WorldFish

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Assam Agribusiness and Rural Transformation Project (APART): Fisheries Sub-Component

Six Month Report- 6 (April, 2021 to September, 2021)

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About WorldFish
WorldFish is an international, not-for-profit research organization that works to reduce hunger and poverty by improving fisheries and aquaculture. It collaborates with numerous international, regional and national partners to deliver transformational impacts to millions of people who depend on fish for food, nutrition and income in the developing world. Headquartered in Penang, Malaysia and with regional offices across Africa, Asia and the Pacific, WorldFish is a member of CGIAR, the world's largest global partnership on agriculture research and innovation for a food secure future.

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List of acronyms

AAU	Assam Agricultural University
APART	Assam Agribusiness & Rural Transformation project
ARIAS	Assam Rural Infrastructure and Agricultural Services Society
ATMA	Agricultural Technology Management Agency
AWP	Annual Work Plan
BDMC	Beel Development Management Committee
BMP	Better Management Practices
CGIAR	Consultative Group on International Agricultural Research
COF	College of Fisheries
CIFA	Central Institute of Freshwater Aquaculture
CIFRI	Central Inland Fisheries Research Institute
DOF	Department of Fisheries
DSSC	District Social Sector Coordinators
FDO	Fishery Development Officer
FGD	Focus Group Discussion
FPG	Farmer Producer Groups
FPC	Farmer Producer Companies
FPOs	Farmer Production Organisations
GoA	Government of Assam
ICAR	Indian Council of Agricultural Research
IMC	Indian Major Carps
IRRI	International Rice Research Institute
KVK	Krishi Vigyan Kendra
ODK	Open Data Kit
PDO	Project Development Objective
POP	Package of Practices
SOP	Standar Operating Procedures
TEF	Technical Expert in Fisheries
VCDP	Value Chain Development Plans
WB	World Bank

1. EXECUTIVE SUMMARY

Government of Assam (GoA), through the Government of India has received a loan of US$200 million from the World Bank (WB) for implementation of Assam Agribusiness and Rural Transformation Project (APART). 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. Fish has been prioritized as one of the value chains for interventions under APART.

WorldFish, part of One CGIAR, has signed a consultancy agreement with ARIAS on 10th Aug 2018 to offer technical assistance to Fisheries sub-component of APART project over a duration of 5 years. ARIAS has provided the effectiveness date for the contract as 17th Aug 2018.

For the Sixth Six months reporting period (April 2021- September 2021) the following key technical activities were completed:

Between April 2021 and September 2021, due to COVID 19 lockdown and travel restrictions WorldFish experts from Penang and Bangladesh could not travel to field sites in Assam, instead virtually interacted with ARIAS, DOF, COF, APART Project teams, conducted virtual trainings, meetings, conducted climate resilient technologies study, developed BMP guidelines, undertook assessments of demonstration practices and provided technical inputs for all the key interventions. Dr. Y. Bhasavaraju, Fish breeding and genetics expert, Dr. B. A. Shamasundar, Fish processing expert, Dr. Baishnaba Charan Ratha, Fish nutrition expert, Dr. Bimal Kinkar Chand, Climate change expert visited several project sites, closely interacted with project participants and other stakeholders and provided technical support for the project activities. Workshops on Fish Value Chain in Assam and on Quality Fish seed Production were conducted. Full time resident national consultant interacted closely with ARIAS, DOF, COF and project team and provided technical support for the project activities. In addition, he has coordinated the virtual discussions with WorldFish experts, attended the meetings conducted by World Bank, ARIAS, DOF, COF and other partners, arranged inputs from WorldFish technical experts and linked it to DOF and project beneficiaries through the FDOs and TEFs in the 16 Districts selected for fisheries sub-component of APART.

Enterprise development opportunities identified in the fish value chain study were communicated and discussed with several APART partners and service providers and collaborations established to support small enterprise development. Enterprise development around the fish feed value chain for the establishment of small and medium feed mills to supply quality fish feeds at affordable costs, establishment of fish seed rearing units under the FPCs for the supply of genetically improved fish seeds of Jayanti rohu and Amur common carp, establishment of dry fish production clusters to produce hygienic dry fishes required for Assam and other North Eastern states, establishment of hygienic retail outlets, live fish transportation units are a few worth considering activities promoted under the project to fill the gaps in fish value chain. WorldFish closely interacted

with ARIAS, DOF and Service providers for the establishment of Famer Producer Groups in Fisheries and also supported to identify the activities to be promoted through the FPCs.

WorldFish, in collaboration with DOF, organised Focus Group Discussions on Better Management Practices for the Farmer Producer Groups in the APART Project Districts. Six focus group discussions (FGDs) were held during the reporting period, with the participation of 118 farmers, including women and youth. For the benefit of DOF officials, APART Project staff, and COF faculty, six virtual meetings, one technical discussion, one ToT programme and two workshops were organised.

WorldFish developed KOBO online forms for collection of data from the beneficiaries and non-beneficiaries of the different interventions in the identified clusters of the project districts. Results of key production related interventions are being collected using ODK tools for performance analysis and fine tuning of BMPs.

During the lockdown period, a study on the impact of Covid-19 pandemic in fisheries and aquculture value chain in Assam was taken up in which 87 fish value chain actors (farmers, beel fisheries, fish inputs suppliers, fish seed producera, fish processora, fish wholesalers and fish retailers) were interviewed over phone to understand and assess the impacts of COVID-19 on the availability and price of aquatic foods and production inputs.

2. INTRODUCTION

WorldFish has signed a consultancy agreement with ARIAS to offer technical assistance to Fisheries sub-component of APART project over a period of 5 years. The project development objective of the Assam Agribusiness & Rural Transformation Project (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”. Keeping in line with the Project Development Objective of APART, the WorldFish technical contribution has the following five broad objectives:

1. Enable sustainable increases in aquaculture production without creating adverse socio economic or environmental impacts (Sustainable Intensification of Aquaculture)
2. Secure and enhance the contribution of small-scale fisheries to food security in Assam (Increasing Diversity and Productivity of Beels)
3. Increase the availability, access and consumption of nutrient-rich, safe fish, especially for women of reproductive age, infants and young children (Improving Fish Value Chains and human nutrition)
4. Develop and promote climate resilient technologies in support of sustainable aquaculture and small-scale fisheries (Climate resilient/smart aquaculture technologies)
5. Promote gender transformative approaches in support of sustainable aquaculture and beel fisheries in Assam (Gender Transformative Approaches in aquaculture & fisheries)

WorldFish has developed an approach to offer technical assistance to implementing partners on a continuous basis to accomplish the broad objectives through 10 key deliverables, namely:

- Deliverable 1: Promoting adoption of BMPs for sustainable intensification of aquaculture
- Deliverable 2: Up-gradation of Existing Indian major carp hatcheries to produce certified seed
- Deliverable 3: Multiplication Centres (MCs) for genetically improved fish strains
- Deliverable 4: Improving productivity of beels
- Deliverable 5: Improving Fish Value Chains
- Deliverable 6: Carp-Mola polyculture
- Deliverable 7: Improving impact of aquaculture and beel fisheries on human nutrition
- Deliverable 8: Promoting climate resilient smart fish production technologies
- Deliverable 9: Gender transformative approaches in support of sustainable aquaculture and beel fisheries
- Deliverable 10: Capacity building of DoF Officers

For each of these deliverables purpose, work done during the reporting period and the observations and recommendations to the implementing agencies is provided under Section 5. Similarly the activity wise work done for all the 10 deliverables during the reporting period is given in Section 9

3. TECHNICAL REPORT

WorldFish activities and recommendations for the project from August 2018 to March 2021 have already been presented in the following reports:

1. ***Inception report*** was submitted to ARIAS and DOF in Sept 2018 and the same has been approved by the ARIAS

2. ***Inception workshop report*** for the workshop that was completed in Aug 2018 to communicate the principles and concept of key interventions under the project to a large group of stakeholders and agree on the roles and responsibilities of WorldFish, DOF and COF

3. ***First Six Months report (August 2018 to March 2019)*** was submitted to ARIAS and DOF in April 2019 and the same has been approved by the ARIAS

4. ***Second Six Months report (April 2019 to September,2019)*** was submitted to ARIAS and DOF in October 2019 and the same has been approved by the ARIAS

5. ***Third Six Months report (October 2019 to March 2020)*** was submitted to ARIAS and DOF in April, 2020 and the same has been approved by the ARIAS

6. ***Fourth Six Months report (April 2020 to September,2020)*** was submitted to ARIAS and DOF in October 2020 and the same has been approved by the ARIAS

7. ***Mid Term review report for the World Bank Mid Term review mission was submitted to ARIAS and DOF on 16th Oct 2020.***

8. ***Fifth Six Months report (October 2020 to March,2021)*** was submitted to ARIAS and DOF in April 2021 and the same has been approved by the ARIAS

This 6th Six Months report is in continuation of previous reports, should not be seen in isolation and all recommendations provided earlier are still valid. This report particularly captures the work done during the period from April, 2021 to September, 2021 and provides additional observations and recommendations for implementing partners.

For successful implementation of key interventions, it is very essential to ensure synchronization and integration of WorldFish observations, recommendations and technical inputs to the Annual Work Plan of DOF and COF, AAU, the implementing partners for the fisheries sub-component of APART.

The present report includes the following major activities taken up by WorldFish during the period from April, 2021 to September, 2021.

WorldFish Experts Inputs: Between April, 2021 and September, 2021 WorldFish experts interacted with World Bank, ARIAS, DOF, COF and project staff and provided technical inputs for all the key interventions. Due to COVID-19 lockdown and travel restrictions, WorldFish team provided technical support virtually for the project activities and gave necessary recommendations. BMPs for Polyculture of

carps with genetically improved fish strains and Polyculture of carps with Freshwater Prawn and SOPs for IMC hatcheries and Multiplication centres were developed by WorldFish for distribution among the project beneficiaries for adoption of improved farming practices. WorldFish National Experts visited Assam, discussed with the Project Partners, visited field, participated in Workshops, Meetings, Discusssions and ToT Program and provided technical support for the project activities.

Resident Consultant Inputs: Full time Resident consultant from WorldFish is working in Assam since 7th January 2019 and is interacting closely with ARIAS, DOF, COF and project team and providing technical inputs related to all the 10 deliverables. In addition, he has participated in the virtual meetings organised by World Bank, ARIAS, DOF and COF, organised virtual discussion of DOF, COF, ARIAS and project staff with WorldFish experts, organised Workshops/Meetings/ Discussions/ToT Program, coordinated inputs from WorldFish technical experts and linked it to DOF and ARIAS for the project implementation of the fisheries sub-component of APART (***Resident National Consultant inputs in Section 10***)

World Bank Mid-Term Review Mission Action Taken: World Bank Mid-Term Review Mission of the APART Project was held during the period from 14th to 21st December, 2020. On 19th December, 2020, Mini-Mission to review the Fisheries Activities was held in which the Mission team members discussed the Fish Value Chain Study conducted by WorldFish, potential for freshwater prawn farming in Assam, Hygienic fish marketing by FishFed. Based on the recommendations of the Mission, a separate meeting for the Fisheries sub-sector was held on 17th June, 2021 in which the new proposals and the on-going activities in fisheries were discussed. Based on the discussions during the meeting, follow-up actions were taken to work out the economics of various demonstrations, identify the demonstrations to be scaled up and to conduct a Workshop on Fish Value chain in Assam for the various stakeholders in Fisheries (***Details of the World Bank Mid-Term Review Mission- Follow-up Action is provided in Section 8***)

Virtual Meetings/Discussions/Trainings/Workshops: During the recent COVID-19 pandemic situation due to travel restrictions, WorldFish experts provided virtual support for the implementation of project interventions by providing necessary technical support to ARIAS, DOF and COF. A series of virtual meetings, one discussion on fish processing, value addition and nutrition promotion under APART, one Training of Trainers program and two Workshops on Fish value chain in Assam and Quality carp seed production in Assam were arranged for the benefit of DOF officials, APART Project staff and COF faculty. During these virtual programmes the WorldFish experts provided technical support to DOF officials, APART Project staff, ARIAS Staff and COF faculty members. ***(Annexure 1)***

On the 6th and 7th of September, 2021, WorldFish experts participated and presented lectures during the Training of Trainers (TOT) programme organised by the College of Fisheries, Assam Agricultural University, Raha in order to empower DoF official staff, APART project staff, KVK staff, and CoF staff with recent project interventions specific to APART project that needed to be conveyed to the farmers.

Dr. Y. Basavaraju, WorldFish Fish breeding and genetics Expert, Dr. Bimal Kinkar Chand, Climate Change Expert, Dr. Arun Padiyar, WorldFish Sustainable Aquaculture Expert, and Dr. R. Suresh, Resident Consultant served as Resource Persons during the TOT programme. (***Annexure 2*****)**

On September 7th, 2021, WorldFish organised a Workshop on Fish value chain in Assam in collaboration with DoF and ARIAS Society with the main objective of understanding the fish feed value chain in Assam, scope of value addition, product development, and marketing to develop various enterprises around the gaps in the fish value chain in Assam. Dr. Nirmallya Mandal, Value Chain Expert, WorldFish, and Mr. Kaustav Mukhapadhyay served as resource persons for the workshop (***Annexure 3***).

WorldFish organised a Workshop on Quality carp seed production in Assam on September 7, 2021 in collaboration with ARIAS and DoF to promote quality carp seed production through better brood stock management, including sourcing of quality brood stock, nourishing brood stock, water quality and health management, scientific breeding program, seed rearing and the use of improved strains for quality carp seed production in both government and private hatcheries. Dr. Y. Basavaraju, WorldFish Expert in Fish Genetics and Breeding, and Dr. Arun Padiyar, WorldFish Expert, served as Resource Persons for the workshop. (***Annexure 4***)

On September 22, 2021, WorldFish, in collaboration with CoF and the ARIAS Society, hosted a discussion on fish processing, value addition, and nutrition promotion as part of APART to better understand the various fish processing methods and value addition of fish and fish products, entrepreneurship opportunities through the preparation of processed/value added fish products, and the role of small fishes as a source of micronutrients in human diets, particularly for pregnant women, lactating mothers and the for cognitive development of a minor children with a particular emphasis on the first 1000 days of child development. (***Annexure 5****)*

Climate Resilient Technologies Study: Application of Climate resilient technologies for productivity enhancement is a project intervention area under APART. With this objective WorldFish has conducted the study for mapping the existing climate resilient technologies practiced by the farmers, identifying the Indigenous Technical Knowledge (ITKs) in climate resilient practices, addressing the gaps in the adoption of climate resilient technologies and to assess the scope for adoption of climate resilient technologies/practices by all fish value chain players. During the reporting period, Stakeholder consultations with ARIAS, DOF, and COF have been conducted and FGDs with stakeholders from pond aquaculture and beel fisheries were arranged for better understanding of the climate resilient practices in beel fisheries and pond aquaculture. Qualitative and quantitative data collections using various tools and methodologies were taken up in the project districts including assessment of the various climate resilient technologies demonstrated in the project by College of Fisheries and implemented by Department of Fisheries. The study is completed and the report will be submitted to ARIAS, DOF and COF for adoption of recommended climate resilient practices.

Covid-19 Impact Study: WorldFish conducted a study during the period of lockdown in June, 2021 to understand the impact of Covid-19 on the aquatic food value chain in Assam. The study was conducted through telephone survey on one time basis for the last three months among various stakeholders of the fish value chain like fishers, farmers, hatchery operators, seed growers, feed mills, feed sellers, traders, processors and retailers from most of the districts representing various regions of Assam. The impact of Covid-19 pandemic situation on production, marketing, employment and income in fisheries and aquaculture sectors in Assam were analysed and presented in the report. (***Annexure 6***)

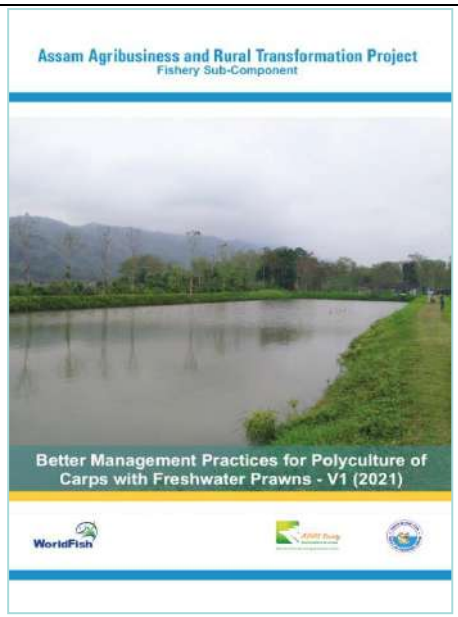
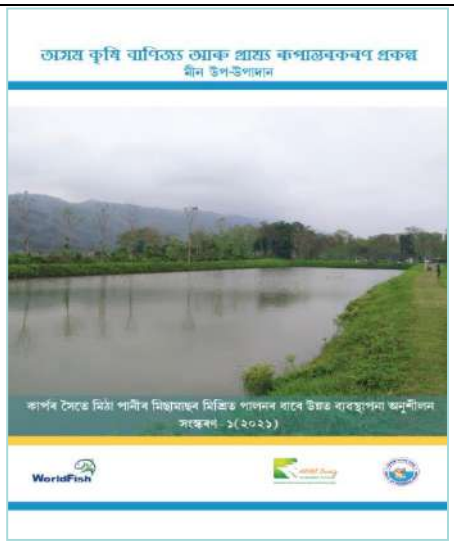
Focus Group Discussions: WorldFish along with COF and DOF organised Focus Group Discussion on Better Management Practices for the Farmer Producer Groups of Fisheries component in the APART Project Districts. During the reporting period 6 FGDs were conducted in 3 districts in which 118 farmers including women and youth participated in which BMP for Paddy-Fish Integrated Farming was provided ***(Annexure 7)***

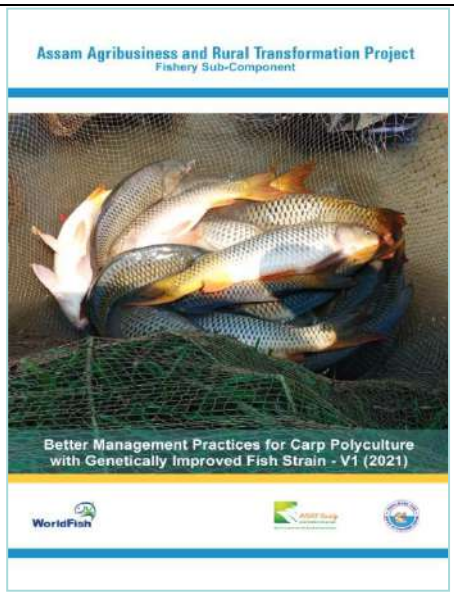
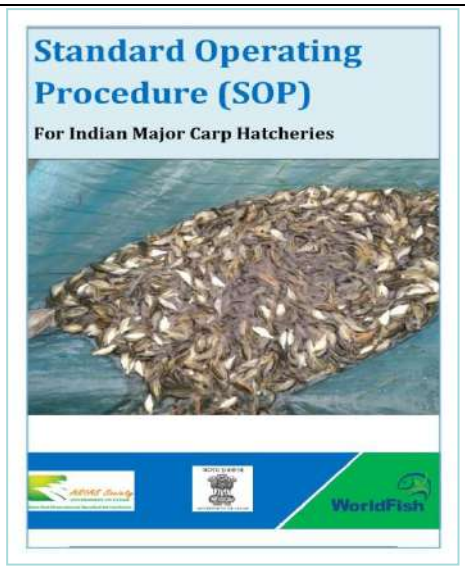
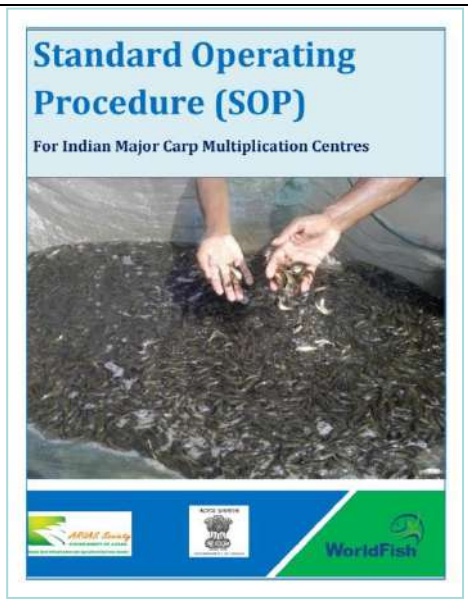
Visits of Experts: Several WorldFish experts visited Assam between April and September 2021, interacted with ARIAS, DOF, COF, primary beneficiaries, government and private hatchery operators, seed growers, private fish processors, and other human nutrition promotion stakeholders and provided technical inputs for all key interventions

WorldFish Extension Products: WorldFish developed BMPs for CArp Polyculture with genetically improved fish strains- V1 ***(Annexure 8)*** and Polyculture of carps with Freshwater Prawns- V1 English and Assamese version ***(Annexure 9).*** WorldFish developed SOPs (Standard Operating Procedure) for Indian Major Carp Hatcheries ***(Annexure 10)*** and SOPs (Standard Operating Procedure) for Indian Major Carp Multiplication Centres ***(Annexure 11).*** Social Behaviour Communication Change materials on Fish in Nutrition, Paddy cum fish integrated farming, Polyculture of carps with mola and other small indigenous fish species and Polyculture of carps with freshwater prawns were published through social media *(**Annexure 12**).*

WorldFish inputs for the Annual Work Plan in Fisheries: For successful implementation of key interventions by the WorldFish under the project, it is very essential to ensure synchronization and integration of WorldFish deliverables to the Annual Work Plan of DOF and COF. For the World Bank project the current annual work plan is for the period from July 2021 to June 2022. WorldFish provided required inputs based on the activities and sub-activities of the deliverables while preparation of the Annual Work Plan of Department of Fisheries, College of Fisheries and ARIAS Society. During the reporting period, the AWP for 2021-22 was discussed on 5th July, 2021, 19th July, 2021, 8th August, 2021 and 12th August, 2021 with the Fishery Coordinator, ARIAS and 16th August, 2021 with Fishery Coordinator, ARIAS and COF, AAU, Raha. On 16th August, 2021 Dr.R.Suresh, Resident Consultant, WorldFish attended and provided necessary inputs during the meeting organised by ARIAS Society with College of Fisheries to finalise the AWP 2021-22 for the capacity building programmes and demonstrations.

4. WORLDFISH KNOWLEDGE PRODUCTS

Sl.No	Item	Knowledge Products
1.	Better Management Practices for Polyculture of Carps with Freshwater Prawns- V1 (English Version)	
2.	Better Management Practices for Polyculture of Carps with Freshwater Prawns- V1 (Assamese Version)	

3.	Better Management Practices for Carp Polyculture with Genetically Improved Fish Strain- V1 (English Version)	
4.	Standard Operating Procedure (SOP) for Indian Major Carp Hatcheries	
5.	Standard Operating Procedure (SOP) for Indian Major Carp Multiplication Centres	

5. SUMMARY OBSERVATIONS AND RECOMMENDATIONS

Considering the (a) inception workshop findings and baseline information (b) field visits and interactions undertaken by WorldFish experts (c) assessment of current practices and capacity needs of project beneficiaries (d) findings and lessons learned from all interventions implemented during 2018-19, 2019-20 and 2020-21 and (e) regular meetings and discussion with DOF, COF, ARIAS and World Bank teams:

WorldFish is proposing the following generic and specific recommendations for the consideration of ARIAS and DOF for implementation of project activities during Year 4 of the project (2021-22).

D1: Promoting adoption of BMPs for sustainable intensification of aquaculture

Key interventions in the fisheries component of APART which include Polyculture of carps in ponds, Climate resilient Paddy cum fish integrated farming practices in low lying flood prone areas and Beel fisheries follow the Package of Practices (POP) developed by Assam Agricultural University. Over and above the POP, for sustainable intensification of aquaculture practices, WorldFish has been developing Better Management practices for the fisheries activities of the project. Since BMPs are dynamic and evolving over the period, the practices will be revised periodically depending on the adoption and benefits.

So far, the following BMPs were developed by WorldFish:

1. ***BMP for Carp Polyculture – V1***
2. ***BMP for Production of Mola and SIS with Carps– V1***
3. ***BMP for Paddy cum Fish Integrated Farming – V1***
4. ***BMP for Beel Fisheries – V1.***
5. ***BMP for IMC Hatcheries for Quality Seed Production – V1***
6. ***BMP for Carp Polyculture with Genetically Improved Fish Strains- V1***
7. ***BMP for Polyculture of Carps with Freshwater Prawns- V1***

During the reporting period, WorldFish provided necessary technical support for the demonstrations for application BMPs to improve the farming practices and also to increase the production and income obtained by the farmers. WorldFish along with Department of Fisheries and College of Fisheries has conducted 6 FPG level FGD programs for wider dissemination of BMPs.

Recommendations:

1. Distributing the BMPs on time to the beneficiaries selected during 2021-22 and also to equal number of non-beneficiaries in the cluster for wider dissemination and adoption.
2. Organising Focus Group Discussion with the FPGs in different clusters on the BMPs for better adoption by the farmers

3. Recording of the activities under the various demonstrations taken up by the beneficiaries in the record books provided.
4. Conducting a survey on the adoption of the BMPs by the beneficiaries and non-beneficiaries of the clusters selected in the project districts at the end of the demonstrations for revising the BMPs.

