values were identified and investigated.

Data Confidentiality and Ethical Considerations

Data Confidentiality

- All interviews were conducted on a one-to-one basis.
- Personal identifiers (name, contact info, etc.) were strictly restricted to this survey.
- Confidentiality of the information provided by the respondent during each interview was maintained.
- There will be one-time use of the information for this study. It will not be used for any other purpose.
- Data was stored securely, with restricted access. Password-protected devices and locked cabinets were used with access only to researchers involved in this study.
- Only the de-identified data was used for analysis, both for qualitative and quantitative information.
- All data, tools, reports and materials generated for this project will be the sole property of the Client. The agency will not share or use the data without the permission of the client.

Ethical Considerations

- Participants were informed why the survey was being conducted, how their data would be used and whether it was anonymous or confidential.

- Consent was gathered from survey participants, which was voluntary and without coercion.
- All respondents were adults; no children were interviewed.
- Participants had the freedom to skip questions or exit the survey at any point.
- Care was taken to ensure that the questions did not cause psychological, social or emotional distress.
- Sensitive topics such as income, religion and social category were asked with sensitivity and enumerators were trained on this.
- True data was presented- in no way was data fabricated, falsified or manipulated. The agency reported findings honestly.
- The enumerators had been trained and were sensitive to cultural norms, language preferences and local customs.
- We have not sought clearance from any Institutional review board (IRB).

Anticipated Risk and Mitigation Plan

The risks anticipated, along with mitigation measures, are mentioned below:

- There was always a risk of a small proportion of CAPI devices/smartphones encountering technical issues. To address this, each team was provided with a buffer device to ensure seamless replacement in case of malfunctions (e.g., screen blanking, keyboard failures).
- There was always a risk of trained enumerators dropping out; therefore, a buffer of trained enumerators was provided, along with a mechanism for quick onboarding to replace the dropouts.
- Non-sampling errors: All efforts were made to minimise non-sampling errors through training. Probable sampling errors that might have been committed in the field were included in the checklist of aspects to be monitored for accompanied interviews, based on insights from CAPI pilots, so that the correct survey process was internalised.
- Lapses in supervision and monitoring will also affect data quality. Considering that the agency undertook field and backend data-based checks, the monitoring and supervision system was anticipated to be active and alert.

To address the issue of network/internet connection especially in remote locations, the field team was provided with an additional SIM connection (preferably with an alternative operator) to ensure uninterrupted internet availability for daily data synchronisation, as required.

Case Studies/Success Stories

Common Facility Center (CFC)

Visit Report: Establishment of Brahmaputra Rice Cluster Pvt Ltd. in Dhekiajuli, Sonitpur

Brahmaputra Rice Cluster Pvt Ltd., promoted by the Industry Association (IA) TAAPIA from Sonitpur, comprises 20 members, including one woman. The Common Facility Center (CFC), designed as a modern pre-boiling steam rice processing unit, is being developed at a total cost of Rs.7.89 crore. Of this, 80% has been financed under the APART project, while the remaining 20% has been mobilized through member contribution.

At present, Assam depends on neighboring states to meet appr... for parboiled rice, which escalates procurement costs. Sonitpur ... hub with inadequate modern rice processing facility. The new CFC, with a daily processing capacity of 4 MT/hr, will source paddy directly from local farmers. The facility is expected to strengthen Assam's rice value chain by reducing dependence on external supplies, lowering local rice prices and providing a reliable market outlet for producers.

As per the signed MoU, TAAPIA - the IA - will retain 5% of the profits towards its operational support, with the remainder accruing to the member-producers. Given the strong regional demand and expected supply-chain efficiencies, the venture is projected to recover nearly 20% of ... two years of operation. In the long run, the CFC is expected to generate local employment, stabilize farmer incomes and foster enterprise-driven rural growth, thereby contributing to sustainable development of the rice sector in Assam.

Visit Report: Subanshiri Enterprises Pvt Ltd., Mustard Oil CFC - Lakhimpur District

Subanshiri Enterprises Pvt Ltd., a Common Facility Center (CFC) primarily focused on mustard oil production, was established in December 2024 with 20 members, including 4 women, who also conduct regular meetings to ensure participation in decision-making. The CFC was developed at a total cost of Rs.4.35 crore, with 80% support from APART and 20% contribution by members.

The enterprise operates under the brand name "Subanshiri" with an installed production capacity of 10 tons per day. At present, however, the unit is only able to utilize about 2.5 tons per day due to multiple challenges, the most critical being irregular electricity supply. The enterprise also sells oil cakes as a by-product, which provides an additional revenue stream.

The governance and operational framework are in place, with a profit-sharing arrangement that allocates 5% of profits to the Implementing Agency (IA). Social, GRM and ICC committees have also been constituted, ensuring compliance with project requirements and oversight of operations.

Financially, the venture has already become profitable but capacity utilization and marketing linkages is required to be improved in the long run.

Despite its potential, the CFC faces several challenges. Key infrastructure gaps include the requirement for more storage space and further development of marketing channels. Packaging materials such as plastic bottles must be procured from Guwahati, significantly increasing production costs. Furthermore, with APART support set to conclude, there is a pressing need to establish robust marketing channels to ensure the enterprise continues to thrive.