D2: Up-gradation of Existing Indian major carp hatcheries to produce certified seed

Towards achieving the target of producing quality certified fish seeds, the following hatcheries of the DOF were upgraded:

(a) Islamabad Fish Seed Farm, Silchar, Cachar district
(b) Ulubari Fish Seed Farm, Guwahati, Kamrup district
(c) Joysagar Fish Seed Farm in Sivasagar district
(d) Borimuri Fish Farm in Lakhimpur district
(e) Amaranga Fish Seed Farm in Kamrup district

During this reporting period, all the selected hatcheries were upgraded and commenced seed production during the last breeding season. WorldFish provided technical support for the procurement of quality broodstock from natural sources and for broodstock tagging and rearing. WorldFish has developed SOP for Indian Major Carp Hatcheries for production of quality carp seed and improve the efficiency and productivity of upgraded hatcheries. BMP for IMC hatcheries for quality seed production developed by WorldFish would help to produce quality carp seeds through scientific breeding programme.

A virtual meeting on "Quality Carp Seed production in Assam under APART" was organized by WorldFish on 19th June, 2021 with DoF, CoF and ARIAS Society in which Dr. Trinh Quoc Trong, Senior Scientist, WorldFish, Malaysia, served as resource person and provided technical information for quality carp seed production in upgraded hatcheries in Assam.

Dr. Y. Basavaraju, Fish Breeding and Genetics Expert visited Assam from 2nd to 9th September, 2021, interacted with the officials of the DOF, ARIAS, COF, private hatchery operators, seed growers and APART staff and provided technical support for quality seed production in Government and Private hatcheries and seed farms. A Workshop on Quality Carp seed production was organised and also TOT program on Quality fish seed production was conducted.

The following activities are recommended to produce certified quality fish seeds by upgraded hatcheries.

Recommendations:

1. The seed production activity has to be implemented and SOP for Indain Major Carp Hatcheries need to be followed in all the 5 upgraded hatcheries during the breeding season in 2022 to produce quality seeds.
2. Procurement and stocking of quality broodstock of IMC from natural sources.
3. Tagging of all the broodstock collected from natural waters and record keeping.
4. Capacity building of the hatchery operators and seed growers on scientific carp breeding and rearing for quality seed production.

5. The upgraded hatcheries to implement the improved fish seed production practices following the BMPs & SOPs provided by WorldFish during 2022 breeding season to produce quality carp seeds.

D3: Multiplication Centres (MCs) for genetically improved fish strains:

The purpose of the activity is to establish fish seed multiplication centres for genetically improved fish strains (e.g. Jayanti rohu, Amur common carp) for production of genetically improved fish seeds and stocking to increase production and productivity. The following fish farms under DOF have been developed as multiplication centres for genetically improved fish strains:

(a) J. B. Garh Fish Seed Farm in Nagaon district
(b) Islamabad Fish Seed Farm in Cachar district
(c) Rangia Fish Farm in Kamrup district
(d) Matilung Fish Farm in Goalpara district

During the reporting period, all the multiplication centres were developed as per the approved plan and technical recommendations provided by WorldFish. WorldFish provided necessary technical support to DOF for the procurement of improved strain, Jayanti rohu and Amur carp from National Freshwater Fish BroodBank (NFFBB), Bhubaneswar.

A virtual meeting on "Quality Carp Seed production in Assam under APART" was organized by WorldFish on 19th June, 2021 with DoF, CoF and ARIAS Society in which Dr. Trinh QuocTrong, Senior Scientist, WorldFish, Malaysia, served as the resource person and discussed about the technical aspects of multiplication centres established in APART Project

Dr. Y. Basavaraju, Fish Breeding and Genetics Expert visited Assam from 2nd to 9th September, 2021, visited the multiplication centres in Goalpara and Nagaon districts and interacted with the officials of the DOF, ARIAS and APART staff and provided technical support for operation of multiplication centres for genetically improved fish strains. WorldFish has developed the SOP for Multiplcation Centres for the production of genetically improved fish strains.

Recommendations:

1. The seed multiplication activities need to be carried out during the year 2022 following the SOP developed and provided by WorldFish
2. Stocking of genetically improved strains of Jayanti rohu and Amur common carp need to be promoted by DOF by multiplication and distribution to the hatcheries and farmers.
3. BMP for Carp polyculture with genetically improved strains have to be implemented by DOF in the Polyculture demonstrations during 2021-22
4. Evaluation of the performance of genetically improved strains, Jayanti rohu and Amur common carp need to be conducted.

D4: Improving productivity of beels:

The total target area for the beel development under APART is 2225 ha. Of the total target, in 2020-21, 26 beels covering an area of 441.62 ha in Nalbari, Dhubri, Goalpara, Kokrajhar, Lakhimpur, Sivasagar, Cachar, Sonitpur, Morigaon, Barpeta and Nagaon districts have been selected for development. The civil works in connection with the development of beels like weed clearance and bund construction have been taken up in most of the beels selected.

During the year 2021-22 identification of additional area of 500 ha for beel development in the project districts is in progress. So far 40 beels in 14 districts covering 718.87 ha have been selected for development under APART out of which BDMC have been formed in 39 beels with 2097 members including 375 women. WorldFish experts have provided technical support for selection of beels and also provided BMPs for Beel fisheries development including technical and governance mechanisms for development through the project.

Recommendations:

1. In each of the beels selected for development, the DOF and APART Project need to implement the BMP guidelines for Beel Fisheries Development provided by WorldFish.
2. The BDMC members have to be oriented through FGD towards the BMPs to be followed for beel improvement.
3. In 2021-22, necessary works connected to technical interventions together with governance issues need be taken up.

D5: Improving Fish Value Chains:

Understanding the Fish Value Chain prevailing in Assam is a pre-requisite for bridging the gaps in the value chain to organise various enterprises and businesses for the development of a sustainable market-led production system. WorldFish has taken up a study to assess the fish value chain, fish feed value chain and the scope of value added products and marketing in Assam. Detailed report of the Fish Value chain study conducted by WorldFish in Assam has already been submitted to ARIAS.

WorldFish conducted a Workshop on Fish vaule chain in Assam on 7th September, 2021 and presented the fish value chain study findings and recommendations to DoF, ARIAS, CIFRI, other stakeholders and service providers of ARIAS to understand scope for enterprise development in fish value chain, the fish feed value chain, scope of value addition, product development, marketing in the context of improving aquaculture and beel fisheries in Assam.

During the reporting period, discussions were held with ARIAS, DOF and other Service providers of the project regarding establishment of FPCs in various APART districts with specific focus on dry fish production, fish feed production and quality fish seed production. So far, 10 FPCs in fisheries have been formed under the project and WorldFish has provided necessary support to ARIAS, DOF and Service Providers to identify the potential activities to be taken up by the FPCs.

Recommendations:

1. Initiatives for entrepreneurship development and enterprise development around the gaps identified in the value chain would help for the development of fisheries and aquaculture in Assam.
2. Community based business organisations like Farmer Producer Companies (FPC), Farmer Producer Organisations (FPO) and cooperatives need to be promoted and/or strengthened for undertaking the activities in the fish value chain.
3. Motivate potential and existing entrepreneurs to take up the role of service providers for various components (production, logistics, value addition and marketing) and support them with right techno-managerial and entrepreneurial knowhow.
4. Strengthening of FPCs, CFCs and FPOs to spearhead Fishery interventions
5. Provision of key services like Finance, Seeds, Input supply, Feed, Marketing, Logistics, and Value addition need to be prioritised.
6. Infrastructure development at FPC and CFC level have to be taken up
7. Supporting various enterprises and service providers in the fish value chain in terms of technical knowhow, finance, capacity building etc.
8. Promote interconnectivity of fresh fish markets, facilitate easy and cost effective transport through inter department liaison.
9. Promote 'clean fish' to ensure sanitation and hygiene across the entire value chain.
10. Promote more involvement of women in all major functions of the value chain

D6: Carp-Mola polyculture in ponds, paddy cum fish culture and in beel fisheries

During 2020-21, Carp-Mola-SIS Polyculture demonstrations were conducted with 130 beneficiaries in 10 districts by stocking 1531 kg of Mola and SIS along with carps in a total water spread area of 36.28 ha. The results of the demonstrations were encouraging and based on the success of the demonstrations during 2020-21, scaling up the technology through demonstrations covering an area of 100 ha is targeted, apart from introduction of Mola-SIS in paddy cum fish integrated farming in 200 ha and in 500 ha of beels during 2021-22.

A virtual meeting on "Carp-Mola-SIS Polyculture-Progress, Problems and Prospects in Assam" was organized by WorldFish on 12th June, 2021. A virtual meeting on "Mola-SIS Promotion in Paddy-Fish farming systems" was organized by WorldFish on 22nd May, 2021 for promoting the mola and SIS in paddy fish farming demonstrations. Dr. Benoy Kumar Barman, Senior Scientist, WorldFish, Bangladesh and Dr. Manos Kumar Saha, Scientist, WorldFish, Bangladesh, served as the resource persons during the virtual meetings and discussed the progress of Carp-Mola-SIS farming in ponds and paddy fields with the DOF and APART Project team and provided technical support for promoting mola-SIS in pond polyculture system and paddy-fish integrated farming systems.

Recommendations:

1. Basic requirements to promote Mola is the identification of the availability of mola broodstock for stocking in the ponds. Hence, the source of mola broodstock need to be identified in the project districts on priority basis.
2. Development of breeding technology for Mola and SIS to support sustainable farming of Mola and SIS and setting up Moa-SIS broodfish programme

3. A recent project of WorldFish approved and funded by GIZ will work on establishing breeding protocols and hatchery systems for SIS in Assam to ensure steady supply of quality SIS seeds. APART project stakeholders and DOF will be invited and involved in this project inception, planning and implementation
4. The technology need to be scaled-up in polyculture ponds, paddy-fish integrated farms and beels in all clusters during 2021-22 towards scaling up the technology already demonstrated.
5. Partial harvesting of mola every fortnight after a latency period of 3 months from stocking for regular consumption and to market excess mola-SIS produced need to be encouraged among the farmers.

D7: Improving impact of aquaculture and beel fisheries on human nutrition

WorldFish is promoting the consumption of fish particularly small fishes rich in micronutrients among the vulnerable sections of the population including pregnant and lactating women and young children. WorldFish has promoted nutrition sensitive aquaculture activities under the project to produce nutrient rich small fishes along with carps in pond aquaculture, paddy-fish integrated farming and beels.

Based on the study conducted in Assam and also with the experience of WorldFish in other countries and in Odisha, nutritious fish based products like dry fish, fish powder and fish chutney have been identified for piloting and demonstration to increase consumption by target groups.

It is also proposed to provide nutritional education among the local communities to promote consumption of SIS particularly during the first 1000 days for pregnant women, lactating mothers and minor children. During the reporting period, WorldFish discussed with the IEC and Communication Team of ARIAS Society and developed Social Behaviour Change Communication (SBCC) products to be used in the APART Project to promote consumption of fish. WorldFish has developed several SBCC materials and conducted Social media promotion of fish on human nutrition**.** A campaign to promote fish in human nutrition is planned with the IEC agency of ARIAS and WorldFish provided necessary technical support for preparing the detailed campaign plan.

Further, there is need for convergence of many departments including Social Welfare, Health, Education etc. and NGOs to promote the consumption of fish for nutritional outcomes. In this connection the Resident consultant discussed with Director of Social Welfare Department for promoting fish in the supplementary nutrition program of Government of Assam for pregnant women, lactating mothers, adolescent girls and minor children. WorldFish Fish Processing and Nutrition experts visited Poshan Abhiyan under the Department of Social Welfare and discussed with the officials the WorldFish initiatives for promoting fish in SNP programs.

Recommendations:

1. Organise awareness programs among rural communities on health benefits of fish consumption particularly in areas where malnutrition is prevalent.
2. Promote consumption of fish particularly small fishes which are rich in micro nutrients.
3. Continue discussions with social welfare and education departments to include fish in the mid-day meal program of schools and Anganwadis and through ICDS and

Poshan Abhiyaan programs of the government based on the lessons from WorldFish project in Odisha

D8: Promoting climate resilient smart fish production technologies:

During 2020-21, Paddy cum Fish integrated farming was demonstrated with 570 beneficiaries covering an area of 288.90 ha. In 2021-22 paddy cum fish integrated farming is targetd to be taken up in 200 ha area.

Government of Assam is considering to expand the area under paddy-fish farming as a climate resilient technology in all the potential districts of Assam to provide the farmers opportunity to overcome the losses due to floods. In this direction, WorldFish and IRRI provided necessary support to Government of Assam and identified suitable areas through GIS mapping for promoting paddy cum fish farming in Assam.

Further during the reporting period, WorldFish has taken up the Study on Climate resilient technologies to support pond aquaculture and beel fisheries. WorldFish Climate Change Expert visited the project districts to collect required information on the climate resilient technologies demonstrated by the project through DOF and COF, climate resilient technologies practiced by the farmers and fisherfolk, indigenous technical knowledge on climate resilient technologies. The study is completed and report will be submitted to ARIAS and DOF.

WorldFish organised a virtual meeting on Paddy-Fish Farming Systems in Assam on July 10, 2021 jointly with IRRI to understand the paddy cum fish farming practises followed in the demonstrations of APART project and to provide technical support for the demonstrations. Dr. Jharendu Pant, WorldFish Expert, and Dr. Kanwar Singh, Resident Consultant and Senior Associate Scientist, IRRI served as resource persons and provided technical guidance for improving current practises with improved paddy varieties, farming practices and other managerial aspects based on the BMP developed jointly by WorldFish and IRRI.

Recommendations:

- Expansion of area under Paddy-fish integrated farming in the project districts
- Mapping and ground trothing of low lying flood prone areas having potential for paddy-fish integrated farming in Assam
- Awareness creation among the paddy farmers from potential areas to practice scientific paddy fish farming to increase production, employment and income

D9: Gender transformative approaches in support of sustainable aquaculture and beel fisheries

APART Project has a target of benefiting at least 30% of women farmers through their participation in the interventions. To fulfil the objectives of the project WorldFish undertook a gender scoping study along with ARIAS and DoF in the selected project districts to identify gaps and entry points for interventions to be more inclusive for women. This was followed by a Gender Integration Workshop organised by ARIAS, WorldFish and Royal Tropical Institute, Netherlands. Based on the outcome of the stakeholder consultations, gender scoping study and Gender integration workshop conducted, WorldFish gender team has provided Gender Integration Recommendations for the Fishery sub-component of the APART Project to ARIAS Society and DOF for implementation during 2020-21.

During the reporting period, women participation in fishery sub-component has improved than the previous years and it was observed that there was around 20% women among the beneficiaries of various demonstrations and in BDMCs in the training programs the participation of the women increased to 35% as the trainings were conducted at the village level which helped more women to participate.

A virtual meeting on Gender Integration in Fisheries component of APART was organised by WorldFish on May 29, 2021 to discuss ways to promote more women participation and women farmers' access to assets and services, involvement in post harvest, and value addition activities. Dr.Surendran Rajaratnam, Gender Expert, WorldFish, Malaysia, Mrs. Arpana Barman, Social Sector Coordinator, ARIAS were the resource persons in which DoF officials, District social sector coordinators, APART staff participated and discussed ways and means for gender integration in the fisheries value chain activities.

Recommendations:

- Gender Integration Recommendations provided by WorldFish have to be implemented by ARIAS, DOF and COF in the fishery sub-component of the project to achieve gender outcome targets.
- Furthermore, the value chain study findings need to be used to enable targeting for women to participate in other value chain activities beyond production.
- Women beneficiaries' role in decision making related to production and marketing activities need to be strengthened by involving them in awareness programs, trainings, meetings etc.
- Building the gender capacity of DOF officials and other project staff regularly is essential to have better understanding of gender approaches in implementation of the project.

D10: Capacity building of DOF Officials and APART Project Staff:

Capacity building of the officials of DOF and the APART staff is a major responsibility of WorldFish in the project.During the reporting period, WorldFish experts participated in the Training of Trainers (ToT) programme organised by the College of Fisheries, Assam Agricultural University, Raha on September 6th and 7th, 2021 and gave lectures to empower DoF officials, APART project staff, KVK scientists and CoF faculty with project intervention specific information to be communicated to the farmers. Dr. Y. Basavaraju, WorldFish Fish Breeding and Genetics expert, Dr. Bimal Kinkar Chand, Climate Change Expert, Dr. Arun Padiyar, WorldFish Value chain Expert, and Dr. R. Suresh, Resident Consultant served as Resource Persons.

During the reporting period, due to Covid-19 pandemic situation and restrictions for travel and organising trainings/meetings etc. capacity building of DOF officials and project staff through exposure visits could not be taken up and targets will be completed once the situation is normal for conducting regular activities. However, WorldFish has organised the following capacity building activities during the reporting period.

Virtual Meetings/Discussions/Trainings/Workshops:

WorldFish experts and Resident consultant provided virtual support for the implementation of project interventions by providing ARIAS, DOF, and COF with the necessary technical

assistance. WorldFish organised virtual trainings on Mola-SIS Promotion in Paddy-Fish farming system, Gender Integration in Fisheries component of APART, Carp-Mola-SIS Polyculture-progress, problems and prospects in Assam, Quality Carp Seed production in Assam under APART and Paddy-Fish Integrated Farming Systems in Assam in which WorldFish Experts participated and provided required technical support.

During the reporting period, WorldFish in collaboration with ARIAS and DOF organised Workshops on Fish value chain in Assam and Quality carp seed production in Assam in which WorldFish experts participated and provided lectures to DOF officials, ARIAS, DOF and APART Project staff and Service providers of ARIAS Society. WorldFish organised a discussion on Fish processing, value addition and nutrition promotion in which WorldFish Fish processing and Nutrition Experts participated and provided technical support to the officials and entrepreneurs.

Focus Group Discussion on BMPs with Farmer Producer Groups:

WorldFish along with COF and DOF has organised Focus Group Discussion on Better Management Practices for the Farmer Producer Groups of Fisheries component in the APART Project Districts. During the period, 6 FGDs were conducted in 3 districts in which 118 beneficiaries and non-beneficiaries including 29 women participated.

Recommendations:

1. Training Modules for the beneficiaries and non-beneficiaries to focus more on the APART Project interventions.
2. Training of Trainers (TOT) program to be organized twice every year under the project by College of Fisheries to develop of pool of trainers as resource persons to conduct the training programmes under the project and to train them on the APART Project activities.
3. Exposure visits of the farmers within and outside the state has to be organized to help them in cross learning from the experiences of progressive farmers
4. National and International Exposure visit and Training of the DOF officials and Project staff would help to enhance their technical capacity to implement the project.

6. OUTCOMES, IMPACT AND SUSTAINABILITY

The outcomes and impact of the various interventions by WorldFish towards the deliverables under the project is summarised below:

Deliverables	Work Done during April 2020 to September, 2021	Overall, from Aug 2018 to September, 2021
D1: Promoting adoption of BMPs for sustainable intensification aquaculture	2 new BMPs developed for Polyculture of Carps with Freshwater Prawns- V1 and Carp polyculture with Genetically Improved Fish Strain- V1. 6 FGD on BMPs conducted	In total 7 BMPs developed and disseminated to 5000 beneficiaries and non-beneficiaries. So far 37 FGDs were conducted in which 996 farmers participated.
D2: Up-gradation of Existing Indian major carp hatcheries to produce certified seed	Upgradation of 5 hatcheries to produce certified seed. SOP for Indian Major carp hatcheries provided Workshop on quality carp seed production in Assam conducted WorldFish Fish breeding expert visited Govt. and private hatcheries and provided technical support to hatchery operators and seed growers	5 Department hatcheries upgraded. Trial seed production taken up in all hatcheries during 2020-21. Domestication and tagging of wild broodstock demonstrated. SOP for IMC Hatcheries developed. Provided technical support for Government and private hatcheries and seed growers
D3: Multiplication Centres (MCs) for genetically improved fish strains	Procurement and stocking seeds of genetically improved strains of Jayanti rohu and Amur carp from NFFBB in the Multiplication Centres SOP for Multiplication Centres provided	Establishment of 4 Multiplication Centres for genetically improved strains. Procurement and stocking seeds of genetically improved strains of Jayanti rohu and Amur carp from NFFBB

D4: Improving productivity of Beels	26 Beels covering 441.62 ha selected during 2020-21 for development	BMP for Beel Fisheries developed and communicated. So far 40 beels in 14 districts covering 718.87 ha have been selected for development under APART out of which BDMC have been formed in 39 beels with 2097 members including 375 women
D5: Improving Fish Value Chains	Workshop on Fish value chain in Assam conducted. 10 Farmer Producer Companies in Fisheries formed by ARIAS, DOF and Service Providers and WorldFish provided technical support to identify the activities of FPCs	Fish Value chain, Fish Feed Value Chain and Scoping Study in Assam completed, and Value chain gaps identified. Fish Value chain in Assam Study Report submitted. Workshop on Fish Value chain conducted. FPCs supported to identify technically feasible and economically viable activities.
D6: Carp-Mola polyculture	Supported DOF for scaling up Plan during 2020-21. 130 Polyculture of carps with Mola-SIS demonstrations conducted in 36.28 ha.	Created awareness on Mola-SIS farming with carps with stakeholders. DOF officials and Project staff trained in Carp-Mola-SIS farming. BMP for production of Mola-SIS with Carps and Record Books developed and distributed to farmers. Demonstrations taken up with 64 beneficiaries covering 21.85 ha in 10 project districts during 2019-20 and 130 beneficiaires in 36.28 ha in 2020-21
D7: Improving impact of aquaculture and beel fisheries on human nutrition	Nutrition sensitive aquaculture activities promoted in pond aquaculture, paddy-fish farms and beels. SBCC materials prepared for Social media campaign to promote fish nutrition. Identified dry fish, fish powder and fish chutney	DOF, ARIAS and COF staff and farmers sensitised on health benefits of fish consumption. Study conducted to understand the consumption behaviour, scope for value added products production, marketing, and consumption in Assam. SBCC materials on fish in human nutrition

	as affordable nutritious fish-based products for piloting and promotion. Preliminary discussion held with Director of Wocial Welfare for including fish in SNP in Assam. Fish Processing and Nutrition experts discussion with private entrepreneurs for value added fish products production and marketing	developed and posted through social media. Nurition sensitive aquaculture promoted in pond polyculture, paddy fish farms and beels. Article on Nutritional importance of fish consumption in First 1000 days published in ARIAS Newsletter.
D8: Promoting climate resilient smart fish production technologies	Provided support for Paddy-fish farming demonstrations of 570 beneficiaries covering 288.90 ha during 2020-21 and another 200 ha area have been targeted for 2021-22. Study on Climate Resilient Technologies for pond aquaculture and beel fisheries completed. Virtual discussion on paddy cum fish farming activities and suggestion for improvement provided.	Climate resilient paddy fish integrated farming demonstrated with 91 farmers (50 ha) during 2018-19, 206 farmers (100 ha) during 2019-20 and 570 farmers (288.90 ha) during 2020-21.BMP for Paddy-fish Farming and Record books jointly developed by WorldFish and IRRI and distributed to the farmers.WorldFish and IRRI jointly supported the Government of Assam in identifying additional area for the expansion of climate resilient Paddy cum fish farming in Assam. Climate resilient technologies study taken up.
D9: Gender transformative approaches in support of sustainable aquaculture and beel fisheries	Gender Scoping Study Report completed along with community profile of beel fisheries and pond aquaculture communities in selected districts of Assam. Virtual meeting conducted to provide support to DOF and APART Project staff for Gender integration in fisheries activities.	DOF, ARIAS and COF sensitised on gender integration in the fisheries activities. Gender Scoping study and Gender Integration Workshop were conducted. Provided Gender Integration Recommendations and Gender Strategy to DOF and ARIAS.

D10: Capacity building of DoF Officers	6 Virtual trainings, meetings and discussions arranged along with DOF, COF, ARIAS officials and Project staff. Participated in the TOT organised by COF for DoF officials, APART Staff, KVK scientists and CoF project staff. Two Woskshops on Fish Value Chain and Quality carp seed production and a Discussion on Fish Processing, Value addition and Nutrition conducted.	Workshops, Trainings, Write-shop, and Meetings conducted, TOT lectures provided, Exposure visits facilitated under the project to build the capacity of DOF, ARIAS, COF and APART staff. Virtual trainings, meetings and discussions arranged for the DOF, COF, ARIAS officials and Project staff.