With its existing capacity, brand identity and growing demand for mustard oil in the region, Subanshiri Enterprises Pvt Ltd. has strong potential for scale-up, provided its marketing, infrastructure and operational constraints are systematically addressed.

Roads

Visit Report: Road Upgradation from Borakota Chapori to Sharani Tinikharia, Bordubia Village, Sonitpur

Under the APART project, a rural connectivity intervention was undertaken to upgrade the road from Borakota Chapori to Sharani Tinikhria in Sonitpur district. The primary objective was to provide farmers with all-weather access to paddy fields and facilitate smoother linkages with nearby markets and clusters including Mojiya FPC, thereby strengthening the local agricultural value chain.

Prior to the intervention, the road was muddy and prone to waterlogging, making it unusable during the rainy season. Farmers primarily relied on carts to transport harvested paddy, as motorized vehicles could not access the fields, which restricted volumes and delayed market arrivals.

The upgradation involved elevating the road and paving it with interlocking concrete blocks, making it motorable throughout the year, improving the timeliness of transportation, reducing post-harvest losses and lowering costs for farmers.

The upgradation was completed in June 2024 at a total cost of Rs. 2.029 crore. A Road Management Committee was constituted to oversee the process, comprising four male and two female members, ensuring community participation and local oversight. By connecting three villages and nearly 150 households, the road has improved year-round accessibility, reduced crop losses during rainy season. It also provides farmers with reliable access to markets, schools, health Centers and other essential services, contributing to both economic and social development.

Post completion, the road has been formally handed over to PWD, ensuring its long-term maintenance and sustainability, with the defect liability period concluded, marking the successful closure of the intervention. Overall, the intervention has transformed accessibility in the area, strengthening agricultural value chains while also improving the quality of life for rural households.

Visit Report: Road Upgradation from Ghimorujan to Jokapara via Ghehua, Biswanath District

Under the APART project, the rural connectivity intervention was undertaken to upgrade the 1.397 km road from Ghimorujan to Jokapara in Biswanath. The primary objective was to provide all-weather access to the facility, facilitating smoother transportation of produce and inputs and strengthening local market linkages. A small stretch of road remains pending due to approvals from the revenue department.

Prior to the intervention, the road was in poor condition, making it difficult for motorized vehicles to reach the FPC. Farmers and members faced challenges transporting fish seed, inputs and harvested produce, which limited volumes, delayed deliveries and increased post-harvest losses. The upgradation involved elevating the road and paving it with interlocking concrete blocks, making it motorable throughout the year and mitigating challenges, thereby improving efficiency and transport volumes.

The intervention was completed in July 2023 at a total cost of Rs. 1.39 crore. The road has enhanced accessibility to the FPC and surrounding areas, strengthening agricultural and aquaculture value chains. By connecting the FPC more effectively to nearby villages and markets, it has also improved access to essential services and facilitated broader economic opportunities for the local community.


Post-completion, the road has been handed over to the Public Works Department (PWD) for maintenance, ensuring long-term sustainability. The defect liability period has been completed, marking the successful closure of the intervention. Overall, the upgraded road has significantly improved connectivity for the Gohpur FPC, supporting both operational efficiency and regional development.

Visit Report: Road Upgradation - Singia Govindapur PWD to No. 1 Thekeraguri Gaon, Machkhowa Mouza, Lakhimpur District


Under the APART project, a rural intervention was undertaken to upgrade the 1.4 km road stretch from Singia Govindapur PWD to No. 1 Thekeraguri Gaon in Lakhimpur. The primary objective was to improve access to nearby agricultural clusters, along with benefiting silk farmers of Charikaria Muga FPC, located nearby.

Before the intervention, the stretch was an earthen road that became muddy and impassable during the rainy season. relied on carts to transport their produce, as motorized vehicles could not operate effectively. This limited the volume transported, delayed deliveries and restricted market opportunities.

The upgradation, completed in July 2024 at a cost of Rs. 1.69 crore, involved elevating the road and paving it with interlocking concrete blocks. With this intervention, the road has become motorable year-round, improving the speed, reliability and volume of transportation. Farmers now have smoother access to markets, reducing post-harvest losses, improving profitability and enabling stronger market linkages.

Post-completion, the road was formally handed over to the Public Works Department (PWD) for maintenance. The defect liability period has also been completed, marking the successful closure of the intervention and ensuring long-term sustainability.

Warehouse

Visit Report: Renovation of ASWC Warehouse, Amingaon (Kamrup District)

The ASWC warehouse at Amingaon in Kamrup district was originally built in 2013 over a land area of 9 bighas, with four godowns of 2,000 MT capacity each. The facility faced several challenges with the entire land being swampy and muddy, lacking proper internal roads and the godowns themselves deteriorating. During the rainy season, the warehouse could hardly be used, as waterlogging and dampness severely affected operations, making it unfit for systematic storage.

Under the APART project, three godowns were renovated, of which one was modernized with a stacking arrangement to introduce process automation in handling and storage. Today, the facility stores a wide range of goods including food grains and branded products, catering largely to traders due to its location near Guwahati city, with NH-27 providing direct connectivity. It now operates at an average occupancy of around 65% and generates Rs. 3.5 lakh profit per month on an average.