7. TEAM DEPLOYED

Sl.No.	Name and Functional Title	Area of Expertise	Position Assigned
1	Michael J Philips, Director of Aquaculture & Fisheries Sciences	Aquaculture	International Expert
2	Chadag V Mohan, Principal Scientist	Aquaculture	International Expert
3	Benoy Kr. Barman, Senior Scientist	Small Scale Fisheries	International Expert
4	Jharendu Pant, Senior Scientist	Aquaculture Systems	International Expert
5	Shakuntala Thilsted, Research Program Leader, Value Chains and Nutrition	Nutrition	International Expert
6	Cynthia McDougall, Senior Scientist	Gender	International Expert
7	Arun Padiyar, Scientist	Value Chain & Marketing	International Expert
8	Trin Trong, Scientist	Genetics	International Expert
9	Shwu Jiau, GIS and Database Expert	GIS	International Expert
10	Rajendran Suresh, Project Coordinator	Project Management	National Expert
11	Surendran Rajaratnam, Gender Specialist	Gender	Additional Non-Key Expert
12	Pincus Lauren, Scientist	Nutrition	Additional Non-Key Expert
13	Manos Kumar Saha, Scientist	Aquaculture	Additional Non-Key Expert
14	Rodrigue Yossa, Scientist	Fish Feeds & Nutrition	Additional Non-Key Expert
15	Bimal Kinkar Chand	Climate Change	Additional Non-Key Expert
16	Y. Basavaraju	Fish breeding	National Expert
17	B.A Shamasundar	Fish Processing	National Expert
18	Baishnaba Charan Ratha	Nutrition	National Expert

8. WORLD BANK MID-TERM REVIEW MISSION-FOLLOW-UP ACTION

World Bank Mid-Term Review Mission of the APART Project was held during the period from 14th to 21st December 2020 through virtual WebEx Meetings. During the mission, presentation on fisheries activities taken up by the Fisheries Department in the project was made by Nodal Officer, APART and Director of Fisheries and WorldFish was represented by Dr.C.V. Mohan, Project Leader and Dr. R. Suresh, Resident Consultant. During the interactions, Mission team felt that the seed and feed are the important inputs which need to be addressed for sustainable aquaculture and fisheries. Further the Mission informed that the economic analysis of the various interventions in fisheries have to be taken up to know the profitability to the farmers. The Mission stressed the need to establish Farmers Producer Companies (FPCs) in fisheries with an overall target of 22 FPCs and to establish at least 5 FPCs on priority basis. Further, it was informed to have a separate discussion for the Fisheries value chain.

On 19th December 2020, Mini-Mission to review the Fisheries Activities was held in which WorldFish activities in the APART Project to provide technical support for the fishery sub-component since inception was presented by Dr. R. Suresh, Resident Consultant. Mission team members discussed the Fish Value Chain Study conducted by WorldFish, potential for freshwater prawn farming in Assam and Hygienic fish marketing by FishFed.

During the APART Project Restructuring Meeting, WorldFish proposal for additional budget towards additional manpower and vehicle was presented and was approved by the Mission in-principle. Accordingly a detailed proposal for an additional budget of 282,802 USD towards engagement of three national non-key experts and for vehicle hiring charges was prepared and submitted to ARIAS on 13th March 2021.

During the period under report, as informed during the World Bank Review Mission, a virtual meeting was held on 17th June, 2016 in which Dr. Arvind Jhamb from World Bank participated and discussed the activities in the fisheries sub-sector with WorldFish, DOF, COF and ARIAS Teams. Dr. C.V.Mohan and Dr.R.Suresh from WorldFish participated in the meeting. New proposals by Department of Fisheries, Capacity building programs by College of Fisheries, WorldFish technical support for the project were discussed.

Follow-up Action Taken:

Based on the discussion during the World Bank Mid-Term Mission and the subsequent meetings with World Bank Expert during June, 2021, the following actions were taken:

Economics of various demonstrations conducted in fisheries under APART

Technical support provided for the prepration of Economics of Polyculture of carps, Polyculture of carps with Mola-SIS, Polyculture of Carps with freshwater prawns and Paddy-Fish farming demonstrations.

Workshop on Fish Value Chain in Assam

For sharing the findings of the Study on fish value chain, fish feed value chain and scope for value addition and marketing of fish and fish products with the various stakeholders in fisheries sector in Assam, a Workshop on Fish Value Chain in Assam was conducted on 7th September, 2021 in which WorldFish Value chain experts presented the results of the study.

Scaling up of Demonstrations

In order to increase the number of demonstrations based on the performance, profitability, acceptance and adoption by the farmers during the previous years, Paddy-fish farming, Polyculture of carps with Freshwater Prawns, Polyculture of carps with Mola- SIS demonstrated by Department of Fisheries and Short duration fish culture demonstrated by College of Fisheires have been identified for scaling up in the project during the coming years.

Restructuring proposal for WorldFish Contract Amendment

Based on the discussions during the World Bank Mid-Term Review and the subsequent meetings with the World Bank team, WorldFish revised the proposal for restructuring the contract to include additional funds of 259,171 USD for additional manpower and hiring of vehicles and submitted to ARIAS Society on 24th August, 2021.

9.DETAILS OF WORK DONE AND OUTPUTS

Project Activities	Work Done (April, 2021 - September 2021)	Outputs (if any)
Deliverable 1. Promoting adoption of BMPs for sustainable intensification of aquaculture		
Activity 1: Analysis of current practices		
Activity 2: Organizing workshop for sensitization of PIU officers	Workshop on Fish Value Chain in Assam and Workshop on Quality carp seed production oganised	Workshop Reports
Activity 3: Designing technical plans for taking up demonstrations for application of BMPs for doubling fish production	Technical plan for taking up demonstrations of Polyculture of carps, Polyculture of carps with Mola-SIS, Polyculture of Carps with Freshwater prawns, Paddy-Fish integrated farming with Mola-SIS, Carp Polyculture with genetically improved fish strains and Beel fisheries development. BMPs on Polyculture of Carps with Freshwater prawns and Carp Polyculture with Genetically Improved strain provided to DOF and ARIAS	2 BMPs Developed BMP for Polyculture of Carps with Freshwater prawns –V1 BMP for Carp Polyculture with Genetically Improved strain – V1
Activity 4: Demonstration for application of BMPs for doubling fish production	Conducted 6 Focus Groups Discussion with the FPGs in which 118 farmers were trained on BMPs. Demonstrations of Polyculture of carps, Polyculture of carps with Fresh water prawn, Polyculture of carps with Mola-SIS and Paddy-Fish integrated farming with Mola-SIS during 2020-21	FGD Report
Activity 5: Development of scaling up approach for wider dissemination of BMPs	Scaling up plan for dissemination of BMPs among Non-beneficiaries by distribution of BMP guidelines, Pond record books and BMP trainings	7 BMP guidelines and 5 Pond record books
Activity 6: M&E of technical demo programs	2019-20 end of demonstration and 2020-21 baseline survey conducted.	Survey formats in KOBO Toolkit for Baseline and Endline survey of demonstrations.

Activity 7: Preparation of technical reports		
Deliverable 2: Up-gradation of Existing Indian major carp hatcheries to produce certified seed		
Activity 1: Baseline survey		
Activity 2: Development of up-gradation plan for hatcheries		
Activity 3: Preparation of Guidelines for identification of sources of quality brood stock & site visits		
Activity 4: Up-gradation of hatcheries & its operationalisation	Five hatcheries operatationalised and produced IMC seeds	
Activity 5: Development of scientific breeding programme & its up-date	BMP for Quality Carp Seed Production Provided. Scientific breeding programme by using the Broodstock from natural collection for Quality Seed Production by the hatcheries developed in consultation with DOF	
Activity 6: Development SOPs, BMPs, quality assurance programme	BMP for Quality Carp Seed Production and SOP for Indian Major carp hatcheries provided.	BMP for Quality Carp seed production SOP for Indian Major Carp hatcheries
Activity 7: Capacity building of hatchery operators (no of hatchery operators/ hapa breeders/ seed growers)	Workshop on Quality carp seed production in Assam. Virtual Meeting with WorldFish Team for Quality Fish seed production. WorldFish expert visited Government & Private hatcheries and provided technical support to the hatchery operators and seed growers. ToT on Quality Fish Seed Production. Provided support to COF for Training module for Quality seed production and to conduct training of hatchery operators and seed growers	Workshop on Quality carp seed production in Assam report ToT program report Virtual Meeting report Training Module for Quality fish seed production

Activity 8: M&E to document the impact		
Activity 9: Preparation/production of report		
Deliverable 3: Multiplication Centres (MCs) for genetically improved fish strains		
Activity 1: Survey to assess the demand for genetically improved strains of fish in project areas		
Activity 2. Selection of public seed farms to set up Multiplication Centers (MCs) using sound technical design to produce genetically improved strains		
Activity 3: Develop plan to set up MCs in public farms for production and dissemination of genetically improved strains		
Activity 4: Setting up of MCs following technical design and commissioning for operationalization	Establishment of 4 multiplication centres with hatchery infrastructure, breeder pond, nursery facilities and biosecurity completed. Trial seed production in all the MCs. WorldFish Expert visited and provided technical support	
Activity 5: Capacity building of the staff and Managers about operation and management of MCs	Workshop on Quality carp seed production. Virtual Meeting with WorldFish Experts on Quality seed production and Gentically Improved fish seeds.	Workshop Report and Virtual Meeting Report
Activity 6: Develop SOPs, BMPs, Biosecurity measures to produce certified seed of genetically improved strains	BMP for Quality fish seed production provided SOP for Tagging of Brood Fishes provided SOP for Indian Major Carp Mulplication Centres provided	BMP for quality seed production SOP for Tagging of Brood fishes SOP for Indian Major Carp Mulplication Centres
Activity 7: Procurement of genetically improved strains of fish (e.g. Joyantirohu)) from ICAR-CIFA	Supported DOF to Procure genetically improved strains Jayanti rohu and Amur Common Carp from NFFBB, Bhubaneswar	

Activity 8: Preparation of BMP manual for adoption of genetically improved fish strains by hatcheries and farmers	BMP manual for genetically improved fish strains stocking in polyculture prepared and provided to DOF and ARIAS	BMP for Carp polyculture with genetically improved fish strains- V1
Activity 9.: M&E to document the quality of fish produced and the and impact		
Activity 10.: Preparation of reports		
Deliverable 4: Improving productivity of beels		
Activity 1: Identification of beel fisheries for project intervention	26 Beels covering 441.62 ha from 8 project districts were selected to implement activities during 2020-21.	
Activity 2: Community mobilization and formation of Beel Development and Management Committee (BDMC)	Community mobilization for formation of Beel Development and Management Committee (BDMC) were taken up in all the beels selected for development during 2020-21.	
Activity 3: Development of FGD guidelines and beel governance mechanisms	Beel governance guidelines provided in the BMP guidelines	BMP for Beel Fisheries
Activity 4: Formulation of scientific interventions strategy, SOP, better management practices &its up-dating	Scientific and technical intervention strategy and better management practices developed and provided as BMP for Beel Fisheries Virtual meeting on Beel fisheries interventions with WorldFish Expert	BMPs for Beel Fisheries
Activity 5: Development of technical training manual &its up-dating		
Activity 6: Demonstration of scientific interventions	Scientific interventions initiated in 14 beels selected during 2019-20 Cage culture demonstration by COF in 7 beels. Visited 2 beels and provided technical guidance	
Activity 7: M&E to document the impact		
Activity 8: Strategy formulation for scaling up operation		

Deliverable 5: Improving Fish Value Chains		
Activity 1: Fish value chain analysis to identify opportunities to enhance efficiency of value chains		
Activity 2: Fish Feed Value Chain Study [Annex-1 of TOR]		
Activity 3: Developing strategies for increasing benefits to fish producers, consumers and small enterprises associated with production, processing, food safety and marketing of fish	Strategies based on the Fish value chain study findings discussed with ARIAS, DOF and Service Providers for increasing benefits to the fish producers, consumers and development of enterprises associated with production, processing and marketing of fish. Fish Processing, Nutrition and Fish Value Chain experts visited and interacted with officials, service providers and entrepreneurs.	Fish Value Chain Study Report
Activity 4: Support to service providers in establishment and operationalization of farmer producer organizations (FPOs) and common service centers (CSCs)	Supported ARIAS, DOF and Service providers in establishment and operationalization of 10 FPCs in fish value chain and identified potential activities for the FPCs Workshop on Fish Value Chain in Assam conducted	Workshop on Fish value chain in Assam report
Activity 5: Technical reports and publications		
Deliverable 6: Carp-Mola polyculture		
Activity 1: Sensitization of stakeholders through FGD	Sensitization of stakeholders through 6 FGD for Polyculture of carps with Mola and SIS taken up in project districts	FGD Report
Activity 2: Development of TOT manual for DoF &CoF officials	Trainers Guide for Farmers Training prepared and provided to COF for use during the training programs	
Activity 3: Conduct TOT	Virtual Meetings with WorldFish Experts from Bangladesh for DOF and APART Staff arranged. Carp-Mola-SIS Technology explained during the TOT program by COF	

Activity 4: Setting up carp-mola/ SIS broodfish programme	Identified sources of mola and other SIS broodfish in many of the project districts Large ponds and beels located within the clusters already identified as good sources of mola and other SIS broodfish. Polyculture demonstration ponds stocked with mola and -SIS to serve as a source of mola-SIS broodstock in the coming years	
Activity 5: Demonstration of POP and BMPs for carp-mola/SIS polyculture farming systems	Carp-Mola-SIS Polyculture demonstrations in 36.28 ha with 130 beneficiaries, Stocking of Mola-SIS promoted along with Paddy-fish farming among 570 beneficiaries in 288.90 ha and Stocking of Mola-SIS in 200 ha of paddy cum fish farming area and 500 ha beel is in progress	BMP for Polyclture of Carps with Mola-SIS
Activity 6: M&E to document the impact		
Activity 7: Designing strategy for scaling up operation		
Activity 8: Scaling up demonstrations		
Activity 9: Technical reports and science report preparation		
Deliverable 7: Improving impact of aquaculture and beel fisheries on human nutrition		
Activity 1: Study on scope and applicability of value addition, marketing and consumption of fish and fish products in Assam [Annex-3 to TOR]		
Activity 2: Stakeholder mapping exercises for identification of development partners promoting human nutrition	Directorate of Social Welfare, Poshan Abhiyan, Education Department, Sarva Siksha Abhiyan have been identified as partners and initial discussions were held by WorldFish	

Activity3: Demonstration on nutrition sensitive aquaculture and beel fisheries programs	Demonstration on nutrition sensitive aquaculture and beel fisheries programs have been taken up and so far 1039 ponds were stocked with Carps, Carp-Mola-SIS and Freshwater prawns apart from 570 demonstrations in 288.90 ha under paddy-fish farming along with Mola-SIS and in 26 beels covering 441.62 ha during 2020-21	
Activity 4: Development of “first 1000 days” nutrition programs through inclusion of fish and fish products in diets & development of nutrition education programs	Preliminary discussion with Director of Social Welfare for promotion of small fish in human nutrition under Poshan Abhiyan Program through Anganwadis for Pregnant and Lactating women and children under First 1000 days Nutrition Program. Nutrition education program and Nutrition campaign Plan for 9 months planned with IEC Agency of ARIAS. Social Media promotion of small fish in human nutrition.	Social Media Posts
Activity 5: Piloting development of affordable nutritious fresh fish and fish based products	Discussion with private enterprises M/s. Astha, M/s.Aquatica and M/s.Stevia PVT. Limited for development of nutritious fish based products and provided technical support for hygienic value added fish products preparation by Fish Processing Expert	
Activity 6: Capacity building of identified stakeholders for nutrition programme activities	Fish in Nutrition Program activities presented during the ToT Program in COF and Workshop on Fish Value Chain	Worshop Report ToT Program Report
Activity 7: Demonstration on production of affordable nutritious fresh fish and fish-based products		
Activity 8: Development of module for social behavior change approaches to increase consumption of nutritious fish		
Activity 9: Workshop on social behaviour change to increase consumption of nutritious fish		
Activity 10: Demonstration on nutrition sensitive aquaculture programme	1039 Demonstrations on Nutrition Sensitive Aquaculture conducted in 309.05 ha during 2020-21	

Activity 11: M&E to document the impact		
Activity 12: Technical reports and science report preparation		
Deliverable 8: Promoting climate resilient smart fish production technologies		
Activity 1: Study of Climate Resilient Technologies/ Practices to Support Pond Aquaculture and Beel Fisheries [Annex-2 of TOR]	Study of Climate Resilient Technologies/ Practices to Support Pond Aquaculture and Beel fisheries completed. Climate resilient technologies demonstrated in the project, Climate resilient practices adopted by the fishers and farmers and indigenous technical knowledge on climate resilient technologies and practices identified through qualitative and quantitative methods	
Activity 2: Workshops on existing climate resilient practices adopted by farmers	Climate Resilient Practices Lecture Provided during the TOT Program of COF Virtual meeting arranged with WorldFish and IRRI Experts to provide technical support for Paddy-Fish Farming demonstrations	ToT Program Report Virtual Meeting Report
Activity 3: Formulation of strategies on different climate smart/resilient aquaculture production technologies and farming systems	Paddy-cum Fish farming and short duration fish culture as Climate smart technological intervention options to manage climate risks or adopt to climate change effects on pond aquaculture are identified. Strategies for promotion of different climate smart/resilient production technologies discussed with ARIAS, DOF and COF. WorldFish and IRRI working jointly to identify suitable areas in Assam for the expansion of Paddy cum fish farming as climate resilient technology in low lying paddy fields inundated by frequent floods.	
Activity 4: Discussion with IRRI to finalize detailed technological issues on rice-fish farming for demo. programme	WorldFish Experts regularly discuss with IRRI under APART on technical interventions in paddy fish farming demonstration program	
Activity 5: Demonstration on rice-fish integrated farming systems	Demonstrations on rice-fish integrated farming systems conducted with 570 farmers in 288.90 ha during 2020-21.	

Activity 6: Demonstration of monoculture (M) and poly-culture (P) technologies with genetically improved fish strains	During 2020-21 demonstrations in 17.05 ha ha involving 55 farmers by using improved fish strains of Jayanti rohu and Amur common carp.	
Activity 7: Demonstration of small indigenous fishes with carp culture	Demonstration of paddy-fish integrated farming systems during 2020-21 with 570 beneficiaries in 288.90 ha by stocking Mola-SIS at the rate of 25 kg/ha	
Activity 8: Refinement of PoPs		
Activity 9: M&E to document the impact		
Activity 10: Technical Reports and Science report preparation		
Deliverable 9: Gender transformative approaches in support of sustainable aquaculture and beel fisheries		
Activity 1: Gender Scoping (Understanding the context with regards to gender norms and practices in selected sites)	Gender Scoping study report based on the study conducted with beel user communities and pond aquaculture communities in selected districts of Assam to understand gender norms and practices.	Gender Scoping Study Report
Activity 2: Gender Assessment (Assessing the Assam APART-WorldFish research across the deliverables to identify opportunity and challenges to enable women to equally access and benefit from the project's intervention)		
Activity 3: Gender Integration (Demonstration of gender integration strategy in APART-WorldFish research in pond and beel fisheries)	Virtual meeting arranged with WorldFish Gender Experts and Project Team for Gender Integration in the APART demonstrations	Virtual Meeting Report
Activity 4: Piloting GTA in selected pond and beel fisheries site		
Activity 5: Gender M & E Conducted pre & post-gender integration as well as pre & post-GTA.		
Activity 6: Technical reports and science report preparation		

Deliverable 10: Capacity building of DoF Officers		
Activity 1: Designing capacity building programs/ training module/prepare training literature for DOF officers on (a) BMPs for sustainable intensification of aquaculture (b) carp-mola/SIS polyculture (c) climate resilient aquaculture (d) post-harvest technologies (e) value addition (f) food safety issues	Provided support to COF in designing capacity building programs for 2021-22. Training modules prepared, Trainers Guide provided, Training materials prepared and provided in the ToT Manual	ToT Manual
Activity 2: Conducting TOT & exposure visit of DOF officers	TOT Program for DoF officials, APART staff, KVK Scientists and CoF project staff.	TOT Program report
Activity 3: Designing capacity building programme/ preparation of training module/ literature for training & exposure of farmers/ fishers	Provided support to DOF and COF in designing and organizing Capacity development programs at FPG level during 2010-22. Supported preparation of training module and literature for training.	
Activity 4: Conducting training & exposure visit of farmers/ fishers/hatchery operators/ seed growers/ fish processors/ market players	Conducted training programmes for farmers along with COF and DOF. 6 Focus Group Discussions were conducted in 3 districts in which 118 farmers participated.	FGD/Training report

10. TECHNICAL INPUTS OF NATIONAL RESIDENT CONSULTANT

Sl.No	Date	Official Met/Meeting Attended	Purpose
1	01.04.2021	Mrs Dimple S Das, Communication Specialist, ARIAS.	Nutrition Promotion campaign.
2	01.04.2021	Mr. Pankaj Bezbaruah, Grant Thornton	DPR for Dry Fish Processing-FPC, Shivasagar.
3	07.04.2021	Dr.Sanjay Sarma, Fishery Coordinator	APART Project works, Fish Knowledge Bank Meeting, General Body meeting of ARIAS society.
4	11.04.2021	Dr.Sanjay Sarma, Fishery Coordinator	KOBO Data Collection for World Bank Review, World Bank Meeting.
5	20.04.2021	Dr.Sanjay Sarma, Fishery Coordinator and Dr. D.J. Sharma, Nodal Officer	APART Project activities, World Bank review of Fisheries
6	22.04.2021	SPD,ARIAS Dr.Sanjay Sarma Fishery Coordinator and Dr. D.J. Sharma, Nodal Officer--	Climate Resilient Technologies under APART.
7	23.04.2021	Dr.Sanjay Sarma, Fishery Coordinator and Dr. D.J. Sharma, Nodal Officer	World Bank Review meeting of Fisheries activities
8	23.04.2021	Dr. Bekzod, Dr. Arvind Jhamb, World Bank, Dr. Baljeet Singh,Dr.Sanjay Sarma, Fishery Coordinator and Dr. D.J. Sharma, Nodal Officer	World Bank meeting Climate Resilient Technologies.
9	24.04.2021	Dr. Bidyut B. Das,AH Cordinator ARIAS, Dr. Atanu, WAMUL	Fodder Crop Cultivation and Fish Farms.
10	26.04.2021	Dr.P.C.Bhuyan, COF,AAU,Raha	Capacity Building-Training programme, Fish Knowledge Bank
11	27.04.2021	Dr.Binod Kalita, COF,AAU,Raha	GIZ SIS Breeding project.
12	28.04.2021	Dr.Sanjay Sarma, Fishery Coordinator and Dr. D.J. Sharma, Nodal Officer	World Bank Review meeting of Fisheries activities

13	29.04.2021	Dr.Sanjay Sarma, Fishery Coordinator	GIZ SIS Project, Freshwater Prawn Farming Field visit to Dimoria.
14	30.04.2021	Dr, Ashok Bhattacharjya , DR, AAU,Jorhat, Dr. Rupam Borgohain, Nodal Officer, AAU,Dr. D.J. Sharma, Nodal Officer ,Dr.Sanjay Sarma, Fishery Coordinator,Dr. Baljeet Singh,ARIAS, Dr.Binod Kalita,COF,AAU,Raha,Dr.P. C.Bhuyan, COF,AAU,Raha	Fish Knowledge Bank Steering committee meeting.
15	30.04.2021	Mrs. Arpana Barman, Social Sector Coordinate, ARIAS	Gender Integration works in Fisheries of APART.
16	08.05.2021	Dr.Sanjay Sarma, Fishery Coordinator and Dr. D.J. Sharma, Nodal Officer	APART Project activities, Virtual meetings WorldFish Experts.
17	11.05.2021	Dr.Sashi Gupta, IIM, Ahmadabad, Mr. Afrin Rahman, ICCSPL.	Agribusiness Growth Lab Progamme of APART - Fisheries activities
18	14.05.2021	Dr.Sanjay Sarma, Fishery Coordinator and Dr. D.J. Sharma, Nodal Officer	APART Project activities Planning Meeting.
19	18.05.2021	Dr.Sanjay Sarma, Fishery Coordinator	Genetically improved strains from NFFBB, Bhubaneswar
20	19.05.2021	Dr.Sanjay Sarma, Fishery Coordinator	WorldFish activities in Assam, Genetically improved Seed stocking in FPC.
21	21.05.2021	Er. Sreemant Phukan	WorldFish activities in APART
22	25.05.2021	Dr.Sanjay Sarma, Fishery Coordinator	KOBO Data Collection of Baseline and Endline survey.
23	28.05.2021	Dr.Sanjay Sarma, Fishery Coordinator and Dr. D.J. Sharma, Nodal Officer	WorldFish Virtual meetings.
24	28.05.2021	Mrs. Arpana Barman, Social Sector Coordinator	Virtual meeting on Gender recommendation in Fisheries.
25	29.05.2021	Dr.P.C.Bhuyan, COF, AAU, Raha	Fish knowledge content development
26	29.05.2021	Dr. Surendran Rajaratnam, Mrs. Arpana Barman, Mrs. Dimple S. Das, Dr.Sanjay Sarma, Fishery Coordinator and Dr. D.J.	Virtual discussion on Gender integration in Fisheries

		Sharma, Nodal Officer , Dr.P.C.Bhuyan, COF,AAU,Raha	
27	05.06.2021	Dr.Atanu Chaterjee, Environmental Coordinator, Dr. S.K.Bhagawati, COF, AAU.	World Environment Day Meeting and Lecture.
28	10.06.2021	Dr. Binod Kalita, Dr. P.C.Bhuyan and COF Faculty	Fish knowledge Bank Technical committee meeting
29	11.06.2021	Miss Dorothy, NFDB ,Guwahati	Rice Fish Farming Discussion
30	12.06.2021	Dr.Sanjay Sarma, Fishery Coordinator, Dr. D.J.Sharma, Nodal Officer	World Bank Meeting to Discuss New Proposal in Fisheries, ARIAS General Body Meeting.
31	12.06.2021	Dr. Benoy Kumar Barman, Dr. Manos Kumar Saha, Dr.Sanjay Sarma, Fishery Coordinator, Dr. D.J.Sharma, Nodal Officer,Dr. P.C.Bhuyan,COF,Raha, DOF officials and APART Staff	Virtual Discussion on Carp Mola SIS Polyculture in Assam.
32	14.06.2021	Dr. Arvind Jhamb, World Bank	WoldFish Proposal for additional Technical Staff and Vehicle Hiring, BMP distribution, Quality Seed production Training, Virtual meetings.
33	17.06.2021	Dr. Arvind Jhamb, World Bank, Dr. C.V.Mohan, WorldFish, Dr.Sanjay Sarma, Fishery Coordinator,Dr. Atanu Chaterjee, Environmental coordinator, Mrs. Arpana Barman, Social Sector Coordinator, Dr. D.J.Sharma, Nodal Officer,Dr. P.C.Bhuyan,COF,Raha, Dr. P.J.Sarma, COF,Raha	World Bank Review Meeting of Fisheries activities by DOF,COF and WorldFish
34	19.06.2021	Mr. N.K.Debnath, Director of Fisheries, Dr. Chandan Chetry, DOF Officials, SIFA Experts and Feed Entrepreneurs	Meeting on Fish Feed Manufacturing in Assam
35	19.06.2021	Dr.Trinh Trong, Dr. C.V.Mohan, Dr. Arun Padiyar, Dr. Sanjay	Virtual meeting on Quality Carp seed production

		Sarma,DOF officials and APART Staff	
36	28.06.2021	Miss Tandra Dey Sarkar, IEC Agency, ARIAS	Fish Nutrition Campaign Club Discussion.
37	29.06.2021	Dr. D.J.Sharma, Nodal Officer	ARIAS GB meeting and WroldFish virtual meeting
38	02.07.2021	Miss Namrata Dutta ,IEC Agency, ARIAS	Social media campaign of APART Fisheries activities
39	05.07.2021	Dr.Sanjay Sarma, Fishery Coordinator	Annual Work plan 2021-2022, Genetically improved strain stocking
40	06.07.2021	Dr.Kanwar Singh, Resident Consultant, IRRI	IRRI Webnier.
41	12.01.2021	Dr.Sanjay Sarma, Fishery Coordinator, Dr. Baljeet, Marketing Specialist, Dr. Rupam Borgoin, Nodal Officer, AAU, Dr. Kalita, Dean, CoF, Dr. P.C. Bhuyan, Coordinator, Dr. Kanwar Singh, RC, IRRI	Fish Knowledge Bank Preparation in APART
42	13.07.2021	Dr. Kanwar Singh,IRRI, Dr. Johindar Minhas, CIP,Dr. Rupam Borgohain, Dr. Kalyan Pathak, AAU, Dr. Baljeet Singh, ARIAS	FGD on Climate resilient Agriculture and Food Systems transformation by IRRI.
43	14.07.2021	Dr.Sanjay Sarma, Fishery Coordinator	SPD Review meeting and APART Project works.
44	15.07.2021	Dr.B. Kalita, Dean, CoF, Dr. P.C. Bhuyan, Coordinator,	Fish Knowledge Bank, Cage culture demonstration in Beels.
45	15.07.2021	Dr.Sanjay Sarma, Fishery Coordinator, Dr.Baljeet Singh, Marketing Specialist	Review meeting of International Agencies in APART by Agriculture Production Commissioner preliminary discussion
46	17.07.2021	Dr.Sanjay Sarma, Fishery Coordinator	Cage culture demonstration in Nalbari Dist.
47	19.07.2021	Dr.Sanjay Sarma, Fishery Coordinator	AWP-2021-2022, Fish knowledge bank ,APC review
48	19.07.2021	Mr. Ravi S. Prasad, IAS,APC, Mr. Vinod Seshan, IAS,SPD, Dr. Baljeet Singh, Dr. Sanjay Sarma, Resident Consultants, International Agencies	Review meeting of International Agencies in APART by Agriculture Production Commissioner

49	20.07.2021	Dr.Sanjay Sarma, Fishery Coordinator	Fish Knowledge Bank, Field visit to Rongia and Nalbari
50	22.07.2021	Dr.Sanjay Sarma, Fishery Coordinator, Dr. D.J.Sharma, Mrs. Lilly, Er. Sreemant Phukan	Visit to Uttara FPC Rangia and Beels in Borkhetri Block, Nalbari Dist.
51	23.07.2021	Dr. B. Kalita, Dr.S. Borthakur, Dr. P.C. Bhuyan, Dr. Rajdeep Dutta.	Fish Knowledge Bank- Content Development.
52	28.07.2021	Dr. Trinh Trong, Dr. C.V.Mohan, Dr. Arun Padiyar, Dr. Y. Basavaraju	WorldFish initiatives for Quality Seed production in APART planning meeting.
53	31.07.2021	Dr. Rajdeep Dutta, COF	Fish Knowledge Bank content development.
54	02.08.2021	Dr. Sanjay Sarma	Quality Fish Seed Production- Vist of Dr. Y. Basavaraju
55	03.08.2021	Dr. D.J.Sharma, Nodal Officer	APART activities, Quality Fish Seed production- Dr. Y. Basavaraju Field visits.
56	05.08.2021	Dr. C.V.Mohan , Dr. Baishnaba Ratha, Mrs. Dimple S. Das, Ms. Tandra Dey Sarkar	Discussion on IEC campaign plan for promoting Fish in Human Nutrition.
57	06.08.2021	Mrs. Dimple S. Das, Ms. Tandra Dey Sarkar, Ms Namrata Dutta	Discussion on IEC campaign plan for promoting Fish in Human Nutrition.
58	08.08.2021	Dr.Sanjay Sarma, Fishery Coordinator	Fish Knowledge Bank, TOT programme in COF, AWP 2021-2022
59	10.08.2021	Dr.Sanjay Sarma, Fishery Coordinator	Fish Knowledge Bank, TOT programme in COF, Beel Fisheries in cooperator.
60	10.08.2021	Mrs. Dimple S. Das, Ms. Tandra Dey Sarkar.	Discussion on IEC campaign plan for promoting Fish in Human Nutrition.
61	11.08.2021	Dr.Sanjay Sarma, Fishery Coordinator, Dr. Baljeet Singh, Mr. Ranjan Das	WorldFish Revised Compact proposal
62	11.08.2021	Dr. Utpal Kalita, Professor, AAU, Dr.Sanjay Sarma, Fishery Coordinator, Dr. Baljeet Singh	IFS Model at Veterinary College Khanapara.
63	12.08.2021	Dr.Sanjay Sarma, Fishery Coordinator, Mrs. Dimple Das, Coomunication Specialist	Fish Knowledge Bank, Fish Nutrition Social media Campaign, AWP 2021-22

63	13.08.2021	Dr. Benoy Kumar Barman, Dr.Sanjay Sarma, Fishery Coordinator, DFDO,DNO Kokrajar	Beel Fisheries in Kokrajhar, Virtual meet
64	13.08.2021	SPD,ARIAS, Resident consultant of International Agencies, Dr. Baljeet singh, Marketing Specialist, Dr.Sanjay Sarma, Fishery Coordinator,	Intensification of technologies under APART
65	16.08.2021	Dr.Sanjay Sarma, Fishery Coordinator	Fisheries activities AWP for 2021-2022
66	16.08.2021	Dr. Rupam Borgohain, Dr. Kalyan Pathak, AAU, Dr. B. Kalita, Dr.P.C.Bhuyan, Dr. P.J.Sarma, Dr. Rajdeep Dutta, Mr. Manash Pratim Dutta, COF, AAU	College of Fisheries activities during 2021-2022
67	18.08.2021	Dr.Sanjay Sarma, Fishery Coordinator	Fish Knowledge bank, TOT at COF, Workshop on Fish Value Chain and Quality Fish Seed Production
68	19.08.2021	Dr. B. Kalita, Dr. S. Borthakur, Dr.P.C.Bhuyan, Dr. Rajdeep Dutta,Dr. S.K.Bhagawati, Dr. P. Saharia, Dr. U.K.Das , Dr.Sanjay Sarma, Dr. D.J.Sharma	Fish knowledge blank content development meeting
69	20.08.2021	Dr.Sanjay Sarma, Fishery Coordinator	Workshop on Fish Value chain, Quality Fish Seed production, TOT at COF
70	20.08.2021	Dr.Sanjay Sarma, Fishery Coordinator, Mr. Sunil Jain, Miss Tandra Dey Sarkar, Miss Namrata Deka	IEC Fish Nutrition campaign plan discussion
71	20.08.2021	Dr.Sanjay Sarma, Fishery Coordinator, Dr. D.J.Sharma,Dr. B. Kalita, Dr.P.C.Bhuyan, RAs, STEF, TEFs	Virtual meeting to discuss workshops and TOT programme
72	24.08.2021	Dr.Sanjay Sarma, Fishery Coordinator	Paddy-Fish farming expansion in Assam
73	24.08.2021	Mrs. Dimple S. Das, Ms. Tandra Dey Sarkar, Ms Namrata Dutta, Dr. Baishnaba Ratha, Dr. Sanjay Sarma	Discussion on IEC campaign plan for promoting Fish in Human Nutrition.
74	31.08.2021	Miss Suranjana Bora, IRRI	GIS map for Paddy Fish farming extension in Assam

75	31.08.2021	Dr. P.C.Bhuyan, COF	TOT Programme at COF.
76	02.09.2021	Dr. Y. Basavaraju, Dr.Sanjay Sarma, Fishery Coordinator, Dr. D.J.Sharma, Mrs. Dimple S. Das,	Quality Fish seed production works in APART by WorldFish startup meeting
77	03.09.2021	Dr. Y. Basavaraju, Dr. D.J.Sharma, DFDO,FDO	Field visit to private fish hatchery in Dudhnoi, Multiplication center in Matilung Farm, Goalpara
78	06.09.2021	Dr. Y. Basavaraju, Dr.Sanjay Sarma, Fishery Coordinator, Dr. D.J.Sharma, Dr. R.C.Barman	Visit to GB Gargh Fish multiplication centre for genetically improved quality seed production
79	06.09.2021	Dr. Y. Basavaraju, Dr.Sanjay Sarma, Fishery Coordinator, Dr. D.J.Sharma, Dr. R.C.Barman	TOT at COF. Gave lecture on Polyculture on Carps, Mola SIS, Freshwater Prawn Farming and Genetically improved stain.
80	07.09.2021	Mr. Nirmallaya Mandal, Mr. Kaustav Mukhopadhaya, Dr. Arun Padiyar, Dr. Y. Basavaraju, Dr.Sanjay Sarma, Fishery Coordinator, Dr. D.J.Sharma, Dr. Binod Kalita, Dr. B.K.Battarcharjya	Workshop on Fish Value Chain in Assam, Workshop on Quality Fish Seed Production
81	08.09.2021	Dr. Y. Basavaraju, Dr.Bimal K. Chand	Visit to private IMC hatcheries in Nilbagan, Hojai, Nagaon to discuss with the each hatchery operators and fish seed growers.
82	10.09.2021	Dr. Bimal K.Chand	Climate Change Study in Assam- PRA in Dimoria.
83	14.09.2021	Dr.Sanjay Sarma	Programme for the visit of WorldFish Fish processing and Nutrition experts
84	15.09.2021	Dr. P.C.Bhuyan, Dr. Rajdeep Dutta	Fish knowledge bank content development.
85	15.09.2021	Mr. Bivash Modi, ACS, Director of Social Welfare,Mr. Sidhananth Dutta,Poshan Abhiyan	Fish in supplementary nutrition programme in Assam
86	16.09.2021	Mr. Bivash Modi, ACS, Director of Social Welfare, Dr. Praveen, UNICEF, Mr. Sidhananth Dutta,Poshan Abhiyan	Fish in supplementary nutrition programme in Assam-WorldFish proposal discussion.
87	16.09.2021	Dr. Ashok Battarcharjya, DR,AAU, Dr. Rupam	Assam Agricultural University APART Activity review meetings

		Borgohain, Dr. Kalyan Pathak,AAU, Dr. P.C.Bhuyan ,COF, Dr. Sanjay Sarma	
88	20.09.2021	Dr. B.A.Shamsundar, Mr. Pankaj Bezbaruah, Mr. Mukesh Kumar, Vyas,GT Consultant	Establishment of Dry fish processing unit in Cachar and Sivasagar FPCs
89	21.09.21	Dr. B.A.Shamsundar, Dr. Bipul Kumar Kakoti, Mr. Inam Akhtar Hussain, COF	Visit to Solar Powered Fish drying unit in Barpeta, Sorthebari District
90	22.09.21	Dr. B.A.Shamsundar, Dr. Baishnaba Ratha, Mr. Nitin Singh, ARIAS, Mr. Amarjit Lahkar, Mr. Inam Akhtar Hussain, Mr. Pankaj Bezbaruah, Fish processing entrepreneurs	Discussion on fish processing, Value addition and fish nutrition
91	23.09.2021	Dr. B.A.Shamsundar, Dr. Baishnaba Ratha	Visit to dry fish market in Jagiroad to discuss with the dry fish merchants. Visit to College of Fisheries, Raha
92	24.09.2021	Dr. Baishnaba Ratha, Dr. Sanjay Sharma, Dr. Baljit Singh, Er. Shreemant Phukan, Mrs. Arpana Barman, Mr. Nitin Singh, Mrs. Dimple Sonari	Fish Nutrition promotion by WorldFish under APART
93	24.09.2021	Dr. B.A.Shamsundar, Dr. Baishnaba Ratha, Mr. Shedananth Dutta, Mrs. Pallabita, Mrs. Anjana Singh, Poshan Abhiyan	Fish in supplementary programme in Anganwadi
94	27.09.2021	Dr. Sanjay Sharma, Mrs. Nibha Kumari, ARIAS, Mr. Nirmallya Mandal, Mr Kaustav	Fish Value Chain Study report
B. Discussions with WorldFish Experts			
Sl.No	**Date**	**WorldFish Expert Discussed**	**Purpose**
1	03.04.2021	Dr.C.V.Mohan	Fish Nutrition promotion in APART
2	07.04.2021	Ms. Neetha Shenoy	MEL Innovation and policies in APART during 2020.
3	08.04.2021	Dr.Arun Padiyar	APART Project activities GIZ Project and Ministry of Fisheries JWG meeting.
4	09.04.2021	Ms. Claire and Mr. Chao	Activity linked invoicing in APART.
5	09.04.2021	Dr.Bimal K. Chand	Climate Change Study in Assam - Progress and Plan of work.

6	09.04.2021	Dr.Bimal K. Chand	Climate Change Study in Assam - Field Work and Report preparation.
7	13.04.2021	Dr. Benjamin Belton , Dr. C.V.Mohan, Dr. Arun Padiyar	GIZ- SIS Breeding Project Budget Meeting.
8	23.04.2021	Dr. Benjamin Belton	GIZ- SIS Breeding Project.
9	29.04.2021	Dr. Surendran Rajaratnam	APART Gender interrogation activities, Gender Scoping reports, Gender Strategy
10	04.05.2021	Dr.Bimal K. Chand	Climate Change Study in Assam - Draft report description.
11	05.05.2021	Dr.Benoy Kumar Barman, WorldFish, Bangladesh, Dr. Sarah Freed, WorldFish.	Rice Fish innovation inventory.
12	10.05.2021	Dr. Benzamin Belton, Dr. Shakuntala Thilsted, Dr. Francois Rajits, Dr. C.V. Mohan, Dr. Arun Padiyar	GIZ- SIS Breeding Project.
13	12.05.2021	Dr. Surendran Rajaratnam	APART Gender interrogation activities.
14	20.05.2021	Dr.Benoy Kumar Barman, Dr. Jharendu Pant	Rice Fish innovation inventory Discussion
15	22.05.2021	Dr.Benoy Kumar Barman, Dr. Manos Kumar Saha, Dr. Arun Padiyar,Dr. Bimal Kinkar Chand, Dr. Sanjay Sarma, Dr. D.J. Sharma.	Virtual Meeting for Mola- SIS promotion in Paddy Fish Farming Systems.
16	25.05.2021	Dr. Arun Padiyar	GIZ- SIS Breeding Project.
17	27.05.2021	Dr. Trinh Trong	Quality Seed production activities in APART.
18	31.05.2021	Dr.Benjamin Belton, Dr. Arun Padiyar.	COVID-19 impact study survey.
19	11.06.2021	Dr. Trinh Trong, Dr. Sanjay Sarma	Virtual Meeting on Quality Seed production preliminary Discussion
20	15.06.2021	Dr. Bimal Kinkar Chand	Climate Resilient Technologies Study in Assam- Status.
21	23.06.2021	Dr.Arun Padiyar	WorldFish Assam , APART Project Works
22	25.06.2021	Dr. Sarah Freed, Dr.Arun Padiyar	One CG-Agro ecology initiative Discussion
23	30.06.2021	Dr.Surendran Rajaratnam,	Publication of Gender works in Assam
24	01.07.2021	Dr. Bimal Kinkar Chand	Climate Resilient Technologies Study in Assam – Field Data collection
25	03.07.2021	Dr. Bimal Kinkar Chand	Climate Resilient Technologies Study in Assam –Progress update meeting
26	03.07.2021	Dr.Arun Padiyar	APART Project Activities

27	08.07.2021	Dr.Jhanrendu Pant	Virtual meeting on Paddy Fish Farming in APART preliminary discussion
28	10.07.2021	Dr.Jhanrendu Pant, Dr. C.V.Mohan, Dr.Arun Padiyar, Dr. Manos Kumar Shaha,Dr. Kanwar Singh,Dr. Bimal Chand, Dr. Sanjay Sarma , Dr. Atanu Chattarjee, Dr. P.C.Bhuyan, Dr. Manash Pratim Dutta, Dr. D.J.Sharma, DOF and APART Staff	Virtual meeting on Paddy Fish Farming in APART
29	14.07.2021	Dr. C.V.Mohan, Dr. Arun Padiyar	WorldFish activities in APART-Planning meeting
30	14.07.2021	Dr. Binod Sethi, Mrs. Moumita Paul	APART GIS works.
31	19.07.2021	Mr. Nirmallya Mandal	GIZ Project on Small scale aquaculture development in Assam
32	21.07.2021	Dr. Bimal Kinkar Chand	Climate Resilient Technologies Study in Assam – Progress Discussion
33	21.07.2021	Dr.Surendran Rajaratnam	Women SHG study in India, International Youth Day Webiner by WorldFish
34	24.07.2021	Dr.Y. Basavaraju	Quality Fish Seed Production Activities in Assam
35	24.07.2021	Dr. Baishnaba Charan Ratha	Fish in Nutrition promotion in Assam
36	28.07.2021	Dr. Trinh Trong, Dr. C.V.Mohan, Dr. Arun Padiyar, Dr. Y. Basavaraju	WorldFish initiatives for Quality Seed production in APART- virtual meeting.
37	30.07.2021	Dr. C.V.Mohan, Dr. Arun Padiyar,Dr. Baishnaba Charan Ratha, Dr. Sanjay Sarma, Mrs. Dimple S. Das	Virtual meeting on promoting Fish in Nutrition under APART
38	03.08.2021	Dr. Sarah Freed, Dr. Arun Padiyar, Dr. Binimoy Mohanty	One CG Agro ecology IDT.
39	06.08.2021	Dr. Bimal Kinkar Chand	Climate Resilient Technologies Study in Assam – Case Studies, Climate smart business opportunities
40	13.08.2021	Dr. C.V.Mohan, Dr. Arun Padiyar	WorldFish India projects discussion
41	19.08.2021	Dr. Benjamin Belton, Dr. C.V.Mohan, Dr. Arun Padiyar	GIZ SIS Breeding project start-up meeting
42	20.08.2021	Dr. Arun Padiyar	Fish value chain workshop and APART activities.

43	20.08.2021	Dr. Baishnaba Ratha	Nutrition promotion in Assam identification of partners.
44	20.08.2021	Dr. Y. Basavaraju	Workshop on Quality Fish seed production, TOT at COF.
45	20.08.2021	Mr. Nirmallya Mandal	Workshop on Fish value chain in Assam
46	21.08.2021	Dr. Y. Basavaraju	Workshop on Quality Fish seed production, TOT at COF, Field visit programme.
47	24.08.2021	Dr.C.V.Mohan and Finance Team, WorldFish	APART Project additional Fund proposal to World Bank
48	24.08.2021	Dr.B.A.Shamsundar	Fish processing activities in APART
49	26.08.2021	Dr.C.V.Mohann, Dr.Arun Padiyar	Climate change study progress, Staff recruitment
50	26.08.2021	Dr. Bimal Kinkar Chand	Climate Resilient Technologies Study in Assam progress
51	28.08.2021	Mr. Nirmallya Mandal, Mr. Kaustuv Mukpadhaya	Fish value chain workshop
52	31.08.2021	Dr. Bimal Kinkar Chand	Climate Resilient Technologies Study in Assam Field visit programme
53	01.09.2021	Dr.Arun Padiyar	Fish value chain workshop, GIZ SIS breeding programme
54	02.09.2021	Dr. Y. Basavaraju	Quality Fish seed production works in APART by WorldFish briefing meeting
55	03.09.2021	Dr.Arun Padiyar	Fish Value Chain workshop, TOT at COF
56	04.09.2021	Dr. Bimal Kinkar Chand	Climate Resilient Technologies Study in Assam Field visit programme
57	10.09.2021	Dr.C.V.Mohan, Dr. Arun Padiyar, Mr. Pratap Singha, Miss Stephania, GIZ	GIZ Small Scale aquaculture development project.
58	11.09.2021	Dr. Bimal Kinkar Chand	Climate Resilient Technologies Study in Assam Wrap-up meeting
59	11.09.2021	Dr.Baishnaba Ratha	Fish Nutrition Promotion in Assam, potential partners identification
60	22.09.2021	Dr. Sarah Freed, Dr. Benoy Kumar Barman, Dr. Manos Kumar Saha, Dr. Philippa	Rice fish farming system inventory of innovations discussion
61	22.09.2021	Dr. Bimal Kinkar Chand	Climate Resilient Technologies Study in Assam report preparation in
62	27.09.2021	Dr. Y. Basavaraju	SOP for IMC hatchery and Multiplication Centres
63	28.09.2021	Dr. Trinh Trong, Dr. Y. Basavaraju	SOP for IMC hatchery and Multiplication Centres

11. KEY SUPPORTING DOCUMENTS

Annexure 1. Virtual Programmes/Meetings by WorldFish Team
Annexure 2. Training of Trainers (ToT) Program on Quality fish seed production
Annexure 3. Workshop on Fish Value Chain in Assam
Annexure 4. Workshop on Quality carp seed production in Assam
Annexure 5. Discussion on Fish Processing, Value addition and Nutrition Promotion in APART
Annexure 6. Covid-19 impacts and adaptations in aquatic food supply chains in Assam
Annexure 7. Focus Group Discussions
Annexure 8. BMP for Carp polyculture with Genettically improved strains- V1.
Annexure 9. BMP for Polyculture of Carp with Freshwater Prawns- V1 (English & Assamese version)
Annexure 10. Standard Operating Procedure (SOP) for Indian Major Carp Hatcheries
Annexure 11. Standard Operating Procedure (SOP) for Indian Major Carp Multiplication Centres
Annexure 12. Social Behaviour Communication Change Social Media Posts

Annexure- 1

Virtual Programmes/Meetings by WorldFish Team

Virtual Programmes/Meetings by WorldFish Team:

During the recent COVID-19 pandemic situation due to travel restrictions, WorldFish experts and Resident consultant provided virtual support for the implementation of project interventions by providing necessary technical support to ARIAS, Director of Fisheries, College of Fisheries, AAU, Raha and to the Technical Expert Fisheries, APART. A series of virtual meetings, discussions, trainings were arranged for the benefit of DoF officials, APART Project staff and CoF faculty which included Virtual discussion on Work plan between WorldFish and APART, Mola-SIS Promotion in Paddy-Fish farming system, Gender Integration in Fisheries component of APART, Carp-Mola-SIS Polyculture-progress, problems and prospects in Assam, Quality Carp Seed production in Assam under APART, Paddy-Fish Systems in Assam. During these virtual programmes DoF officials, APART Project staff, ARIAS Specialists, WorldFish Odhisa team and CoF faculty members actively participated and interacted with the WorldFish experts.