The intervention also included the construction of internal roads, installation of weighbridge and provision of drainage facilities, toilets, drinking water and fire protection systems. Importantly, facilities for prophylactic treatment such as fumigation covers and sprayers, were introduced. Labor compliance and worker safety have been given due importance with first aid, sanitation and other conveniences ensuring a safe working environment. To encourage farmer participation, a 10% discount is provided over the standard schedule of rates.

The warehouse has emerged as a modern and efficient storage hub, employing seven workers and ensuring secure services. By providing reliable storage options, the intervention has enhanced trade efficiency and improved farmer access to post-harvest services in the region. While the renovation has significantly upgraded the facility, the fourth godown and the approach road still require improvement and can be considered for future upgradation.






Visit Report: Renovation of ASWC Warehouse in Kharupetia (Darrang District)

The Assam State Warehousing Corporation (ASWC) warehouse at Kharupetia in Darrang district is more than 50 years old and comprises six godowns with a total storage capacity of 7,650 MT. Over time, the facility had deteriorated, lacking proper infrastructure and thereby affecting operational efficiency.

Under the APART project, the warehouse was renovated, leading to significant improvements in storage infrastructure and functionality. Today, it stores a wide range of commodities, including food grains such as paddy, maize and arecanut along with branded goods handled by private organizations. Prior to the intervention, the warehouse operated at only 50-60% capacity utilization; following the renovation, utilization levels have increased to nearly 87%.

The intervention also included the provision of drainage facilities, toilets, drinking water and fire protection systems, making the warehouse a safe and reliable storage facility. The warehouse currently employs five workers and is truck-accessible, with nearby markets enhancing its relevance. Labor compliance and worker safety have also been prioritized with arrangements for first aid, sanitation and other conveniences ensuring a safe working environment. To encourage farmer participation, a 10% discount is provided over the standard schedule of rates.

Overall, the renovation has revitalized this long-standing facility, improving its utilization and reliability for both farmers and traders. However, some gaps remain. The warehouse does not yet have its own weighbridge, relying instead on a private facility located 1.5 km away. In addition, the absence of CCTV cameras limits surveillance and monitoring capacity. Addressing these gaps would further strengthen efficiency, security and service delivery.

Markets

Visit Report: Bondapara Market, Kamrup Rural District

Bondapara Market, a weekly Thursday market in Kamrup Rural district, is spread across 4 bighas and plays an important role in facilitating trade in agricultural produce and livestock. Under the APART project, the market was upgraded with retail sheds, internal roads, toilets, drinking water facilities, garbage disposal bins, etc. These interventions have made the market more organized and accessible compared to earlier, when sellers were compelled to sit on the highway during rains due to lack of infrastructure. However, provision of solar lighting is still missing and no system of auctions has been introduced.

The market attracts around 40 sellers on regular days and nearly 200 sellers during peak seasons, highlighting its importance as a rural economic hub. Farmers, including those associated with nearby FPCs and production clusters, actively use the market, thereby linking around 15–20 villages to wider trading opportunities. Its accessibility to the highway

(NH 37) has further boosted participation by buyers and sellers from surrounding areas. The market operates on an open-out-cry system and e-auctions are not yet implemented.

The market is currently managed by a 21-member Market Committee, which has taken it on lease. While the committee plays a central role in managing operations and collecting fees, it is notable that there are no female members in the governing structure, which limits inclusivity- even though some women do participate as sellers. Around 10 workers are employed to support operations and maintenance, while a small office building located nearby serves as a base for committee activities.

Overall, the upgraded facilities have created wider economic opportunities by enabling farmers to bring larger volumes of produce, reducing post-harvest losses and attracting traders from beyond the immediate villages/blocks. This has strengthened linkages between producers and buyers, improved price realization and reduced distress selling during peak harvest seasons. By making the market cleaner, more accessible and reliable, the intervention has not only boosted rural trade but also contributed to better livelihoods and community development in the surrounding villages.



Visit Report: Amjonga Market, Goalpara District

Amjonga Market, a historic Tuesday market in Goalpara, spread across 9 bighas, serves as a key trading hub for surrounding villages and neighboring regions. Under the APART project, the market was upgraded with internal roads, toilets, drinking water facilities, garbage disposal bins, parking spaces, retail sheds, etc. These facilities have made the market more organized, accessible and reliable, significantly reducing earlier challenges faced by buyers and sellers. However, dedicated packaging facilities, internet connectivity, cold storage and a guest house are still not available.

The direct connectivity from NH 37 with a railway station nearby provides strong access, attracting buyers and traders not only from Goalpara but also from Kamrup, Bongaigaon and even across the Meghalaya border. The market deals with a diverse range of commodities including vegetables, fish, arecanut, garments, handloom, handicrafts, bamboo, etc., with paddy trading taking place in the early morning hours. Supported by nearby paddy and banana clusters, it caters to 13-14 villages and regularly attracts over 200 buyers along with 3-4 wholesale traders. The market operates on an open-out-cry system and does not yet have e-auctions. An ATM nearby adds convenience for both traders and farmers.