Sl No.	Date	Topic for the virtual meeting	Resource Person
1	14-5-2021	Virtual Discussion between WorldFish, DOF, COF and ARIAS for APART Activities	Dr. R. Suresh, Project Co-ordinator, WorldFish project-Assam, Dr. Sanjay Sharma, Fishery Co-ordinator, ARIAS and Dr. Dhrubyajyoti Sharma, Nodal Officer, APART, OPIU.
2	22-5-2021	Virtual Discussion on Mola-SIS Promotion in Paddy-Fish farming system	Dr. Benoy Kumar Barman, Senior Scientists, WorldFish.
3	29-5-2021	Virtual Discussion on Gender Integration in Fisheries component of APART	Dr. Surendran Rajaratnam , Gender Expert, WorldFish.
4	12-6-2021	Virtual Discussion on Carp-Mola-SIS Polyculture-progress, problems and prospects in Assam	Dr. Benoy Kumar Barman, Senior Scientist, WorldFish and Dr. Manos Kumar Saha, WorldFish Expert.
5	19-6-2021	Virtual Discussion on Quality Carp Seed production in Assam under APART	Dr. Trinh Quoc Trong, Senior Scientist, WorldFish, Malaysia
6	10-7-2021	Virtual Discussion on Paddy-Fish Systems in Assam	Dr. Jharendu Pant, WorldFish Expert and Dr. Kanwar Singh, Resident Consultant & Senior Associate Scientist, IRRI.

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WorldFish

Assam Agribusiness and Rural Transformation Project (APART)

Virtual Discussion on

Discussion between WorldFish, DOF, COF and ARIAS for APART Activities

Dr. Rajendran Suresh,
Resident Consultant, WorldFish, APART

Date: 14-05-2021
Time: 6:30 – 8:00 PM

REPORT

WorldFish

Department of Fisheries, Govt. of Assam

Virtual Discussion between WorldFish, DOF, COF and ARIAS for APART Activities

A virtual meeting was organized by WorldFish on 14 May for the discussion on the following agenda:

1. Status of APART Fishery Activities during the present Covid-19 situation.
2. WorldFish Experts virtual Technical support for the APART activities.
3. Quality seed production strategy for upgraded hatcheries and multiplication centers under APART.
4. World Bank Team discussion for New Proposals in Fisheries
5. AWP for 2021-22
6. Any other matters.

At the outset, Dr R. Suresh, Project coordinator, WorldFish Project-Assam welcomed all the participants and gave a brief introduction and objectives of the meeting. Dr. R. Suresh, explained the WorldFish proposal to conduct Virtual meetings, Workshops, Trainings for the DOF officials and APART Project staff on a weekly basis where WorldFish Experts will participate and provide technical support for the project activities. So, accordingly it was decided for conducting virtual meeting every week on Saturdays at 6.30 pm on different topics regarding to culture of mola in Paddy cum Fish culture, polyculture ponds and in beels, Seed rearing, Supporting Beel activities, Upgradation of hatcheries and Multiplication centres, Quality seed production etc.

The seed availability of Jayanti Rohu and Amur Carp for stocking in the demonstrations was also discussed in the meeting. It was informed that the 10 Fisheries Producer Company (FPC) have the stock of the genetically improved strain seeds in their farm, so it was suggested to collect the details and also the quantity of the seeds available for stocking in the APART project districts. Accordingly it is discussed that the details should be given to all the TEFs and ECFs about the 10 FPC where the Genetically Improved strains are available.

Dr. Suresh also suggested for conducting the Virtual training to the different private hatcheries owners for producing good quality seeds, therefore accordingly he suggested to prepare a good presentation in Assamese on the quality seed production.

Kobo tool box data collection of the Endline Survey and the Baseline Survey was also discussed and it was decided that the TEFs should complete at least 50 nos of Endline survey and 50 nos of the Baseline survey. The status of the Mola stocking in Polyculture was also discussed.

List of participants:

SL No	Name	Designation
1	Dr. Rajendran Suresh	Resident Consultant, WorldFish, Assam
2	Dr. Dhrubyajyoti Sharma	APART Nodal Officer, OPIU
3	Dr. Sanjay Sharma	Fishery Co-ordinator, ARIAS
4	Dr. Pradip Chandra Bhuyan	Professor, College of Fisheries, Assam
5	Dr. Sanjay Sharma	Fishery Co-ordinator, ARIAS
6	Mr. Manas Pratim Dutta	CoF Asst. Professor
7	Dr. Pabitra Kumar Saharia	Asst. Professor, CoF Raha
8	Dr. Pranjyoti Sharma	Professor & HoD, CoF, Raha
9	Pranjal Pratim Gautam	Project Associate, APART
10	Mrs. Begum RehenaParvin	TEF, OPIU
11	Ms. Neeta Beypi	TEF, WorldFish, APART
12	Mr. KalpajitGogoi	TEF, WorldFish, APART
13	Nabamika Sonowal	TEF, WorldFish, APART
14	Mr. Rupan Pegu	TEF, Kamrup
15	Mr. Bubul Sainary	TEF, Goalpara, APART
16	Gunajit Talukdar	TEF, Nalbari, APART
17	Mr. Suman Saikia	TEF, Jorhat, APART
18	Mr. Dipankar Pathak	TEF, Kokrajhar, APART
19	Mr. Prakash Kolita	TEF, Nagaon
20	Mr. Abu Suwan	TEF, Morigaon
21	Mr. Tingku Phukan	TEF, Cachar
22	Mr. Kandarpa Borua	TEF, Lakhimpur, APART
23	Jyotirmoyee Das	TEF, Sonitpur, APART
24	DeepankarTalukdar	TEF, Darrang
25	Sanayaima Singha	TEF, Barpeta
26	Biswajit Borah	Project Associate, COF, APART
27	Mr. Pranjal Pratim Gautam	Project Associate, COF, APART

28	Ajimoon Nissa Khan	Project Associate, COF, APART
29	Kangkana Das	Project Associate, COF, APART
30	Kaustav Gayan	MIS, APART
31	Mahmud Ali	ECF, Sivasagar
32	Sudakshina Kalita	ECF, Kamrup
33	Bidhuy Kumar Medhi	ECF, Nagaon
34	Bobita	ECF, Darrang
35	Ruhini Nath	ECF, Morigaon
36	Ajit Rai	ECF, Jorhat
37	Sarjiz Akhtar	ECF, Golaghat
38	Utpal Chakraborty	ECF, Dhubri
39	Mohan Haloi	ECF, Nalbari
40	Priyanka Choudhary	ECF, Nalbari
41	Rajibul Islam	ECF, barpeta

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WorldFish

Assam Agribusiness and Rural Transformation Project (APART)

Virtual Meeting on

Mola-SIS promotion in Paddy-Fish farming system

Expert: Dr. Benoy Kumar Barman and Sr. Scientist, WorldFish

Date: 22-05-2021
Time: 6:30 – 8:00 PM

REPORT

WorldFish

Department of Fisheries, Govt. of Assam

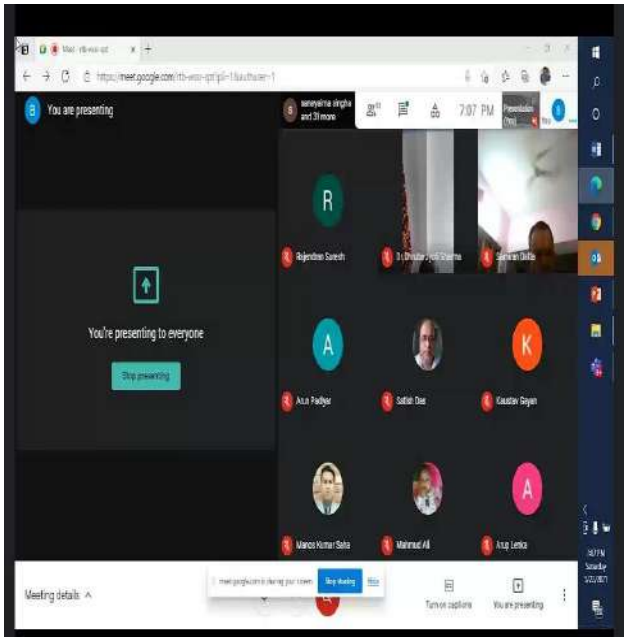
Virtual Discussion on Mola-SIS Promotion in Paddy-Fish farming system

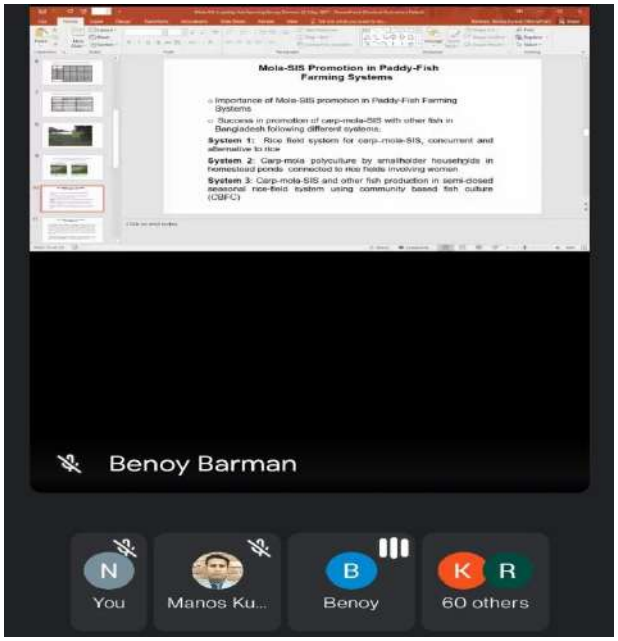
A virtual meeting on "Mola-SIS Promotion in Paddy-Fish farming system" was organized by WorldFish in collaboration with DoF, CoF and ARIAS Society on 22nd May, 2021. Dr. Benoy Kumar Barman, Senior Scientist, WorldFish, Bangladesh served as the resource person for the meeting. A total of 60 participants attended the virtual meeting. The participants include College of Fisheries Staffs, Department of Fisheries Officials, WorldFish Odisha team, WorldFish Experts from Bangladesh, ARIAS Society team, Nodal Officer, APART, Fisheries Coordinator and TEFs and ECFs, APART.

At the outset, Dr Suresh, Project coordinator, WorldFish Project-Assam welcomed all the participants and gave a brief introduction and objectives of the meeting. Dr. Benoy Kumar Barman, Senior Scientist, WorldFish gave a presentation on "Mola-SIS Promotion in Paddy-Fish farming system". He presented and discussed in detail about the background, Paddy cum Fish farming in APART project, Assam, Mola-SIS Promotion in Paddy-Fish farming systems etc.

Issues on promotion of Mola-SIS Promotion in Paddy-Fish farming systems and field level technical and other issues on Paddy-Fish farming and particularly on Mola-SIS promotion was also discussed in the meeting. Dr. Benoy Kumar Barman also shared the Bangladesh experiences and some success stories regarding the Mola-SIS in Paddy-Fish farming system in Bangladesh.

. A series of discussion followed after the presentation regarding the identification of the sources of Mola, stocking of Mola, live transportation of Mola, Paddy variety, etc. After the presentation Dr. Suresh, Resident Consultant, WorldFish, Assam, thanked all the participants for their active participation and discussion.





List of participants:

Sl. No.	Name	Designation
1	Dr. Mohan Chadag	Principal Scientist, WorldFish, Malaysia
2	Dr. Benoy Kumar Barman	Senior Scientist, WorldFish, Bangladesh
3	Dr. Arun Padiyar	Project Manager, WorldFish, Odisha
4	Dr. Benoy Kumar Barman	Senior Scientist, WorldFish, Bangladesh
5	Binimaya Mohanty	Senior Aquaculture Specialist
6	Dr. Rajendran Suresh	Resident Consultant, WorldFish, Assam
7	Dr. Sanjay Sharma	Fishery Co-ordinator, ARIAS
8	Dr. Dhrubyajyoti Sharma	APART Nodal Officer, OPIU
9	Dr. Pradip Chandra Bhuyan	CoF Asst. Professor
10	Mr. ManasPratim Dutta	CoF Asst. Professor
11	Dr. Bimal Chand,	WorldFish Expert
12	Dr. Baishnaba Charan Ratha	Project Manager USAID IPP, WorldFish, Odisha
13	Ms. Dimple Sonari Das	Public Information and Communication Specialist, ARIAS Society
14	Dr. Pabitra Kumar Saharia	Asst. Professor, CoFRaha
15	Dr. Pranjyoti Sharma	Professor &HoD, CoF, Raha
16	PranjalPratimGautam	Project Associate, APART
17	Bikram Keshari Baliarsingh	Senior Aquaculture Specialist
18	Satish Ranjan Das	Communication Manager
19	SamiranDatta	Aquaculture Expert
20	Amar Gaikwad	Aquaculture Specialist
21	Neetha Shenoy	Aquaculture Specialist
22	Aparajitapriyadarsini	Technical Coordinator
23	ArddhenduSekharMohanty	Technical Coordinator
24	KhirodachandraNayak	Technical Coordinator
25	Manoj Kumar Sahoo	Technical Coordinator

26	Susanta Kumar Mishra	Technical Coordinator
27	Suvendra Kumar das	Technical Coordinator
28	Aditya Narayan Dash	Technical Analyst
29	Anil Kumar Sahu	Technical Analyst
30	Arup RanjanLenka	Technical Analyst
31	Kalpajit Gogoi	TEF, WorldFish
32	Neeta Beypi	TEF, WorldFish
33	NabamikaSonowal	TEF, WorldFish
34	RupanPegu	TEF, Kamrup
35	Dipankar Pathak	Kokrajhar
36	DipankarTalukdar	TEF, Darrang
37	KaustavGayan	MIS, APART
38	Mahmud Ali	TEF, Sivasagar
39	Rehena parvin	TEF, OPIU
40	Biswajit Bora	ECF, OPIU
41	AjimoonNissa Khan	Project Associate, APART, AAU
42	BubulSainary	TEF, Goalpara
43	Kandarpa Boruah	TEF, Lakhimpur
44	Prakash kalita	TEF, Nagaon
45	SanayaimaSinhga	TEF, Barpeta
46	Abu Suvan	TEF, Morigaon
47	Monjita Hazarika	ECF, Sonitpur
48	Kangkana Das	Project Associate, COF, APART
49	Jyotirmoyee Das	TEF, Sonitpur, APART
50	GunajitTalukdar	TEF, Nalbari, APART
51	Mr. SumanSaikia	TEF, Jorhat, APART

52	Mr. TingkuPhukan	TEF, Cachar
53	SudakshinaKalita	ECF, Kamrup
54	Bidhuy Kumar Medhi	ECF, Nagaon
55	Ajit Rai	ECF, Jorhat
56	Utpal Chakraborty	ECF, Dhubri
57	Rajibul Islam	ECF, barpeta
58	Bobita	ECF, Darrang
59	Mohan Haloi	ECF, Nalbari
60	RuhiniNath	ECF, Morigaon
61	Biswajit Borah	Project Associate, CoF, APART

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WorldFish

Assam Agribusiness and Rural Transformation Project (APART)

Virtual Meeting on

Gender Integration in Fisheries component of APART

Expert: Dr. Surendran Rajaratnam,
Gender Expert, WorldFish

Date: 29-05-2021
Time: 6:30 – 8:00 PM

REPORT

WorldFish

Department of Fisheries, Govt. of Assam

Virtual Discussion on Gender Integration in Fisheries component of APART

A virtual discussion on "**Gender Integration in Fisheries component of APART"** was organized by WorldFish in collaboration with DoF, CoF and ARIAS Society on 29th May, 2021. Dr. Surendran Rajaratnam, Gender Expert, WorldFish, Malaysia served as the resource person for the meeting. A total of 45 participants attended the virtual meeting. The participants include College of Fisheries Staffs, Department of Fisheries Officials, ARIAS Society team, District Social Sector Coordinators, Nodal Officer, APART, Fisheries Coordinator and TEFs and ECFs, APART.

At the outset, Dr Suresh, Project coordinator, WorldFish Project-Assam welcomed all the participants and gave a brief introduction and objectives of the meeting.

Dr. Arpana Barman, Social Sector Coordinator, ARIAS, talked about the World Bank expectation of the Women participation in the APART Project. She discussed about the importance of the documentation of the Women participation in the various activities of the Project. She suggested that the women involvement in the project as well as the benefits they are getting from the project should be regularly documented. The women in the project should be empowered as well as guidance should be given to the women on Better Management Practices in the fish culture. Focus Group Discussion should be conducted within the women group.

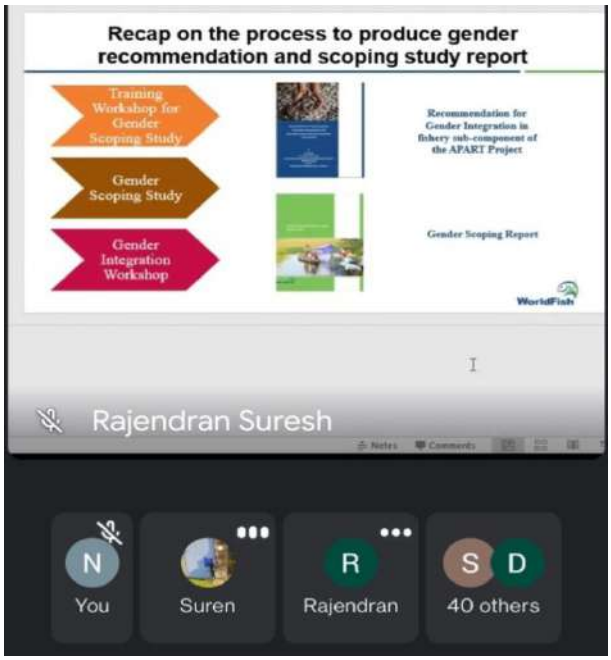
Dr. Surendran Rajaratnam, Gender Expert, WorldFish, then gave a presentation on "**Gender Integration in Fisheries component of APART"**. He discussed about the women farmers access to agricultural assets and services and about increasing the number of farmers adopting improved agricultural technology in production, post harvest and in value addition. He suggested that the project needs to consider gender dynamics between different type of women and men, and address both visible markers of inequalities (*ie.* participation) as well as formal and informal underlying barriers (*eg.* Policies, unequal/harmful gender norms and relations).

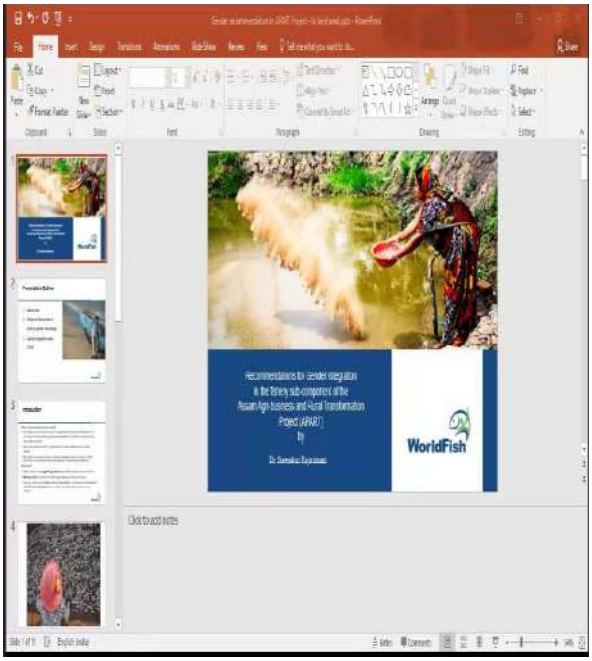
He also discussed about the findings and the recommendation for Gender Integration in fishery as well as about the Gender Scoping Study Report of the APART districts. Dr. Surendran highlighted the cross cutting issues and the steps to be followed in the field:-

i. Revisit the selection criteria for targeting interventions for different intervention packages to ensure those who most need the support are reached.
ii. Revisit the implementation around 30% targeting of women to be beneficiaries.
iii. Prioritize that the upcoming value chain study integrates a gender lens into the analysis to identify entry points for women involvement in fish agri-business.
iv. Prioritize identifying gender integration entry points within Beel governance.
v. Integrate gender within existing M&E tools and indentify new qualitative indicators around gender for APART existing results framework.

Dr. Dhrubajyoti Sharma, Nodal Officer, APART, and Sanjay Sharma, Fishery Coordinator informed that till date the project has not been able to achieve its target on the participation of women and therefore they advised that in the coming years of the project the field Technical officer from beginning of the project years hould give importance in sensitizing women through awareness program and to select and include more women beneficiaries in the project. They suggested the TEF to increase and include more women beneficiary in Beel Fisheries.

Dr. Suresh suggested the TEF to encourage more women to be involved in different activities. He advised for conducting more Focus Group Discussion between women, impact analysis and case studies of the successful women beneficiaries to be documented to bring changes in the project.





List of participants:

SL No.	Name	Designation
1	Dr.SurendranRajaratnam	Gender Expert, WorldFish, Malaysia
2	Dr. Arpana Barman	SSMS, APART
3	Dr. Rajendran Suresh	Resident Consultant, WorldFish, Assam
4	Dr. Dhrubyajyoti Sharma	Nodal Officer, OPIU
5	Dr. Sanjay Sharma	Fishery Co-ordinator, ARIAS
6	Dr. Pradip Chandra Bhuyan	Professor, College of Fisheries, Assam
7	Mrs. Begum RehenaParvin	TEF, OPIU
8	Ms. Neeta Beypi	TEF, WorldFish, APART
9	Mr. KalpajitGogoi	TEF, WorldFish, APART
10	NabamikaSonowal	TEF, WorldFish, APART
11	Mr. RupanPegu	TEF, Kamrup
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16	Mr. PrakashKolita	TEF, Nagaon
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25	AjimoonNissa Khan	Project Associate, COF, APART
26	Kangkana Das	Project Associate, COF, APART
27	Dr. Pabitra Kumar Saharia	CoF

28	KaustavGayan	MIS, APART
29	Mahmud Ali	ECF, Sivasagar
30	SudakshinaKalita	ECF, Kamrup
31	Bidhuy Kumar Medhi	ECF, Nagaon
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35	SarjizAkhtar	ECF, Golaghat
36	UtpalChakraborty	ECF, Dhubri
37	Mohan Haloi	ECF, Nalbari
38	PriyankaChoudhary	ECF, Nalbari
39	Rajibul Islam	ECF, barpeta
40	RanjanSaikia	DSSC, Nagaon
41	NilotpolGogoi	DSSC, North Lakhimpur
42	Sabin Deka	DSSC, Nalbari
43	RenuBasumatary	DSSC, Kokrajhar
44	DibyajyoitiBaruah	DSSC, Golaghat
45	SanjuktaBhargavPhukan	DSSC, Barpeta

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Assam Agribusiness and Rural Transformation Project (APART)

Virtual Discussion on

Carp-Mola-SIS Polyculture in Assam- Progress, Problems and Prospects

Dr. Benoy Kumar Barman,
Sr. Scientist, WorldFish

Date: 12-06-2021
Time: 6:30 – 8:00 PM

REPORT

WorldFish

Department of Fisheries, Govt. of Assam

Virtual Discussion on Carp-Mola-SIS Polyculture-progress, problems and prospects in Assam

A virtual discussion on **"Carp-Mola-SIS Polyculture-progress, problems and prospects in Assam"** was organized by WorldFish in collaboration with DoF, CoF and ARIAS Society on 12th June, 2021. Dr. Benoy Kumar Barman, Senior Scientist, WorldFish, Bangladesh and Dr. Manos Kumar Saha, WorldFish, Bangladesh served as resource persons for the meeting. A total of 26 participants attended the virtual meeting. The participants include Nodal Officer, APART, Fisheries Coordinator, ARIAS, Department of Fisheries Officials, College of Fisheries Staffs and TEFs and ECFs, APART.

At the outset, Dr Suresh, Project coordinator, WorldFish project-Assam welcomed all the participants and gave a brief introduction and objectives of the meeting.

Dr. Sanjay Sharma, Project Coordinator and Dr. Dhrubajyoti Sharma, Nodal Officer APART, talked about how the culture of Mola with Carp has played an important role in fisheries interventions of the APART project because the farmers are able to earn additional profit of about Rs 50000/ha (400-500 kg/ha) from mola alone from the Carp-Mola polyculture system without hampering the Carp production. Therefore the TEF were requested for more mola stocking in ponds, paddy fields and in Beels in their concerned districts.

Dr. Benoy Kumar Barman, Senior Scientist, WorldFish, then gave a presentation on "**Carp-Mola-SIS Polyculture-progress, problems and prospects in Assam"**.

Dr. Benoy Kumar Barman discussed that the Mola and SIS are not competitors and do not affect the carp production but actually complimenting the production and adding additional income. The most important advantage of culturing Mola-SIS is because of its high levels of micronutrients which are beneficial to minor children, lactating and pregnant women. Awareness should be given to all the stakeholders especially the policy makers, technical experts, officials etc. that farming of Mola-SIS is important in pond polyculture system, Beels and in Paddy field sand it actually increases the diversity not only mola but also other indigenous species within the system. He cited his experiences from Bangladesh that in one of the Beels when they introduced Mola, they found out that the 40 other indigenous species present in the Beel almost got increased. Mola is actually contributing to additional production n and on the other hand it also compliments the production of other species.

Dr. Pradip Bhuyan, COF, suggested that the messages of nutritional aspects of the Mola and also about the additional income from Mola should be given and highlighted in the FDG meeting. He aslo suggested that the mall backyard ponds which people neglect for culturing of fish should be identified and encouraged for culturing the mola and other indegenious species which in return will help them in their domestic consumption as well, as for selling.