The market is managed by a committee, which has taken it on lease. The committee does not charge farmers for selling their produce and collects fees only from traders. About 11 workers and 6 collectors support daily maintenance and operations. Women’s participation is strong and around 70% of market participants are from tribal communities. Documentation practices are established with systematic records maintained on trader participation and fee collection.



Overall, this market has strengthened linkages between producers and buyers, improved price realization and reduced distress selling during peak harvest seasons. With its strategic location and diverse participation, Amjonga Market holds strong potential as a regional hub. Addressing gaps such as drainage, electricity and storage along with strengthening marketing and management, will be vital for ensuring sustainability and inclusive growth.

Visit Report: Upgradation of Ketkibari Market, Tezpur, Sonitpur District

Ketkibari Market, a bi-weekly market in Tezpur, was originally established in 1942 over a total land area of 9 bighas and 3 katha. Under the APART project, the market underwent significant infrastructure upgrades including retail sheds, internal roads, drainage, washrooms, garbage disposal bins, street lighting, etc. These improvements have made the market cleaner, better organized and fully accessible to motorized vehicles. However, dedicated packaging facilities, internet connectivity, cold storage and a guest house are still not available.

The market primarily serves as a trading hub for vegetables and other local produce, catering not only to local farmers and traders but also attracting buyers from neighboring districts such as Darrang and Nagaon, thereby enhancing trade volumes and linking producers to broader markets. Farmers from nearby production clusters, including Mojiya and Jaymoti FPCs, actively use the market to sell their produce. While there is no dedicated space for women vendors, women are allowed to sell at a lower daily rent compared to men, which encourages their participation. The market operates on an open-out-cry system and e-auctions are not yet implemented.

The market is leased at Rs. 9 lakh per year, with an 11-member Market Committee overseeing daily operations, including collection of sitting charges and other fees from sellers. Fourteen workers are employed to manage market activities, while sweepers help maintain cleanliness compared to its earlier state. An ATM nearby adds convenience for both traders and farmers.



Despite these improvements, governance and documentation remain weak. The Market Committee currently lacks transparency in operations, record-keeping and financial management, which may affect long-term sustainability and equitable benefit distribution. Addressing these gaps will be crucial to fully leverage the upgraded infrastructure and ensure that both farmers and traders continue to benefit from the market.

Milk - Success stories of Formal Milk value-chain

Success Story 1: Kanchandhenu Dugdha Utpadak Samabay Samitee Ltd., Thamna

Established in 2018 with APART's support, Kanchandhenu DUSS has transformed milk production and marketing in Thamna village. What began with just **10 liters per day from 6 farmers** has grown into a thriving cooperative of nearly **200 farmers producing 800 liters per day**. The cooperative has flourished, becoming an integral part of the village's fabric.

Their active involvement in the milk business has led to a consistent increase in their cattle herd size accompanied by steep growth in production over the years. The result of all these endeavors amounted to a disbursement of Rs. 6,25,404 to the farmer members in 5 financial years since the APART intervention.

***Table 100**: Year-wise Additional Milk Price paid to the Farmer Members- Kanchandhenu DUSS*

Financial Year	No. of Producer	Additional Milk Price Paid
2019-2020	41	28,636
2020-2021	62	99,826
2021-2022	105	2,14,801
2022-2023	94	32,133
2023-2024	99	2,50,008
Total		**6,25,404**

Through training, AI services, and fodder support under APART and WAMUL, farmers adopted clean milk production practices, crossbred cattle, sustainable fodder management (silage, Napier cultivation, maize for feed) and effective livestock management strategies. This not only improved productivity but also reduced input costs.

***Table 101:** Comparison of Before and After APART- Kanchandhenu DUSS*

SN	Parameters*	2019-2020	2023-2024	2024-2025 up to Sept-24
1	Avg. Milk Quantity / Day	112.02	306.06	289.77
2	No. of Total Pourer	125	288	288
3	No. of Active Pourer	116	127	106
4	Avg. Milk Quantity/Farmer	0.97	2.41	2.73
5	Avg. Fat% and SNF%	4.61 & 8.63	4.63 & 8.60	4.63 & 8.64
6	Avg. Milk Price (in Rs/L)	37.06	43.79	43.93
7	AI %	20%	70%	80%

**Details are of Peak Season*

Today, Kanchandhenu DUSS stands as a strong example of a sustainable rural dairy ecosystem. By combining collective action with technology adoption, market linkages and sustainable fodder practices, the cooperative has enhanced productivity, secured better incomes and built resilience against challenges such as COVID-19 and seasonal floods.

Success Story 2: Dandua Dugdha Utpadak Samabai Samity Ltd.

Dandua, a village near Mayong in Assam, long struggled with marketing its milk despite having easy access to markets. Farmers could not ensure regular disposal, discouraging many from taking up dairying as a livelihood.

This changed with the formation of the *Dandua Dugdha Utpadak Samabay Samiti* on 21st June 2019, when 15 farmers, led by Mr. Dip Kumar Deka, associated with WAMUL under the APART project.