Dr. Benoy Kumar Barman suggested that since it is very difficult to actually estimate the total availability of mola in the pond, the recommended quantity (50 kg/ha) can be stocked in the pond since it will not hamper the already available mola as well as the carp because of the partial harvesting of mola in every month. And in this case during the first harvesting more mola should be harvested and then the mola availability will come to a balance. He added that stocking more quantity of mola lead to higher production rather than decrease in the production. The factors and criteria of transporting of live mola was also discussed in the meeting. Dr. Manos Saha then suggested the importance of using the grading net, hardening the mola fishes, separating of the small fishes from the bigger fishes without harming them, conditioning of fishes in the hapa etc. for the live collection of mola.

The process and the problem in collection of Mola source live from large water bodies like Beels was also discussed in the meeting. Dr. Benoy Kumar Barman and Dr. Manos Saha advice that mola should be collected from ponds by continuously feeding the mola to make the mola strong, and then transferred to the actual pond for stocking.

Dr. Suresh adviced that the most important thing for Carp-Mola promotion in Assam is the use of the grader net from the stage of collection of brood fishes for stocking to harvesting of the mola for marketing in live condition. He suggested to the TEF for popularizing the use of the grader net among the farmers.

At last the meeting was concluded with vote of thanks to the entire participant.

List of the participants:

Sl No.	Name	Designation
1	Dr. Benoy Kumar Barman	Senior Scientist, WorldFish, Bangladesh
2	Dr. Manos Kumar Saha	WorldFish Expert, Bangladesh
3	Dr. Rajendran Suresh	Resident Consultant, WorldFish, Assam
4	Dr. Pradip Chandra Bhuyan	Professor, College of Fisheries, Assam
5	Dr. Dhrubyajyoti Sharma	Nodal Officer, OPIU
6	Dr. Sanjay Sharma	Fishery Co-ordinator, ARIAS
7	KalpajitGogoi	TEF, WorldFish
8	Neeta Beypi	TEF, WorldFish
9	NabamikaSonowal	TEF, WorldFish
10	Jyotirmoye Das	TEF, Sonitpur
11	KandarpaBoruah	TEF, Lakhimpur
12	PranjalPratimGautam	Project Associate, APART, AAU
13	RehenaParvin	TEF, OPIU
14	RupanPegu	TEF, Kamrup
15	SanayamaSingha	TEF, Barpeta
16	TinkuPhukan	TEF, Cachar
17	Abu Suvan	TEF, Morigaon
18	Ajimoon,Khan	Project Associate, APART, AAU
19	Biswajit Borah	ECF, OPIU
20	BubulSainary	TEF, Goalpara
21	DipankarPathak	TEF, Kokrajhar
22	DipankarTalukdar	TEF, Darrang
23	KaustavGayan	MIS, APART
24	Mahmud Ali	ECF, Sivasagar
25	PrakashKalita	TEF, Nagaon
26	SarjishAkhtar	ECF, Golaghat

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WorldFish

Assam Agribusiness and Rural Transformation Project (APART)

Virtual Meeting
on

Quality Carp Seed Production in Upgraded hatcheries and Multiplication Centres

Dr. Trinh Trong,
Sr. Scientist, WorldFish, Malaysia

Date: 19-06-2021
Time: 6:30 – 8:00 PM

REPORT

WorldFish

Department of Fisheries, Govt. of Assam

Virtual Discussion on Quality Carp Seed production in Assam under APART

A virtual meeting on **"Quality Carp Seed production in Assam under APART"** was organized by WorldFish in collaboration with DoF, CoF and ARIAS Society on 19th June, 2021. Dr. Trinh Quoc Trong, Senior Scientist, WorldFish, Malaysia, served as the resource person for the meeting. A total of 39 participants attended the virtual meeting. The participants include Dr. Mohan Chadag, Principal Scientist, WorldFish, Malaysia, WorldFish Odisha team, Department of Fisheries Officials, Nodal Officer, APART, Fisheries Coordinator, ARIAS and TEFs and ECFs, APART.

At the outset, Dr Suresh, Project co-coordinator, WorldFish project-Assam welcomed all the participants and gave a brief introduction and purpose of the meeting.

Dr. Mohan Chadag, Principal Scientist, discussed the importance of record keeping for the source of seed, their performance, mortality, their FCR. He addressed that what we lack in many parts of India is the lack of evidence to really pin point the real reason for poor performance of the seed. He advised for the record keeping right from the hatchery operation to the farm operation. Therefore the information generated will be able to give lot of evidence and therefore will be able to pick up hatcheries that are very well performing. He informed that performance assessment and record keeping are most important for the success of improving the good quality of seed. He also advised to clearly understand the difference between the quality seed and improved seed. The main objectives of all the hatcheries should be how to provide and improve the accessibility and availability of improved seed and high quality seed to the farmers. Therefore strong dissemination, seed distribution network and a good tracking system is important for improving the quality of seeds.

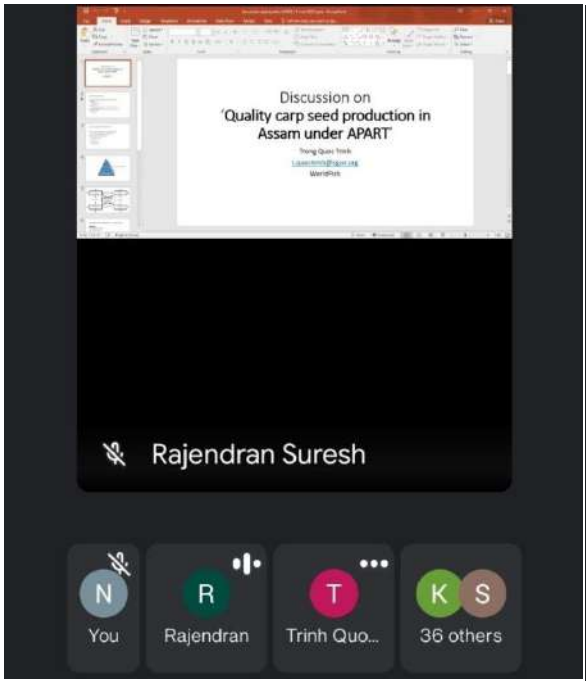
Dr. Arun Padiyar, WorldFish Expert Odisha, discussed about the problem and the major issues of the seed quality in Odisha. He reported that many farmers in Odisha are directly stocking fry instead of fingerlings and the farm outcome come down without knowing the survival percentage. Therefore he informed that they are promoting fingerling stocking in a war footing basis in the State, ie, Zero size fingerlings (50-100 grams).

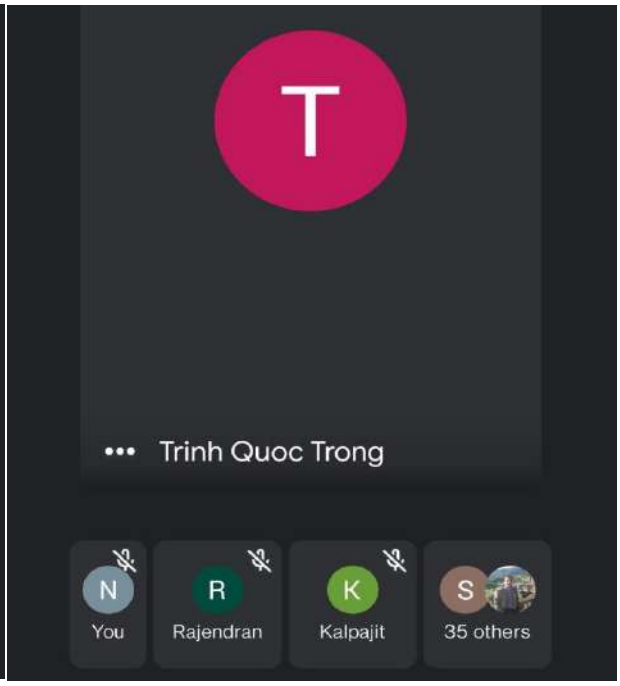
Dr. Sanjay Sharma gave a briefing about the Upgraded Hatcheries and the Multiplication Centres under APART. He suggested the TEFs for bringing the farmers of their concerned area to the hatcheries as well as the up-gradation centres so that the farmer can see and learn how the quality seed can be produced and as well as quality broodstock can be maintained.

Dr. Trinh Quoc Trong gave a presentation on the topic **"Quality Carp Seed production in Assam under APART".** He explained that seed contribute 1/3th to grow-out (production) success, and the other 2/3 are Feed and Management. He explained that to maintain high quality seed, brood stock management and best management practices at both multiplication centre and hatcheries are important. He also explained the concept of multiplication centre. He explained that the multiplication centre does not improve quality of the seed but it rather maintain whatever

is already improved in the breeding nucleus. Therefore to achieve this broodstock management is very important. He suggested for regular record keeping. The multiplication centre should be able to receive new improved fish or new generation to replace the old ones. He also discussed about the roles of the hatcheries. He advised for not using the offspring in the hatcheries as a broodstock in the next generation because it will reduce the performance since inbreeding rate will increase.

At last the meeting was concluded by giving vote of thanks to all the participants.





List of the participants:

Sl No.	Name	Designation
1	Dr. Trinh QuocTrong	Senior Scientist, WorldFish, Malaysia
2	Dr. Mohan Chadag	Principal Scientist, WorldFish, Malaysia
3	Dr. ArunPadiyar	Propject Manager, WorldFish, Odhisa
4	Dr. Baishnaba Charan Ratha	Project Manager USAID IPP, WorldFish, Odhisa
5	Dr. Rajendran Suresh	Resident Consultant, WorldFish, Assam
6	Dr. Sanjay Sharma	Fishery Co-ordinator, ARIAS
7	Aditya Narayan Dash	Technical Analyst, WorldFish, Odhisa
8	Amar Gaikwad	Aquaculture Specialist, WorldFish, Odhisa
9	Anil Kumar Sahu	Technical Analyst, WorldFish, Odhisa
10	Arup Ranjan Lenka	Technical Analyst, WorldFish, Odhisa
11	Binod Sethi	Technical Coordinator, WorldFish, Odhisa
12	Susanta Kumar Mishra	Technical Coordinator, WorldFish, Odhisa
13	Khirod Nayak	Technical Coordinator, WorldFish, Odhisa
14	Manoj Kumar Sahoo	Technical Coordinator, WorldFish, Odhisa
15	Neetha Shenoy	Aquaculture Specialist, WorldFish, Odhisa
16	Samiran Datta	Aquaculture Expert, WorldFish, Odhisa
17	Satish Das	Communication Manager, WorldFish, Odhisa
18	Saurav Kumar Biswal	
19	Suvendra Kumar Dash	Technical Analyst, WorldFish, Odhisa
20	Aparajita Priyadarshini	Technical Coordinator, WorldFish, Odhisa

21	Arddhenu Sekhar Mohanty	Technical Coordinator, WorldFish, Odhisa
22	Bikram Baliarsingh	Senior Aquaculture Specialist, WorldFish, Odhisa
23	Binimay Mohanty	Senior Aquaculture Specialist, WorldFish, Odhisa
24	Pal Moumita	
25	KalpajitGogoi	TEF, WorldFish
26	Neeta Beypi	TEF, WorldFish
27	NabamikaSonowal	TEF, WorldFish
28	DipankarPathak	TEF, Kokrajhar
29	DipankarTalukdar	TEF, Darrang
30	KaustavGayan	MIS, APART
31	Mahmud Ali	TEF, Sivasagar
32	Rehenaparvin	TEF, OPIU
33	AjimoonNissa Khan	Project Associate, APART, AAU
34	BubulSainary	TEF, Goalpara
35	KandarpaBoruah	TEF, Lakhimpur
36	Prakashkalita	TEF, Nagaon
37	SanayaimaSinhga	TEF, Barpeta
38	DibyaJyotiDevnath	FDO, Cachar
39	Abu Suvan	TEF, Morigaon

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WorldFish

Assam Agribusiness and Rural Transformation Project (APART)

Virtual Meeting on

Paddy-Fish Integrated Farming in Assam under APART

Dr. Jharendu Pant,
Sr. Scientist, WorldFish, Malaysia

Dr. Kanwar Singh,
Resident Consultant, IRRI

Date: 10-07-2021
Time: 6:30 – 8:00 PM

REPORT

WorldFish

Department of Fisheries, Govt. of Assam

Virtual Discussion on Paddy-Fish Systems in Assam

A virtual discussion on "Paddy-Fish Farming Systems in Assam" was organized by WorldFish in collaboration with DoF, CoF and ARIAS Society on 10th July, 2021. Dr. Jharendu Pant, WorldFish Expert and Dr. Kanwar Singh, Resident Consultant and Senior Associate Scientist, IRRI, served as resource persons for the meeting. A total of 41 participants attended the virtual meeting. The participants include Dr. Mohan Chadag, Principal Scientist, Dr. Atanu Chatterjee, Environment Specialist, ARIAS Society, Dr. Benoy Kumar Barman, WorldFish Expert, Bangladesh, Dr. Manos Saha, WorldFish Expert, Arun Padiyar, WorldFish Expert, Odisha, Odisha WorldFish team, Dr. Bimal Chand, WorldFish Expert, Dr. Rahul Priyadarshi, IRRI, CoF Team, Dr. Suresh, Resident Consultant, WorldFish, Dr. Sanjay Sharma, Project Coordinator and TEFs.

At the outset, Dr Suresh, Project coordinator, WorldFish Project-Assam welcomed all the participants and gave a brief introduction and the purpose and objectives of the meeting.

Dr. Jharendu Pant, gave a presentation and described about Paddy-Fish farming system in Assam, mainly focused on recommendations and suggestion for improving Paddy-fish farming in Assam. He discussed about enabling sustainable increases in aquaculture production without creating adverse socio-economic or environmental impacts. He described the Better management practices (BMP) for Paddy-Fish farming system developed by WorldFish and explained about the focus areas of the BMP regarding quality seed, feed and feeding, management practices (culture facility, culture period, stocking and harvesting strategies, water quality management etc.), building social systems resilience and maintaining ecosystem resilience. He discussed and explained about the traditional fish farming system as well as about the paddy-fish systems evolved in the recent decade. He explained in detail about the crop calendar to be practiced for paddy-fish farming. He also mentioned about the importance of culturing small indigenous fishes and mola in paddy-fish farming along with the carps.

Dr. Kanwar Singh, Resident Consultant and Senior Associate Scientist, IRRI, gave a presentation on the Recent Developments in Paddy Value Chain in Assam. He mentioned about the issues and problems farmers faced with Paddy production as well as discussed about the different solutions to overcome the problems. He described about the focused areas in Rice value chain regarding Strengthening Seed Systems, Mechanization, Rice value-chain and post harvest management drying, storage, milling, cropping system approach etc. He also discussed about some of the stress tolerant rice varieties (STRVs), popularization of premium quality rice for higher profitability, sustainable approach for pest-management, weed management, improved harvesting technologies etc.

Dr. Suresh, Resident Consultant, WorldFish, mentioned about the gap in adoption of BMPs since the farmers still continues practicing the old traditional paddy-fish farming system and are still not adapted to the new technology. He requested the officials from the IRRI to technically

support and provides their suggestion on paddy production in the revised Better Management Practices (BMP), which will be provided to the TEFs and the farmers for practicing the paddy-fish farming system in a better way. He mentioned that the adaption survey for paddy-fish farming is taken up and the BMP shall be revised.

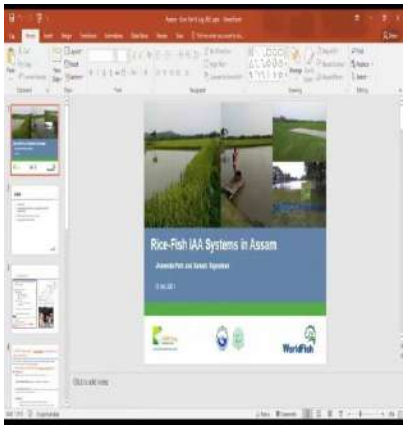
Dr. Sanjay Sharma, Project Co-coordinator mentioned about the importance of culturing the improved strain and the small indigenous fishes and SIS along with carps in the paddy-fish farming system. He described that the rice variety Bina dhan11 should be suggested to the farmers due to its production, market value, submergence tolerant etc. He then mentioned that in APART project already 50-70% of the farmers are culturing Bina dhan11 with fishes.

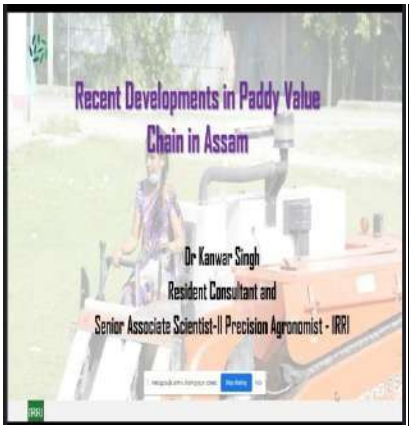
Dr. Bimal Chand, Climate Expert, WorldFish shared his experiences based on the observations during visit to Assam for the climate study. He mentioned that the paddy farmers should be motivated for taking up the paddy-fish farming system as diversification. He suggested for the GI tagging of the paddy variety used in Assam.

Dr. Atanu Chatterjee, suggested for following the WHO recommended Baned pesticides list for incorporating in the "Better Management Practices of paddy-fish system". He mentioned selection of pesticides and its doses to be used in paddy farming are important.

Mr. Kalpajit Gogoi, TEF, WorldFish shared his observation from his visits to the different paddy-fish farming sites. He explained that farmers from different districts and regions practice different method of paddy-fish farming system, for *eg.*, in Nagaon and Morigaon districts the farmers give more importance to the fishes than the paddy and they are even ready for sacrificing the paddy for the fishes, they cut the paddy and feed it to the fishes. And on the other hand in Nalbari district the farmers give more importance to the paddy for eg., they even use MOC as fertilizer for the paddy and are getting higher paddy production.

At last the meeting was concluded with vote of thanks to all the participants.





List of the participant

Sl No	Name	Designation
1	Dr. Jharendu Pant	WorldFish Expert
2	Dr. Mohan Chadag	Principal Scientist, WorldFish, Malaysia
3	Dr. ArunPadiyar	Propject Manager, WorldFish, Odhisa
4	Dr. Benoy Kumar Barman	Senior Scientist, WorldFish, Bangladesh
5	Dr. Manos Kumar Saha	WorldFish Expert, Bangladesh
6	Dr. Kanwar Singh	Resident Consultant and Senior Associate Scientist, IRRI,
7	Dr. Atanu Chatterjee,	Environment Specialist, ARIAS Society,
8	Dr. BinimayMohanty	Senior Aquaculture Specialist, WorldFish, Odhisa
9	Dr. Bimal Chand,	WorldFish Expert
10	Dr. Rajendran Suresh	Resident Consultant, WorldFish, Assam
11	Dr. Sanjay Sharma	Fishery Co-ordinator, ARIAS
12	Dr. Pradip Chandra Bhuyan	CoF Asst. Professor
13	Mr. ManasPratim Dutta	CoF Asst. Professor
14	Aditya Narayan Dash	Technical Analyst, WorldFish, Odhisa
15	Amar Gaikwad	Aquaculture Specialist, WorldFish, Odhisa
16	Anil Kumar Sahu	Technical Analyst, WorldFish, Odhisa
17	Binod Sethi	Technical Coordinator, WorldFish, Odhisa
18	Susanta Kumar Mishra	Technical Coordinator, WorldFish, Odhisa
19	Manoj Kumar Sahoo	Technical Coordinator, WorldFish, Odhisa
20	NeethaShenoy	Aquaculture Specialist, WorldFish, Odhisa
21	Dorothy MS	NFDB team
22	Satish Das	Communication Manager, WorldFish, Odhisa
23	Saurav Kumar Biswal	
24	Bikram Baliarsingh	Senior Aquaculture Specialist, WorldFish, Odhisa
25	Biswajit Borah	ECF, OPIU
26	KalpajitGogoi	TEF, WorldFish
27	Neeta Beypi	TEF, WorldFish
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35	AjimoonNissa Khan	Project Associate, APART, AAU

36	BubulSainary	TEF, Goalpara
37	KandarpaBoruah	TEF, Lakhimpur
38	Prakashkalita	TEF, Nagaon
39	SanayaimaSinhga	TEF, Barpeta
40	Abu Suvan	TEF, Morigaon
41	Monjita Hazarika	ECF, Sonitpur

Annexure- 2
Training of Trainers (TOT) Program on Quality Fish seed Production

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WorldFish

REPORT

WorldFish

College of Fisheries, Raha, Assam Agricultural University

Department of Fisheries, Govt. of Assam

TRAINING OF TRAINERS (TOT) PROGRAM ON QUALITY FISH SEED PRODUCTION UNDER WORLD BANK FUNDED ASSAM AGRIBUSINESS AND RURAL TRANSFORMATION PROJECT (APART)

Two days Training of Trainers (TOT) program on Quality Fish Seed Production was organized by College of Fisheries, Assam Agricultural University, Raha under World Bank funded Assam Agribusiness and Rural Transformation Project (APART). The training program was conducted from 6th September, 2021 to 7th September, 2021.

Dr. Yaraguntappa Basavaraju, WorldFish Expert, Karnataka, Dr. Arun Padiyar, WorldFish Expert, Odisha and Dr. B. K. Chand, WorldFish Expert, West Bengal served as Resource Persons for the training program. Welcome Address given by Dr. Pradip Chandra Bhuyan, Professor, Department of Economics and Extension, College of Fisheries, AAU, Raha and inaugural address was given by Dr. Binod Kalita, Dean, College of Fisheries, AAU, Raha. The training program was attended by the SMS, DFDO and FDO, Technical Experts Fisheries of all Project Districts, Project Associate, College of Fisheries under APART and TEF of WorldFish under APART. The list of participants of the training program is annexed in the report.

DAY 1- 6th September, 2021at College of Fisheries, AAU, Raha:

As per schedule, during 9.30-10.00 A.M, registration of participants in the Conference Hall of College of Fisheries, AAU, Raha.

At the beginning welcome address was given by Dr. Pradip Chandra Bhuyan, Professor, Department of Economics and Extension, College of Fisheries, AAU, Raha and inaugural address was given by Dr. Binod Kalita, Dean, College of Fisheries, AAU, Raha in the presence of Dr. Sanjay Sarma, Fishery Coordinator, ARIASS, Dr. D.J. Sharma, Nodal officer, APART, DoF, Dr. Raman Ch, Barman, DFDO, Nagaon, Dr. R. Suresh, Resident Consultant, WorldFish , Dr. Basavaraju Yaraguntappa, WorldFish Expert .

An overall presentation of APART activities in Assam by ARIASS and Fishery department was given by Dr. Dhruba Jyoti Sharma and Dr. Sanjay Sarma. Details regarding resources of Assam, Fish and fish seed production of Assam, Productivity and Production Gap, Development programmes, Schemes, Targets and Achievements were given.

Dr. P. C. Bhuyan, gave brief details about the APART activities conducted by College of Fisheries, Raha, AAU till date.

Dr. R. Suresh, Resident Consultant, WorldFish also gave a brief about WorldFish activities in APART. Details about promotion of BMPs for sustainable aquaculture, Upgradation of existing Indian major carp hatcheries to produce certified seed, Carp-Mola polyculture and other deliverables.

Dr. Y. Basavaraju, WorldFish expert, gave a presentation on "Scientific protocols for Quality Fish Seed production". The presentation included information about Fish seed status nationally, Assam Fisheries, importance of Fish seed Quality, Broodstock management, Proper technique of Induce breeding, and Record keeping. He concluded that balancing both genetic management of brood stock and following Standard operational procedures (SOP) on broodstock management, breeding, hatchery practices and nursing spawn is very crucial for quality seed production.

An interaction was held with WorldFish expert, Dr. R. Suresh regarding Polyculture of Carps under APART. He gave a presentation on Polyculture of Carps, Polyculture of carps with Mola-SIS, Polyculture of carps with genetically improved strains and Polyculture of Carps with Freshwater Prawns, Polyculture demonstration and publications of BMPs and record keeping for Polyculture of Carps.

Dr. Arun Padiyar, Project Manager, Odisha-WorldFish Project, delivered a lecture on "Nutrition-sensitive Aquaculture Systems". He explained the implementation of fish based nutrition through a Pilot in KISS and Special Schools, Poshan Abhiyan: ICDS Anganwadi supplementary Nutrition Program to inclusion in State Nutrition Strategy – SOPAN. These initiatives also increased the average fish production in the state and also involvement of women towards livelihood support and food security.

With these lectures, the training was concluded for the first day.

DAY 2 - 7th September, 2021 at College of Fisheries, AAU, Raha:

The training started with Dr. Bimal K. Chand, WorldFish Expert, who gave a presentation on "Climate Resilient Technologies for Aquatic Food Production System in Assam". He gave brief description about the Earth, Environment, Climate, Causes of Climate change, Responses, Overall impacts of Climate change on Aquatic food production system of Assam etc. He suggested about nine methods of Climate Resilient Technologies viz. Short duration fish culture, Overwintering of seed, Paddy cum Fish culture, Polyculture of carps with Mola-SIS, Freshwater Prawn, Cage culture in Beels, Multiple Stocking and Multiple Harvesting and Production and improvement in Beel through stock enhancement. He concluded with some coping measures against flood and climate risks.

Dr. D. K. Sarma, Professor, CoF, had a discussion regarding "Carp yearling production/Over wintering seed production".

Dr. Rajdeep Dutta, Asst. Professor of CoF, gave a presentation on "Beel Fisheries Development". The presentation included selection of beels, Formation of Beel Development and Management committee, Plan and Budget. He also briefed about stock enhancement of beels, harvesting in beels and also monitoring and record keeping.