From the outset, APART extended strong support to the society. An Automatic Milk Collection System (AMCS) was installed, ensuring transparency and building farmers' trust. Training and inputs on improved feeding practices, along with subsidized cattle feed, mineral mixtures and fodder seeds, enhanced both milk quality and productivity.

Table 102: *Comparison of Before and After APART- Dandua DUSS*

SN	Parameters	2019-2020	2023-2024	2024-2025 up to Sept-24
1	Avg. Milk Quantity / Day	134.86	260.84	257.53
2	No. of Total Pourer	94	184	185
3	No. of Active Pourer	93	49	46
4	Avg. Milk Quantity/Farmer	1.45	5.32	5.60
5	Avg. Fat% and SNF%	4.62 & 8.28	4.57 & 8.26	4.57 & 8.28
6	Avg. Milk Price (in Rs/L)	36.19	41.70	41.92
7	AI %	30%	70%	80%

To address fodder shortages in this low-lying area, APART introduced silage-making techniques. Farmers were trained, provided chaff cutters and silage bags and now prepare fodder reserves for lean periods. Veterinary executives and AI services improved herd quality, helping farmers shift from low-yielding local breeds to cross-breeds producing 12-15 liters of milk per day.

Capacity-building programs on clean milk production, animal nutrition and cooperative management further strengthened operations. Farmers also received stainless steel cans, a milking machine and exposure to modern practices.

As a result, dairying in Dandua has become viable and sustainable. The cumulative efforts of farmer members of Dandua society have resulted in a total of Rs.5,65,907 returned to them as additional milk price since the APART intervention. The farmers have made rapid progress which can clearly be seen from the year-on-year incremental value they have received as additional milk price.

Table 103: *Year-wise Additional Milk Price paid to the Farmer Members- Dandua DUSS*

Financial Year	Nos. of Producers	Additional Milk Price Paid
2019-2020	28	38613
2020-2021	32	1,10,517
2021-2022	40	1,90,849
2022-2023	34	22,057
2023-2024	44	2,03,871
Total		**5,65,907**

Today, the Dandua Society stands as a shining example of how collective effort, supported by the right interventions, can transform rural dairying into a sustainable and profitable enterprise.

Milk - Success stories of Informal Milk value-chain

Success Story 1: Kamdhenu (all women) Mahila DUSS, Sonitpur

The Kamdhenu Mahila DUSS, an all-women cooperative in Sonitpur, was established in August 2022 with 30 members and an initial daily milk collection of 100 liters. The members participated in a five-day milk producer's training, where they learned scientific cattle rearing, hygienic milk production practices and improved animal nutrition and healthcare. Currently, it has 23 active members, all women and has successfully doubled its daily milk collection to 200 liters. The milk is supplied to Purabi Dairy, generating a monthly income in the range of Rs 1.5-2.0 lakh, demonstrating both economic empowerment and improved livelihoods for its members.

Success Story 2: Jinjiram Dairy Cooperative Society, Goalpara

In August 2021, 30 dairy farmers, including 17 women, participated in a five-day milk producer's training program. Following the training, they came together to form the Jinjiram Dugdha Utpadak Samabay Samittee with 40 members. The cooperative initially collected 800-1,000 liters of milk per day. Over time, with improved practices and project support, daily collection has risen to about 5,500 liters. Of this, around 3,500 liters are supplied to WAMUL, while the remaining quantity is sold locally, including sweet shops. The initiative has significantly enhanced milk production and enabled farmers to achieve better price realization.

Fish- Success stories and Case studies

Uttaran Farmer Producer Company Ltd. Kamrup, Assam	Gohpur Fish Farmer Producer Company Ltd. Biswanath, Assam
Quality Fish Feed	**Fish Seed Hatchery**
	
The FPC received support from the APART project for establishing a fish feed mill (Common Service Center) with a total project cost of Rs.62.5 lakh, comprising Rs.50 lakhs from APART, Rs.6.25 lakh as	The FPC is primarily focused on fish seed production and has benefitted from a wide range of support under the APART project, including high yielding fish seeds, pond construction, training on improved practices and packages of practices (PoPs). Members benefit from access to improved fish seed varieties at affordable prices, coupled with

Uttaran Farmer Producer Company Ltd. Kamrup, Assam	Gohpur Fish Farmer Producer Company Ltd. Biswanath, Assam
a bank loan and Rs.6.25 lakh contribution from members.	technical guidance, which has translated into higher productivity.

Case Study- From Tradition to Transformation: Shambhu Haloi's Journey in Sustainable Fish Farming

Fish farming is a vital economic and livelihood activity for rural communities in Assam. While diversification of species and farming practices has the potential to boost productivity, income and sustainability, many farmers still rely heavily on traditional methods and primarily cultivate major and minor carp species.

The success story of Shri Shambhu Haloi (son of the late Dhiren Haloi) from Khatkatara village in Barkhanajan, Nalbari District, serves as an inspiring example of how adopting specialized practices and diversifying species can significantly enhance outcomes. By incorporating high-value giant freshwater prawns (*Macrobrachium rosenbergii*) into his existing carp polyculture system under the World Bank assisted Assam Agribusiness and Rural Transformation Project (APART), Shambhu managed to double his income.