The training program ended with the presentation on "Hygienic dry fish production and value added products" by Mr. Inam Akhtar Hussain, Assistant Professor, CoF, Raha, and also he gave a tour of the Fish processing department where the equipments are installed for various value added fish products viz. Fish sausage, Fish pickle, solar tent drier for fish drying and Smoked Fish. He also said that the Fish sausage and Fermented Fish product are still under process of standardization.

The participants' evaluation was conducted and feedback of the ToT program was obtained which are appended in the report.

Eventually the program closed with the distribution of Certificates and vote of thanks by Dr. P. C. Bhuyan.


QUALITY FISH SEED PRODUCTION


QUALITY FISH SEED PRODUCTION


QUALITY FISH SEED PRODUCTION
COLLEGE OF FISHERIES

Fish Pickle in Standing Pouch

Fish Bhujia

Local Fish Pickle

PROGRAMME SCHEDULE

Date: 06/09/2021

Time	Topic	Resource Person
9:30 – 10:00 am	Registration	
10:00 – 10:05 am	Welcome Address	Dr. Pradip Chandra Bhuyan, Professor, Department of Economics and Extension College of Fisheries, AAU, Raha
10:05 – 10:15 am	Inaugural Address	Dr. Binod Kalita, Dean, College of Fisheries, AAU, Raha
10:15 -10:30 am	APART Activities by ARIASS, Govt. of Assam	Dr. Sanjay Sarma, Fishery Coordinator, ARIASS
10:30 – 10:45 am	APART Activities by Department of Fisheries, Govt. of Assam	Dr. D.J. Sharma, Nodal officer, APART, DoF
10:45 – 11:00 am	APART Activities by WorldFish	Dr. R. Suresh, Resident Consultant, WorldFish
11:00 – 11:15 am	APART Activities by College of Fisheries, AAU, Raha	Dr. Pradip Chandra Bhuyan, College of Fisheries, AAU, Raha
11:15 – 11:30 am	Group Photo and Tea break	
11:30 – 1:30 pm	Quality carp seed production	Dr. Basavaraju Yaraguntappa, WorldFish Expert
1:30 – 2:30 pm	Lunch Break	
2:30 – 4:30 pm	Polyculture of Carps, Polyculture of Carps with genetically improved strains, Polyculture of Carps with Mola & SIS, Polyculture of Carps with Fresh water Prawn	Dr. R. Suresh, Resident Consultant, WorldFish
4:30 – 5:00 pm	Nutrition sensitive Aquaculture and Promoting Fish Nutrition	Dr. Arun Padiyar, Project Manager, WorldFish-Odisha
5:00 pm	Closing of the session with high tea	

Date: 07/09/2021

Time	Topic	Resource Person
10:00 – 11:15 am	Climate Resilient Fish culture Technologies - Paddy cum fish integrated Farming	Dr. B. K. Chand, WorldFish Expert
	Short Duration Fish Culture Technology	Dr. S. Borthakur, Prof. Department of Aquaculture
11:45 – 12:00 noon	Tea break	
12:00 – 12:30 pm	Carp yearling/ production of over wintering seed	Dr. D. K. Sarma, Prof. Department of Aquaculture
12:30 – 1:00 pm	Multiple Stocking and multiple harvesting Technology	Dr. P.K.Saharia, Asst. Prof. Department of Aquaculture
1:00 – 1:30 pm	Hygienic dry fish production and value added products	Mr. Inam Akhtar Hussain, Asst. Prof., Department of Fish Processing Technology
1:30 – 2:30 pm	Lunch Break	
2:30 – 3:30 am	Beel Fisheries Development	Dr.Rajdeep Dutta, Asst. Prof. Dept. of AEM
3:30 – 4:30 pm	Fish Value Chain	Dr. Arun Padiyar, WorldFish Expert
4:30 – 4:45 pm	Evaluation and feedback	
4:45 – 4:55 pm	Certificate Distribution and Closing remarks	Dr. Binod Kalita, Dean, College of Fisheries, AAU, Raha
4:55 – 5:00 pm	Vote of Thanks	Dr. P. C. Bhuyan, Professor and Head, Dept. of FEES

LIST OF PARTICIPANTS

Training of Trainers			
Slno.	**Name**	**Address**	**Contact**
1	Nilangana Kalita, APART Nodal Officer	Golaghat	8723023133
2	Pinky R. Basumutary, PA (APART)	Jorhat	8974214850
3	Ajimoon Nissa, PA, APART	WorldFish, SIPC	8848597252
4	Parag Saikia, SMS	KVK, Kamrup	9101787776
5	Ankur Rajib Ongshi, SMS	Nalbari	8822762671
6	Nabamika Sonowal, TEF	WorldFish, SIPC	9101062046
7	Kangkana Das, PA, APART	KVK, Barpeta	9365181870
8	Jibon Jyoti Yein, PA	KVK, Jorhat	8638784098
9	Rupam Pegu, TEF, APART	Kamrup	7599501151
10	Biswajit Borah, PA, APART	Sonitpur	9957211236
11	Gobinda Basumutary, DNO, APART	Kokrajhar	9678212249
12	Dipankar Talukdar, TEF, APART	Darrang	7002561962
13	Tingku Phukan, TEF, APART	Cachar	7086990155
14	Khanindra Bhuyan, FDO	Jorhat	8575592251
15	Prakash Kalita, TEF, APART	Nagaon	7002487580
16	Sushil Kr. Nath, SDFDO	Hojai	9435231126
17	Jiaur Rahman, FDO	Darrang	8638997661
18	Jyotirmoyee Das, TEF, APART	Sonitpur	8134044777
19	Sanayaima Singha, TEF, APART	Barpeta	8011506152
20	Suman Saikia, TEF, APART	Jorhat & Golaghat	8474846912
21	Abu Suvan, TEF, APART	Morigaon	7002269881
22	Gunajit Talukdar, TEF, APART	Nalbari	6002012964
23	Mahmud Ali, ECF	Sivasagar	9365231318
24	Abu Sufian, SDFDO	Hailakandi	6002044156
25	Bubul Sainary, TEF, APART	Goalpara	8638299927
26	Julfikar Ali, DNO	Dhubri	9101073960
27	Kandarpa Boruah, TEF, APART	Lakhimpur	7002399756
28	Anuwar H. Khan, FDO	Morigaon	8638189400
29	Dipankar Pathak, TEF, APART	Kokrajhar	8011139508
30	Bidyut Bikash Medhi, J.E.	Nagaon	9435662720

EVALUATION

At the end of the ToT program, evaluation was carried out with the objective about the participant's knowledge and understanding of the APART activities in Assam. A test paper containing 20 questions given to the participants.

Average score is 16 out of 20. These shows that the participants are aware and have a thorough knowledge and understanding of the APART activities in Assam.

COMMENTS AND FEEDBACK

1. Please give your feedback on the Topics covered during the ToT
    a. V. Good
    b. Excellent class of Dr. D. K. Sarma
    c. Nutritive sensitive is a new topic that I came across & it was wonderful to see its implementation in Odissa. And introduction and implementation of Amur Common Carp in practical aspects is well received.
    d. It was very fruitful and lecture delivery was very excellent
    e. Covers necessary Topics
    f. Different types of medicine and inputs developed by different companies for piscicultural purposes and its effect on Fish culture.
    g. I am very happy with the topics covered during the ToT i.e. Quality carp seed production and Climate resilient paddy cum fish culture Technology delivered by Sir B.K. Chand.
    h. Honestly, all the lecture & interactions refresh up knowledge those I have. Basically it is more effective to me in the field of quality seed production concept & polyculture of carps with small indigenous spp.
    i. Great presentation with lots of opportunities to ask questions which all made for a really enjoyable & informative source. The course is very much useful considering long term aspects.

2. Do you need any other topics to be covered during the ToT

    a. Effect of Climate Change in breeding and Seed production.
    b. Qualitative & Quantitative analysis of egg and spawn.
    c. Breeding Technology of Locally demanded fish species 'Pavo' *Ompok pabda.*
    d. In-pond Raceway System.
    e. Record keeping of FPG.
    f. Topics to be covered in Broodstock management.

g. Whatever topics that were presented were quite informative and sound. But more of interative sessions could improve the lectures and would make it interesting.
h. Extension and communication management with farmer.

3. Whether three topics would help you to better implement the APART activities
    a. Yes, topics covered during the ToT will help to implement the APART activities in field level.
    b. Yes, it did improve the technical capacity.
4. Do you feel that your Technical capacity is improved during the ToT
    a. Yes after the training we got knowledge on Carp prawn polyculture system and seed rearing practices.
    b. Yes I have gained knowledge on different aspects of Fish culture Technology which will be better applicable to our state resources.
5. Overall, your feedback on the ToT program attended by you
    a. Nice.
    b. It is good to have class for refreshment prior knowledge.
    c. Excellent arrangement & good resources person, they covered all topic related to quality seed production.
    d. Fruitful and will help to serve the farming community in near future.
    e. Clear insight of the culture systems in Assam.
    f. It was well planned and layed out, easy to follow. Especially the class taken by Dr. Basavaraju & Dr. Padiyar was really interesting and informative, it will help during training to the farmers.
6. Please give your suggestions for improvement of the future ToT program
    a. One Field visit of Demonstration.
    b. Exposure visit to Farmer Field.
    c. Usage of Water quality parameters kit.
    d. TA/DA should be provided in cash, if possible for accommodation also.
    e. Classes should be based on practical implementation rather than data that can be applicable in field.
    f. Fish Disease topic may be incorporated.
    g. Please make it a 3days program to cover more topics.

PPT by Bimal Kinkar Chand

Earth System, Environment & Climate

Earth system has 4 major sub-systems:

- Land (Lithosphere)
- Water (hydrosphere) - Abiotic Components
- Air (Atmosphere)
- Living things (Biosphere) - Biotic Component

The living things depend on above 3 non-living things for their survival and interact with them constantly.

Environment is the surroundings in which the living and nonliving things interact with.

Climate is the average weather in a given area over a longer period of time (the average temperature in different seasons, rainfall, sunshine, etc.

Green House Gases (GHGs) are essential in controlling to our climate.

GHGs

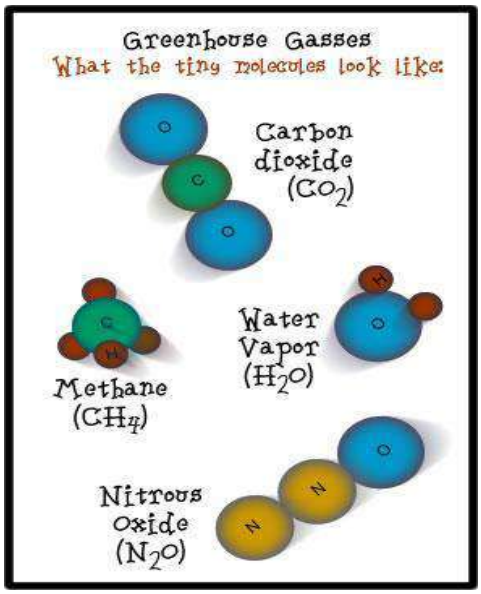
GHG are basically the heat entrapping gases. When sunlight fall on earth during daytime, most of the radiation reflect back to space in night. But the GHGs present in the atmosphere retain a part of it and thus maintain the temperature of the atmosphere.

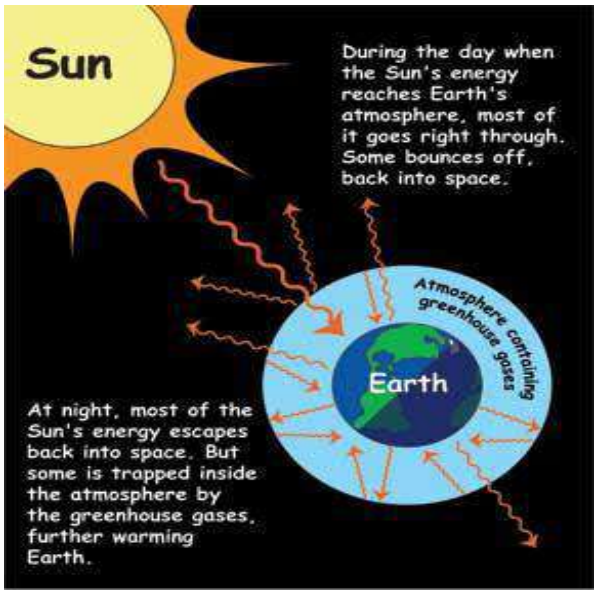
Natural Greenhouse Effect

It is essential to support life in any planet. Without it, Earth would have no living things and would be more like Venus or Mars. This is because the temperature would be on average 30 ^{0}C colder than it is.

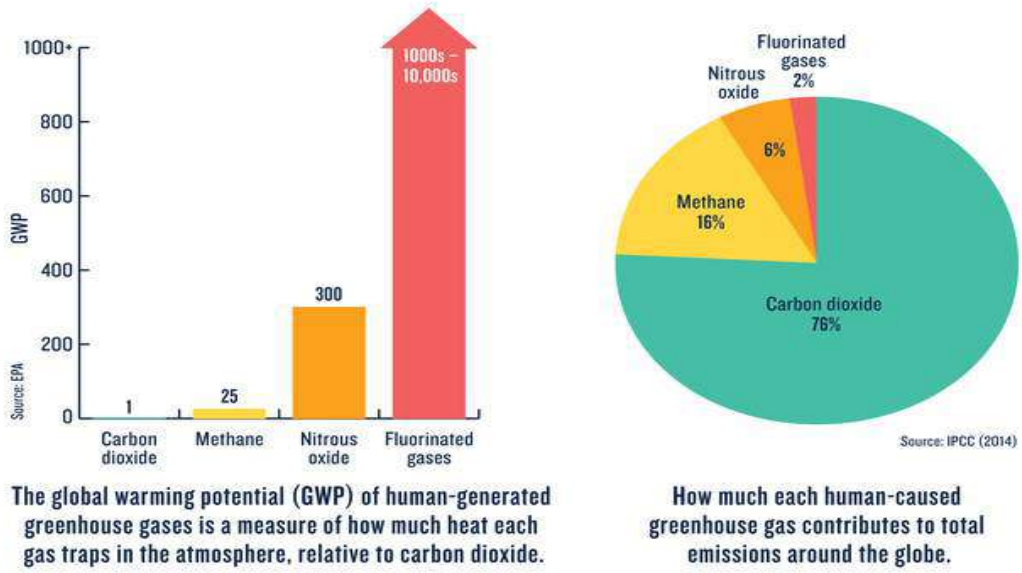
Enhanced Greenhouse Effect

Due to increase in concentration of GHGs in the atmosphere, much more of the heat energy from the sun is trapped in the earth's atmosphere, making it hotter. This effect is mainly due to anthropogenic activities





The Greenhouse Effect



Causes of Climate Change

Natural Causes

1) Continental drift
2) Volcanoes
3) The Earth's Tilts
4) Ocean Currents
5) Intensity of Solar Radiation

Anthropogenic Causes

1) Green Houses Gases

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (NO_2)
- Chloroflorocarbons(CFCs)
- Ozone (O_3)
- Water Vapors (H_2O)

2) Land Use Change

Deforestation
Urbanization

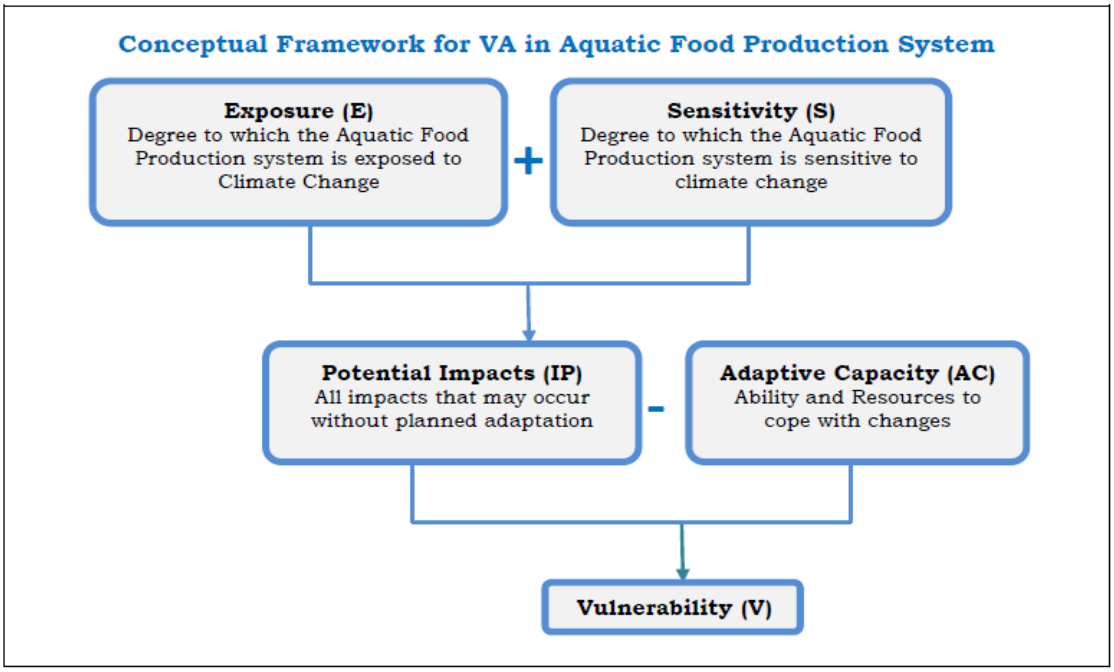
Response to Climate Change

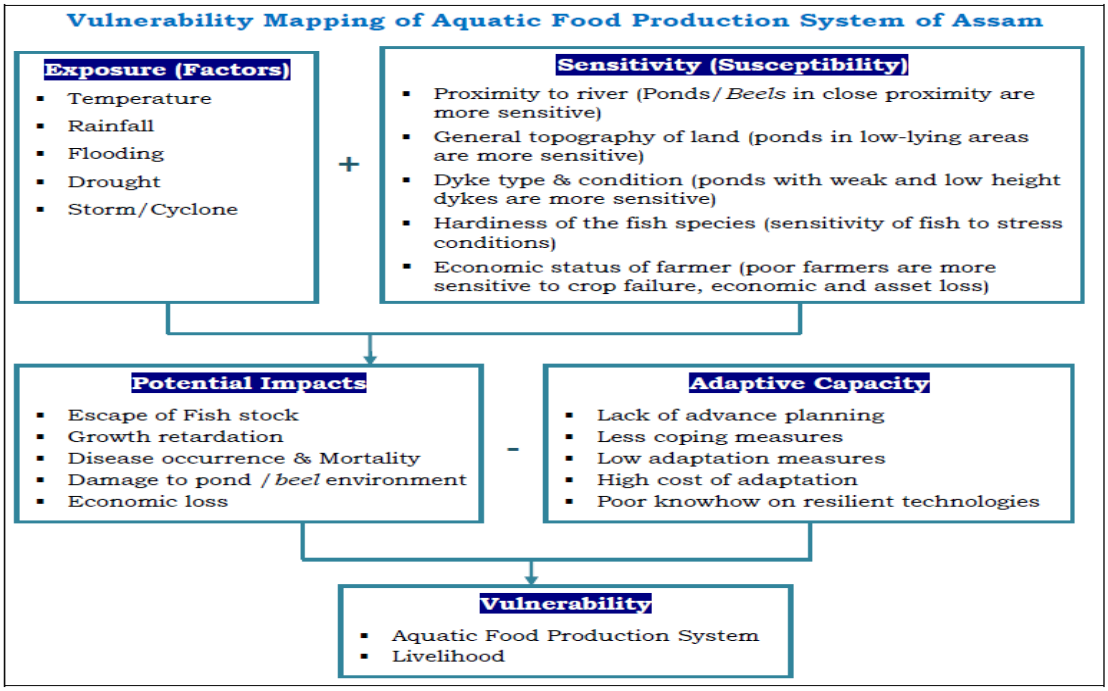
There are 3 Key areas of response

1. **Science:** Promoting the science needed for decision making on mitigation and adaptation
2. **Mitigation:** Mitigating climate change by reducing greenhouse gas emissions
3. **Adaptation:** Adapting to the changes that are inevitable, no matter what mitigative action is taken

Adaptation → Build Resilience

Adaptation → Accommodate Change





Overall Impacts of Climate Change on Aquatic Food production System of Assam

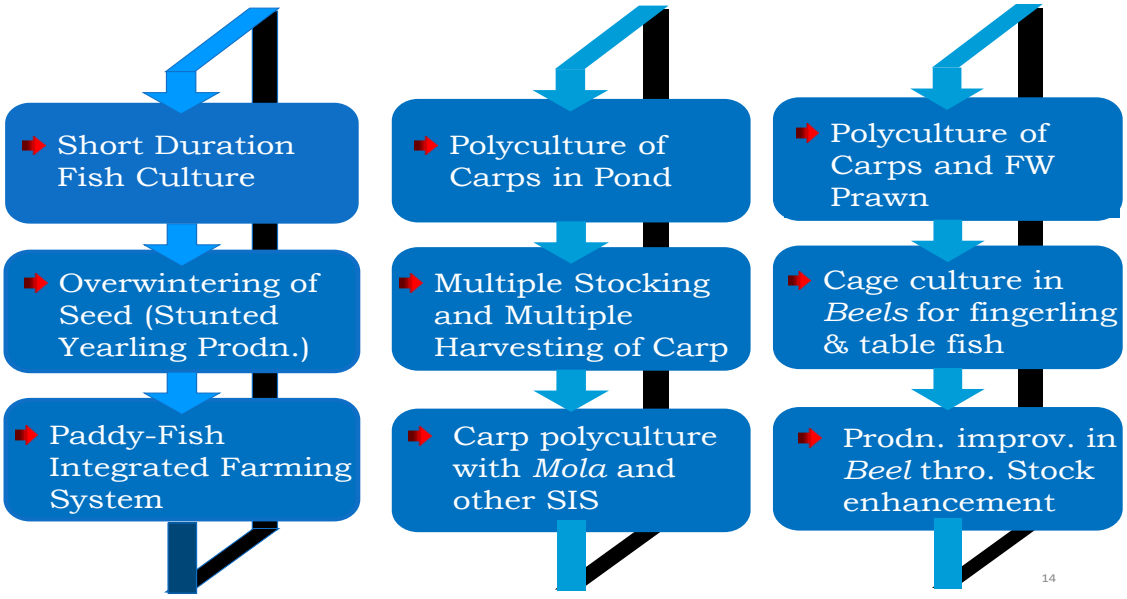
Drivers	Potential Impacts		
	Fish	Production System	Stakeholder
Warming (Warming of water)	▪ Increased metabolism ▪ Increased growth rate ▪ Advancement in the onset of breeding and longer breeding period for carps.	▪ Increased fish production ▪ Improved feed conversion efficiency for species with higher thermal tolerance ▪ Shift to shorter production cycle ▪ Intensified production	▪ Shorter production cycles leading to more income and higher profit
	▪ Increased plankton respiration and proliferation ▪ Changes in reproduction ▪ Increased/ decreased transmission of some diseases	▪ Lower feed conversion efficiency for species subjected to increased stress ▪ Increased harmful algal blooms	▪ More feed required
	▪ Decreased performance for species with narrow thermal range ▪ Increased sensitivity to other drivers like low pH, pathogens	▪ More risk on account of disease	

Drivers	Potential Impacts		
	Fish	Production System	Stakeholder
Lowering of Dissolved Oxygen (Hypoxia)	▪ Increased mortality ▪ Reduced growth ▪ Higher sensitivity to some pathogens	▪ Lower carrying capacity of pond ▪ Increased aeration costs ▪ Reduction in the number of annual crops where hypoxia is seasonal	▪ Increased aeration costs ▪ Farmers culturing hardy species like tilapia, pangasius, etc. not affected
Changes in other Hydro-graphic variables	▪ Increased mortality ▪ Reduced growth	▪ Poor water quality ▪ Accumulation of wastes	▪ Changes in production levels
Flood	▪ Escape of fish stock from pond ▪ Entry of unwanted fishes ▪ Growth retardation of fishes ▪ Increased mortality	▪ Breach of pond dyke ▪ Ingression of flood water into pond ▪ Increased risk of fish escapes as a result of flooding, overspills ▪ Deterioration of water quality	▪ Loss in production ▪ Facility destruction ▪ Economic loss

Drivers	Potential Impacts		
	Fish	Production System	Stakeholder
Drought / water stress situation	▪ Mortality ▪ Reduced growth ▪ High physiological stress	▪ Less water ▪ Early drying of pond and wetlands in summer ▪ Poor water quality ▪ Eutrophication of pond and wetlands ▪ Reduced production efficiency	▪ Loss or disruption of Livelihoods ▪ Increased competition for water ▪ Economic loss
Depletion of ground water leading to water stress condition	▪ High physiological stress ▪ Reduced growth ▪ Mortality	▪ More risk for ground water dependent production system ▪ Reduced production efficiency ▪ Poor water quality	▪ Higher costs of maintaining pond water levels ▪ Poor production ▪ Economic loss
High intensity weather event (heavy rain, storm, etc.)	▪ Increased mortality ▪ Escape of fish stock & entry of unwanted species	▪ Disruption in supply of inputs such as Seed, feed etc. ▪ Pollution by heavy runoff	▪ Increased work hazards ▪ Economic loss