Shambhu, who is around 42 years old, owned two ponds and initially practiced traditional fish farming methods. In 2020-21, he was selected as a beneficiary of the APART project, receiving key inputs including freshwater prawn seed and feed, quality carp seed, fish feed, lime, zeolite and fertilizers. Additionally, he received technical support from WorldFish and the District Department of Fisheries.

With this support, Shambhu transitioned to a more scientific approach, replacing low-value bottom-dwelling species like Mrigal with high-value freshwater prawns. The results were remarkable. Following APART guidelines, he harvested 87 kg of prawns, earning approximately Rs. 52,200 and 876 kg of carps, bringing in Rs.1,31,400. Encouraged by this success, Shambhu invested his earnings to construct five additional ponds and set up nursery rearing facilities on his ancestral land, with continued guidance from the Nalbari District Fisheries Office.

Today, Shambhu is a thriving entrepreneur and a passionate advocate of freshwater prawn polyculture. His story has inspired at least 21 other farmers in the region to adopt similar practices, especially among educated rural youth seeking local income-generating opportunities in the aftermath of the COVID-19 pandemic.

"The World Bank-aided APART scheme has been a turning point in my life," says Shambhu. "Freshwater prawn farming was new to me, but with the continuous support and guidance from the Department of Fisheries, I was able to successfully produce both prawns and carps in the same pond and nearly double my income. I'm confident that this practice will continue to boost my earnings and I'm committed to encouraging other farmers to follow this path."

Success Story: Pilot cum scaling- Inclusion of nutrient-dense small fish powder in diets among pre-school children of Anganwadi Centers and LP School children through a partnership approach at Bongaon Block in Kamrup District of Assam[23]

The *Matsya Paripusti* initiative was piloted to address child malnutrition by introducing dried small fish powder into the Integrated Child Development Scheme (ICDS) Supplementary Nutrition Program (SNP). The fish powder was incorporated into hot cooked meals served at Anganwadi Centers. Scientific

[23] https://hdl.handle.net/10568/172473

research highlighted that fish powder is a rich source of protein, has essential fatty acids, and vital minerals such as calcium, phosphorus, iron and zinc.

The pilot, implemented in Kamrup district, demonstrated encouraging results. Incorporation of fish powder into children's meals led to a reduction in underweight and severe stunting rates among Anganwadi children. It also contributed to measurable improvements in Body Mass Index (BMI), weight and height among lower primary school children. The pilot project demonstrates a promising approach to addressing child malnutrition through the inclusion of nutrient-dense small fish powder in children's diets.

FPC - Case 1: Srijoni Farmer Producer Company (FPC), Goalpara District

The Srijoni Farmer Producer Company (FPC) was facilitated by SESTA NGO, initially formed with around 500 members and now expanded to 766 members, of which 200-250 are currently active. The FPC is managed by a Board of 5 directors and received business planning training support during its early stages. All members of the FPC are women, making it a women-led institution that enhances inclusivity and local empowerment.

The FPC primarily focuses on paddy (Joha rice), turmeric and banana, which are the major commodities cultivated in the surrounding production clusters. Demonstration activities have been conducted effectively, though challenges such as water scarcity and lack of irrigation facilities led to seed losses in some cases.

To strengthen its operations, the FPC received support for establishing a Common Service Center (CSC) with banana as the major commodity. Under APART, required machinery has been delivered to the Common Service Center (CSC) but frequent power cuts due to the ongoing construction of the connecting NH-37 highway impedes operations at times.

In terms of governance, the FPC has established strong institutional mechanisms including a Grievance Redressal Mechanism (GRM), a Social Committee and a Local Complaint Committee (LCC). An Internal Complaints Committee (ICC) will also be formed soon. A social audit has already been conducted, reflecting transparency and accountability in operations.

Overall, while Srijoni FPC demonstrates strong governance and active women's participation, its growth potential depends on addressing operational gaps at the CFC, ensuring functional infrastructure and expanding irrigation facilities to fully leverage its commodity base. Managerial handholding is also required to ensure sustainability and to enable the FPC to achieve growth and operational efficiency.



Case 2: Mapakkai Agro Producers Company Ltd, Swani Rani Block, Kamrup Rural

Mapakkai Agro Producers Company Ltd was established in August 2020 with over 680 members. At present, around 400 members are actively participating, of which 97% are women, organized into 34 Farmer Interest Groups (FIGs). The Board of Directors consists of five members, supported by five promoters. The FPC primarily focuses on Eri silk fabric and

its finished products, while various FIGs are engaged in activities such as yarn production, traditional eri rearing, etc. Importantly, this is among the first organized efforts in the state to bring together silk farmers and weavers under a single collective platform, an initiative made possible through the support of the APART project in Assam.

To strengthen its operations, the FPC received support for establishing a Common Service Center (CSC) on 12th August 2024 with a total project cost of Rs. 63 lakhs, comprising Rs. 50 lakhs support from APART, Rs. 6 lakhs contributed by members and a Rs. 7 lakhs bank loan. However, the support came nearly four years after the FPC's establishment, which delayed the streamlining of production and operations.

Prior to receiving CSC support, production and processing were limited, with most FIGs functioning independently and lacking coordinated infrastructure. Minimal access to machinery, storage and processing facilities hindered members from scaling up their activities.

Despite strong initial membership, the FPC still lacks a concrete business plan, documentation remains poor and most machinery at the CSC is not yet operational. Intensive technical and managerial handholding is urgently required to ensure sustainability and to enable the FPC to achieve growth and operational efficiency. However, even at this stage, the CSC has enabled members to access new opportunities by participating in workshops and exhibitions which has improved their market exposure and provided initial linkages to marketing channels.

Case 3: Mojiya Farmers Producers Company Ltd., Dhekiajuli (Sonitpur District)

Mojiya Farmers Producers Company Ltd. was established on 10th November 2021 and currently has 500 members, including 143 women, organized into 20 Farmer Interest Groups (FIGs). The Board of Directors comprises 14 members, ensuring representation and collective decision-making. Collectively, members own about 2,000 hectares of farmland.

The FPC has positioned itself in the seed sector, with paddy seed as its primary product marketed under the brand name Utpadan. Currently, around 80 farmers are actively engaged in seed production, while other members pursue diverse agricultural activities. All members benefit from technical assistance and training facilitated by the FPC, along with support in marketing their produce. For storage, the FPC rents a 10,000 sq. ft. godown with a 100 MT capacity, typically for 4-5 months a year, with about 80% of the financing supported through a bank loan.

On the governance front, the FPC has instituted strong systems, including Annual General Meetings (AGM), financial audits, social audits, a Grievance Redressal Mechanism (GRM) and an Internal Complaints Committee (ICC). Dividends have not yet been distributed to shareholders, though management has indicated that this will likely commence from the next financial year.

The Utpadan brand has already provided significant visibility and market traction giving the FPC a competitive edge over many of its peers. However, to ensure scale and sustainability beyond the APART project, further support will be essential. The current reliance on rented storage highlights the need for availability of dedicated infrastructure, alongside local packaging facilities and continued handholding, to secure long-term growth.

Common Service Centers (CSCs)

Case 1: Jaymoti Farmers Producers Company Ltd., Dhekiajuli, Sonitpur

Jaymoti Farmers Producers Company Ltd. was established in October 2021 with 653 members, all actively participating women farmers. Collectively, members own around 1,000 hectares of farmland. The FPC primarily focuses on crops such as mustard, potato, paddy, pumpkin and black gram, employing a strategic approach where each Farmer Interest Group (FIG) allocates land for different crops proportionately, balancing home consumption and marketable surplus.

The FPC has benefitted significantly from APART support, receiving quality seeds and short-term resilient varieties (STRVs) that enhanced yields and profits even during flood conditions. While all members cultivate crops across their farmland, in 2023-24, over 200 farmers cultivated pumpkin on 3,000 bighas land and sold the produce to various traders of Kolkata, Agartala and other regional markets, resulting in substantial profits. Additionally, the FPC undertook contract farming with PepsiCo for 100 bighas of mustard in 2023, receiving technical training and packages of practices (PoP) to ensure assured buyback and profitability. Profits from this initiative were shared directly with the participating farmers and the FPC plans to expand contract farming to 200 bighas in 2025. The success of contract farming demonstrates a scalable and sustainable approach to income generation for members.

Strong governance and leadership have been key to the FPC’s success. Chairperson Kamal Kumari Boro has been instrumental in effectively managing operations, with robust systems in place for collective decision-making and member participation. Her exemplary leadership was nationally recognized when she received the Atal Gaurav Award in Delhi in 2023.

In 2025, the FPC received a Common Service Center (CSC) valued at Rs. 37 lakhs, comprising Rs. 30 lakh support from APART and Rs. 7.5 lakh contributed by members. The CSC, with a daily processing capacity of 1.5 tons, facilitates the production of mustard oil and oilcakes, generating profits of over Rs. 4.15 lakh from February 2025 to date, earmarked for equitable distribution among members. The CSC adds a sustainable revenue stream, ensuring continued benefits for members independent of external project support.

Despite these successes, challenges remain, including irrigation-related constraints, electricity issues and the absence of a dedicated godown (currently under application). The FPC has responsibly managed short-term loans, such as an Rs. 8 lakh loan for Boro paddy cultivation from RangDe, which is expected to be easily repaid given the high profitability of operations.

Overall, Jaymoti FPC stands out as a highly profitable, well-governed and member-centric cooperative, demonstrating successful collective farming, strategic market linkages and strong institutional leadership, setting a benchmark for other FPCs in the state. The FPC is well-positioned to remain sustainable and continue delivering benefits to its members even after the conclusion of the APART project.

Case 2: Gohpur Fish Farmers Producer Company Ltd., Biswanath District

Gohpur Fish Farmers Producer Company Ltd. was established in 2020 with about 400 stakeholders organized into 40 Farmer Interest Groups (FIGs), of which more than 200 are

currently active members. The FPC is primarily focused on fish seed production and has benefitted from a wide range of support under the APART project, including high yielding fish seeds, pond construction, training on improved practices and packages of practices (PoPs). Members benefit from access to improved fish seed varieties at affordable prices, coupled with technical guidance, which has translated into higher productivity. An approach road to the site was also upgraded under APART to improve connectivity, though a small stretch is still pending due to revenue department approvals.

To strengthen operations, a Common Service Center (CSC) was established about 2.5 years ago, with a total investment of Rs. 77 lakhs, Rs. 50 lakhs supported under APART and Rs. 27 lakhs mobilized by members through a bank loan. The CSC, along with trained manpower, office setup and seed bank, has enabled large-scale training activities; recently, the FPC trained 322 fish farmers, enhancing skills and capacity across the region.

Financially, the FPC is operating profitably. It reported revenues of Rs. 48 lakhs in financial year 2024-25 and is targeting Rs. 60 lakhs for financial year 2025-26. The FPC is also focusing on developing its own brand identity and expanding into direct retail seed sales through stores. To finance its operations, it has availed loans from Samunnati, which it is well-positioned to repay given its healthy performance.

The strategic location of the FPC, close to the entry point to Itanagar from the Doloni-Lakhimpur highway, makes it well-positioned to access larger markets in the future. With Itanagar airport expected to commence cargo services soon, opportunities for interstate exports are expanding, further strengthening the prospects for scale and sustainability.

While the FPC has demonstrated commendable progress in building profitable operations and expanding opportunities, certain governance challenges persist. Currently, the profit-sharing mechanism is not clearly defined, raising concerns that members may not be benefiting equitably. To ensure long-term sustainability, it is important that the FPC functions in a way where growth and returns are shared fairly among all members, rather than being unequally concentrated. Going forward, greater emphasis will be required on strengthening transparency and establishing clear benefit-sharing mechanisms, which are crucial for maintaining member confidence and maximizing the FPC's overall impact.

Case 3: Uttaran Farmers Producers Company Ltd in Kamrup Rural

Uttaran Farmers Producers Company Ltd was established in March 2021 with 436 members, organized into 17 Farmer Interest Groups (FIGs). Currently, around 50% of the members are actively participating, of whom 60% attended the Annual General Meeting held in December 2024. The Board of Directors comprises 10 members (two women), including promotors. The FPC primarily focuses on aquaculture, particularly fish feed production and distribution.

To strengthen its operations, the FPC received support from the APART project for establishing a fish feed mill (Common Service Center) with a total project cost of Rs. 62.5 lakhs, comprising Rs. 50 lakhs from APART, Rs. 6.25 lakhs as a bank loan and Rs. 6.25 lakhs contribution from members.

During the financial year 2024-25, the FPC generated a turnover of Rs. 27 lakhs. Although no dividend has been distributed to shareholders to date, selected members receive benefits such as technical inputs, access to Kisan Credit Cards (KCC), fingerlings, fish feed and seed by the FPC.

The FPC is operationally profitable and performing well in the aquaculture sector; however, governance, transparency and inclusive growth require greater attention. The current operations are not fully aligned with the member-centric principles of an FPC, where all members should benefit and grow together. Strengthening management practices, ensuring equitable profit-sharing and fostering an inclusive growth model will be essential to achieve long-term sustainability and maximize benefits for all members.

Xamahar

Success story: Driving FPC Growth through Trade Financing Support

Mandia FPC in Barpeta and Bortola FPC in Nalbari district received the support of trade financing from DeHaat in the last FY. Maize as a commodity DeHaat came into agreement with Suguna Foods to establish a guaranteed market linkage to the producer companies. With proper monitoring of the supply chain from DeHaat to ensure all the required quality for the trade, FPCs completed 90+ MT maize trading with cumulative revenue of Rs.20+ Lakhs.

Impact of Trade Financing-

Trade financing has proved to be a crucial instrument for the FPCs (Bortola and Mandia FPC) to tackle the working capital crisis in the FPC. Bortola FPC has been able to successfully regulate rotation of the working capital through the trade financing nature of financing support. Bortola FPCs first transaction with Suguna food took place on 24th April 2024 and marketed maize worth Rs. 4.73 lakhs. After immediate payment from DeHaat, they were able to rotate the same amount for procurement of another three rounds generating cumulative business turnover of Rs. 14.75 lakhs in just three-week time.

- **Mr. Bhagawan Kalita- Bortola FPC, member farmer**

Mr. Bhagawan Kalita, a shareholder farmer of Bortola FPC cultivating around 6 acres in the Char area, produced over 100 quintals of maize and sold all his marketable surplus to the FPC, earning Rs. 2.12 lakhs with a net profit of Rs. 1.6 lakhs. Compared to past sales to local traders- who offered lower and non-transparent prices- the FPC ensured better returns and immediate payment, enabling him to plan for the next season and highlighting the benefits of collective trading.

- **Mr. Jamal Uddin- Mandia FPC, member farmer**

Mr. Jamal Uddin, a maize cultivator from Mandia FPC with about 4 acres under cultivation, previously faced non-transparent trade and delays in payment when selling to local vendors. Following the Xamahar Challenge Fund intervention with DeHaat and Mandia FPC, he sold maize worth over Rs. 2 lakhs through a transparent process, earning a net profit of around Rs. 1.5 lakhs and receiving payment within 2–3 days, compared to the 1–2 months earlier.