Drivers	Potential Impacts		
	Fish	Production System	Stakeholder
Less predictable rainy/dry season	▪ Impacting fish mating and spawning behaviour	▪ Affecting the hatchery operations ▪ Loss in breeding opportunity	▪ Decreased ability to plan the work ▪ Economic loss
Climatic hazards causing food safety issues	▪ May get contaminated with heavy metals and pesticides, infected with food borne parasites and pathogens	▪ Overflowing of untreated sewage during flood ▪ Increasing run-off of fertilizers, topsoil, as well as pollutants, such as pesticides, herbicides, trace metals and persistent organic pollutants	▪ Health hazards ▪ Economic loss
Knowledge Gaps in resilient practices	▪ The impact may differ depending upon the spectrum of tolerances of cultured species	▪ Farm facilities are not in sync with adaptation requirements	▪ Farmers make ill-informed aquaculture choices ▪ Higher cost of adaptation if maladaptation

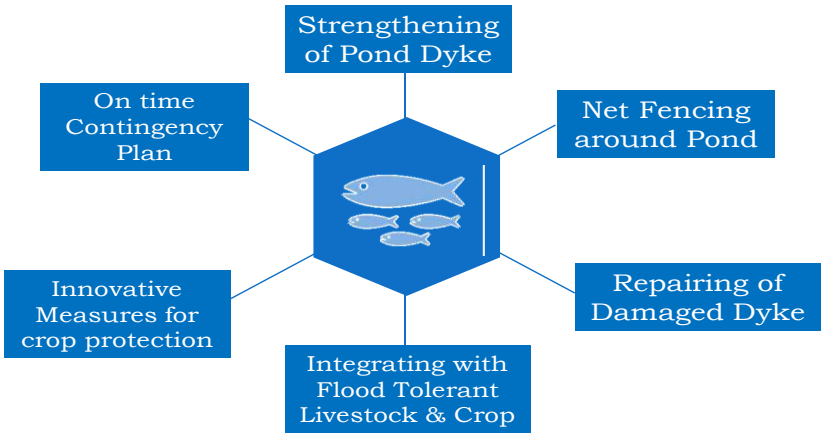
Climate Resilient Technologies Implemented/Suggested

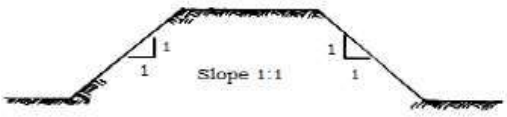
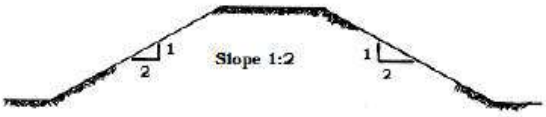
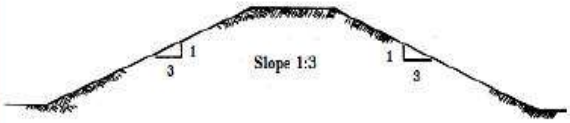
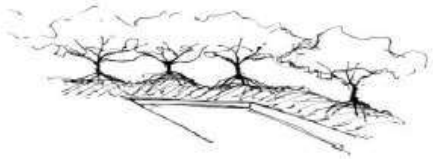


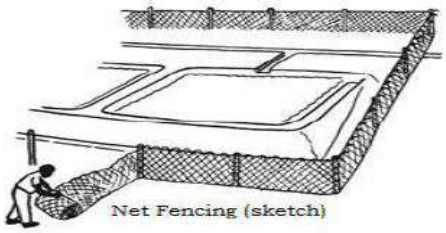
Evaluation Criteria for Fishery Technologies from Climate Resilience perspective

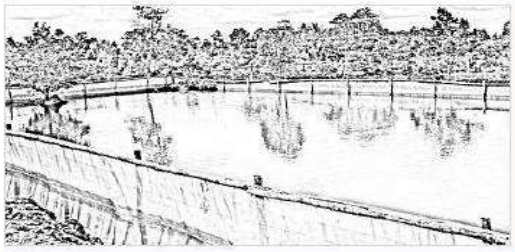
1. **Adaptation Hypothesis**
   Expectation or prediction that will be tested through field demonstration
2. **Key Features**
   Salient features of the technology satisfying adaptation hypothesis
3. **Adaptation Benefits**
   How the technology helps in achieving reduced sensitivity, reduced vulnerability and improved adaptive capacity
4. **Production Results**
   Whether the technology is able to reduce the loss due to climate impact and what is the production level
5. **Driving Forces**
   Lucrative Features of the technology for the farmers / fishers
6. **Restraining Forces**
   Features of the technology that are preventing farmers or fishers to adopt
7. **Sustainability**
   Whether the technology is sustainable technically, financially and environmentally.
8. **Replicability**
   What is the possibility of technology spreading to new areas.

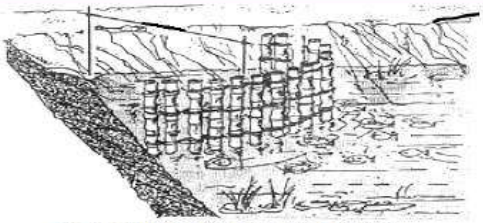
Coping measures against Flooding

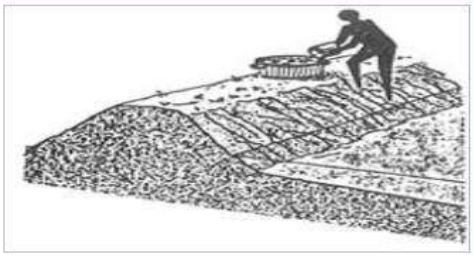


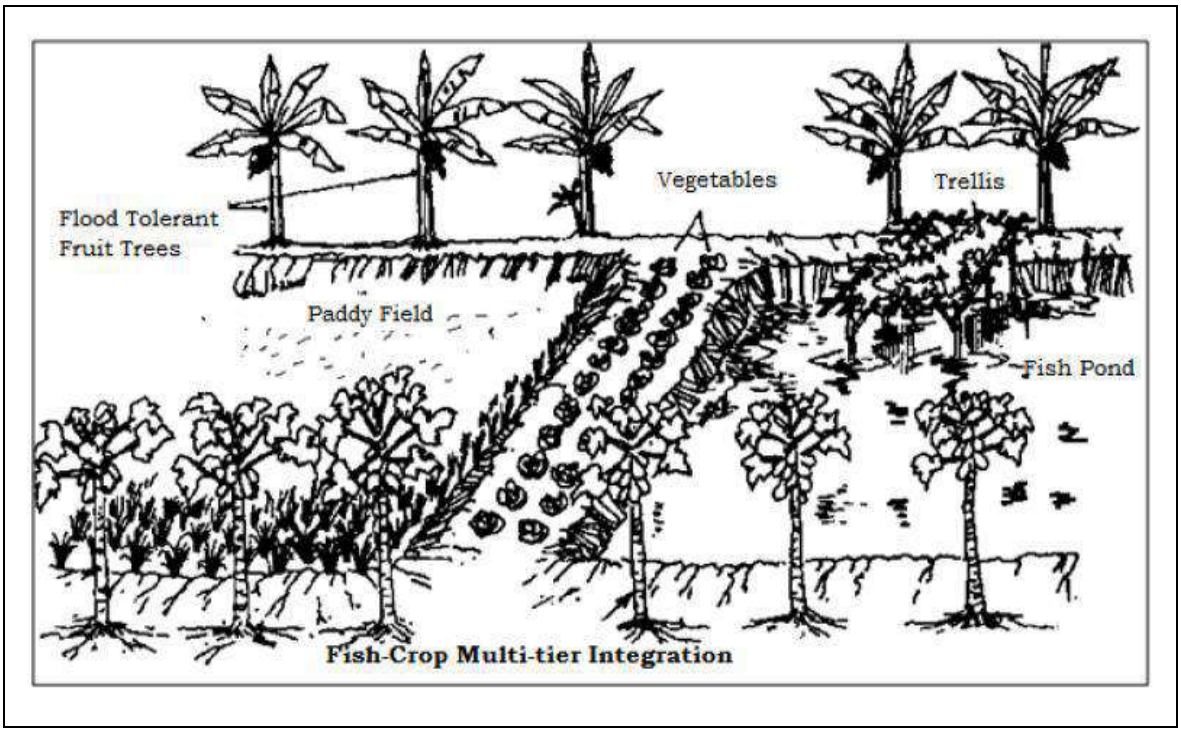
Slope of the Fish Pond Dyke	Feature
	**Steep Slope:** less stable dyke, vulnerable to damage by flooding, prone to erosion by water wave, use less area for dyke.
	**Medium Slope:** Fairly stable dyke, less vulnerable to damage by flooding, less prone to erosion by water wave. Occupies more space for dyke construction.
	**Gentle Slope:** Very stable dyke, least vulnerable to damage by flooding & erosion. Occupies much more space for dyke and thus create scope for vegetable cultivation on the slope of the dyke.
	Plantation on the top & grass on the slope of dyke will give better stability and protect from erosion.


Net Fencing (sketch)




Repairing of damaged dyke





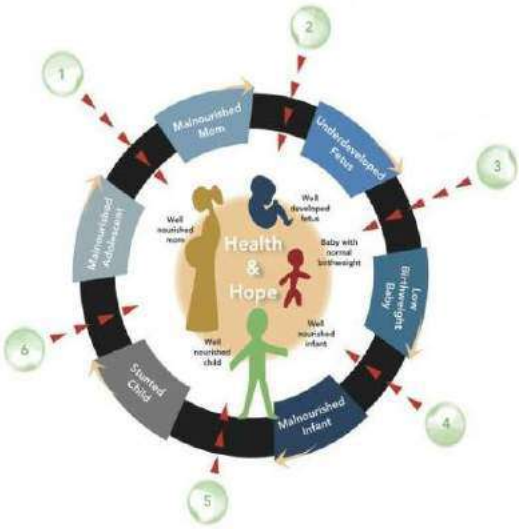
Fish-Crop Multi-tier Integration

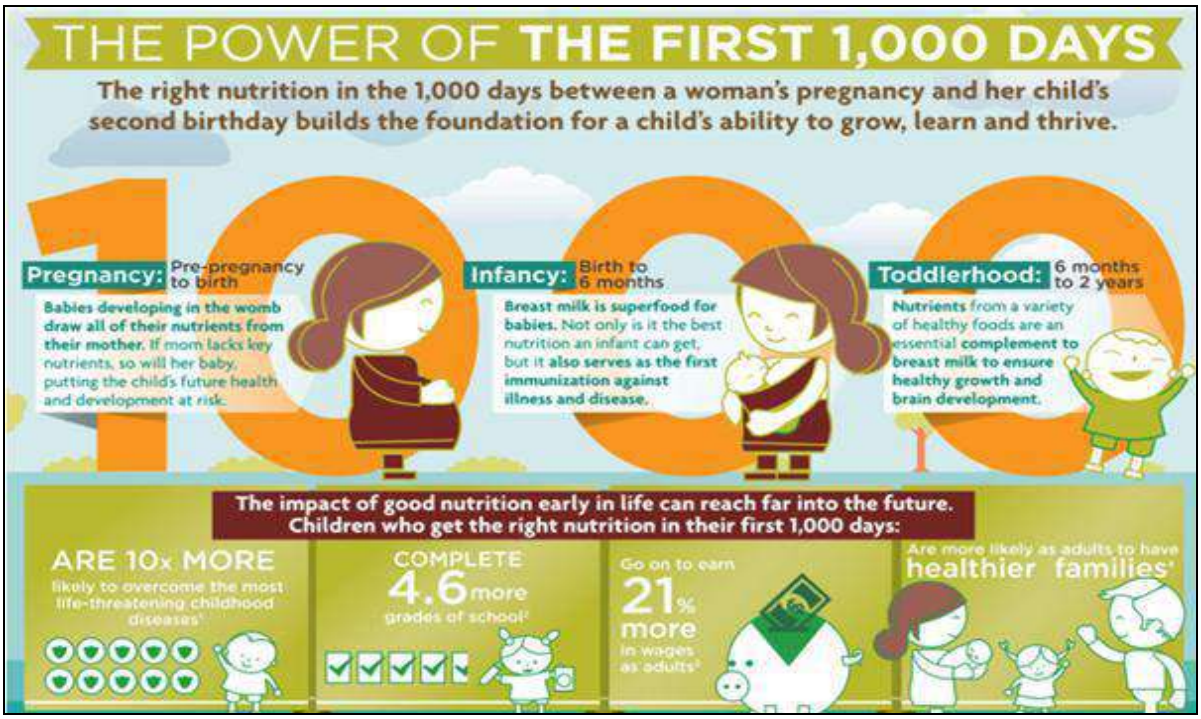
PRESENTATION BY DR. ARUN PADIYAR

Nutritious Food is important for Health of People

- Upto mid 1990's Food Security for eradication of hunger was priority of the Government
- From mid 1990's the Government focus shifted to Nutritional Security for eradication of malnutrition
- Malnutrition or Hidden Hunger is due to Micro-nutrient deficiencies
- 38.40% of the children below 6 in India are undernourihsed *(NFHS-4 : 2015-16)*
- Improved nutrition is critical for improved early childhood development

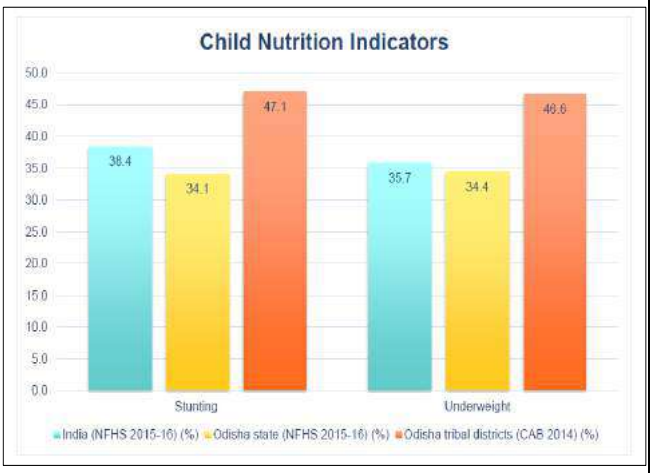
Malnutrition Cycle



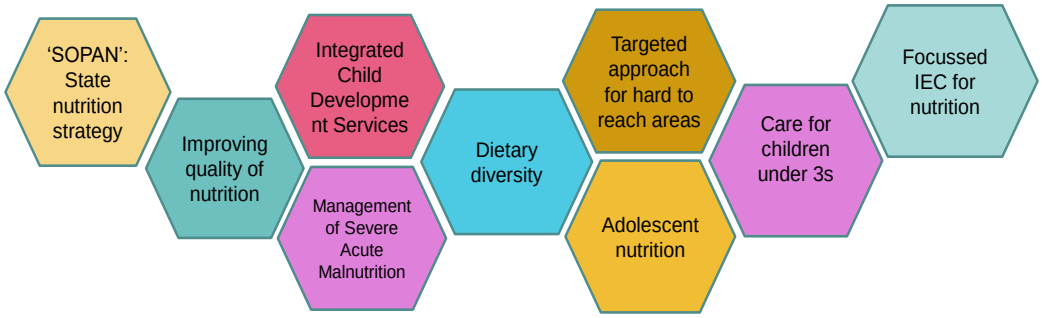


Poshan Abhiyan: ICDS Anganwadi Supplementary Nutrition Program

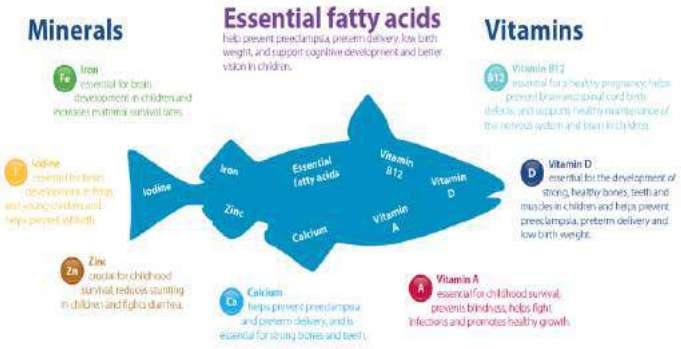
- For example, in Odisha there are about 62,000 Anganwadi centers
- 4.24 million children (below 6) and pregnant & nursing women are registered under Supplementary Nutrition Program
- Hot Cooked Meals (HCM) for children of 3-6 age group
- Take Home Ration (THR) to Pregnant & Lactating Mothers, and Adolescent Girls



Odisha has Multi-pronged Approach for Nutrition

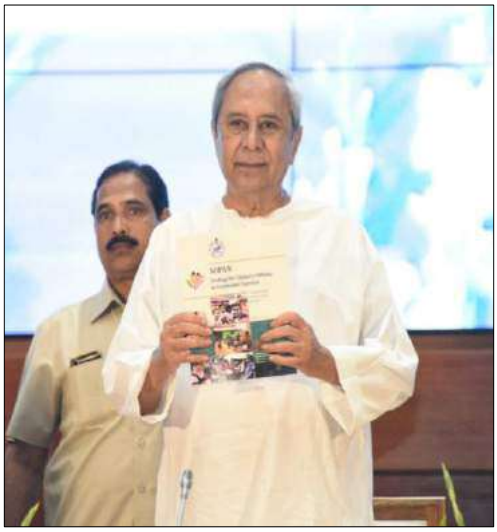


Odisha has recognised Importance of Fish for Fast-tracking Reduction of Micronutrient Deficiencies



- 95% people in Odisha consume fish
- Per capita consumption 16 kg/year
- Fish in abundance in marine and inland waters justifies inclusion of fish in state nutrition program
- 4th largest fish producing state:873,000 MT
- Scope for producing more fish:
  - 480 kms coastline
  - 1.10 million hectares tanks, reservoirs, lakes, rivers, estuaries etc

Fish Based Nutrition included in State Nutrition Strategy – SOPAN



Process Followed for Inclusion of Fish Based Nutrition in ICDS SNP

1. Inclusion of Fresh and Dried fish in mid-day meals of school children in KISS boarding school Bhubaneswar and in 21 Special schools for 8 months in 2019
2. High level brainstorming interaction between WF Scientists, Malaysia and Senior officials of Odisha Government and Study tour to Cambodia during November 2019
3. WorldFish was invited by WCD Dept. to be a member in State Technical Advisory Group (TAG) on Nutrition
4. Approval of the proposal of inclusion of fish based nutrition in SNP by the TAG
5. Inclusion of Fish Based Nutrition in State Nutrition Policy SOPAN during March 2020
6. Signing of 5 year MoU between WCD and WF for Fish based nutrition in ICDS SNP in November 2020
7. Preparation of SOP for inclusion of Fish Based Nutrition in SNP in consultation with various stakeholders
8. Training and awareness program for Anganwadi Workers & helpers, ICDS-Supervisors, ASHA, Jaanch committee, mothers committee representatives, community leaders and ad-hoc visiting Government officials
9. Roll out of pilot in Mayurbhanj District of Odisha in April 2021 with Baseline study of Anganwadi SNP in March 2021
10. Evaluation of outcomes by October 2021 and suggestions to Government for further actions for wider scaling

Initial Pilot in KISS and Special Schools







Interaction between Odisha Bureaucrats and WorldFish scientists for:

- **Policies and programs to promote nutrition-sensitive fish production systems**
- **Promotion of fish consumption in vulnerable communities**

1. Development Commissioner-cum-Additional Chief Secretary
2. Agriculture Production Commissioner-cum-Additional Chief Secretary
3. Principal Secretary, Women & Child Development Dept.
4. Commissioner-cum-Secretary, Fisheries & ARD Dept.


MoU Signed with WorldFish in Nov,2020 for Inclusion of Fish based Nutrition in SNP

Activities for Increasing Availability, Accessibility & Consumption of Small Fish

1. Piloting of fish based nutrition in 50 Anganwadi Centers

2. Hygienic solar drying of fish by Women SHGs for open market & ICDS SNP:
   - 50 solar driers per year under MSME Department
   - Marine small fish - Anchovies, sardines are dried

3. Nutrition-sensitive carp mola polyculture in freshwater tanks for household level consumption
   - Fish farming in Gram Panchayat tanks by Women SHGs – 6000 tanks over last 3 years
   - Household backyard tanks – 789 tanks

Piloting of Fish Inclusion in Anganwadi SNP

In 50 Anganwadi Centers in Mayurbhanj District

Purpose of the Pilot & Expected Outcomes

Purpose

- To improve the dietary diversity and micronutrient intakes of women & children covered in SNP
- To test the acceptability of dried fish products (eg. taste, ease-of-use) by tribal community & Angwandi Workers

Expected Outcomes

- Enhanced dietary diversity
- Enhanced micronutrient intake
- Community need-based intervention
- Promotion of healthier eating habits
- Promotion of local and culturally appropriate foods

Hot Cooked Meal to 1200 children;

Take Home Ration to 800 pregnant & nursing women & adolescent girls

Based on the outcomes & experiences, Government would take steps to upscale this program across the state

Dried fish packets in Take Home Ration

40 grams/day/adult; 3 days a week

Fish powder used in Hot Cooked Meal

8 grams/day/child, 5 days a week

Solar Dried Fish by Women SHGs

- "One District One Product" program under Pradhan Mantri Formalisation of MSME Scheme
- 50 solar fish driers every year
- At least 1500 women in coastal fishing villages generate additional income from this business venture

Low-cost Solar Fish Drier

Marine small fishes such as Anchovies, Sardines are dried by Women Self Help Groups

Fish Farming in Gram Panchayat Tanks (Community Tanks) by Women SHGs

- > 6000 WSHGs; > 60,000 women started this fish farming venture for additional income and nutritional gains
- Government invested Rs. 45 Crores in last 3 years

Fish Farming in Agriculture Farm Tanks

- This is a new convergence scheme with Agriculture Department for fish production in 10,000 Agriculture Farm ponds

Crop Outcomes from GP tanks managed by WSHGs

Sl. No.	Parameters	2018–2019	2019–2020
1	WSHGs that benefitted under the program	1681	2469
2	WSHGs randomly selected and surveyed	370 (22%)	592 (24%)
3	Districts covered under the survey	30	30
4	Blocks covered under the survey	180	228
5	Average size of Gram Panchayat (GP) tank	0.77 ha	1.02 ha
6	Tanks completely harvested within 12 months of stocking	104 (28%)	141 (24%)
7	Tanks producing carp	370 (100%)	592 (100%)
8	Tanks producing carp and mola	202 (55%)	311 (53%)
9	Tanks producing carp, other small indigenous species (SIS)	33 (9%)	51 (9%)
10	WSHGs that turned a profit	316 (85%)	532 (90%)
11	Average fish production	1725 kg/ha	1956 kg/ha
12	SIS production	166 Kg/Ha	172 Kg/Ha
13	Average cost of production	INR 115,947/ha	INR 123,377/ha
14	Average value of fish produced	INR 243,570/ha	INR 278,333/ha
15	Average profit margin	INR 127,622/ha	INR 153,543/ha

Convergence & Collaborations

Institutional Convergence

1. Fisheries & Animal Resources Development
2. Women & Child Development
3. Mission Shakti Development
4. Panchayati Raj & Drinking Water Development
5. Micro Small & Medium Enterprises Development

Institutes

1. ICAR-Central Institute of Fisheries Technology
2. ICAR-Central Inland Fisheries Research Institute
3. MS Swaminathan Research Foundation
4. Kalinga Institute of Social Sciences, Bhubaneswar

Private Sector

1. Falcon Marine Exports Ltd., Bhubaneswar
2. Ruchi Foodlines Pvt. Ltd., Cuttack

Lessons Learned and Way Forward

- Political will, blended with proactive bureaucracy, help grounding initiatives
- Inter-departmental convergence important
- Technical inputs critical - WorldFish, now an important partner
- Partnership with national ICAR research institutes has helped develop age-specific fish-based products & design large scale delivery mechanisms
- Involvement of women in livelihood support and food security





WorldFish Activities in APART

R. Suresh, Resident Consultant

6th September, 2021

WorldFish

Sl. No	WorldFish Deliverables
1	**Deliverable A:** Inception Report
2	**Deliverable 1.** Promoting adoption of BMPs for sustainable intensification of aquaculture
3	**Deliverable 2:** Up-gradation of Existing Indian major carp hatcheries to produce certified seed
4	**Deliverable 3:** Multiplication Centres (MCs) for genetically improved fish strains
5	**Deliverable 4:** Improving productivity of beels
6	**Deliverable 5:** Improving Fish Value Chains
7	**Deliverable 6:** Carp-Mola polyculture
8	**Deliverable 7**: Improving impact of aquaculture and beel fisheries on human nutrition
9	**Deliverable 8:** Promoting climate resilient smart fish production technologies
10	**Deliverable 9:** Gender transformative approaches in support of sustainable aquaculture and beel fisheries
11	**Deliverable 10:** Capacity building of DoF Officers

WorldFish

WorldFish Activities - BMPs

Sl no.	Deliverables	Work done
1	**Promoting adoption of BMPs for sustainable intensification of aquaculture.**	5 BMPs and 4 records book developed in Assamese, printed and distributed among beneficiaries and non-beneficiaries, BMP for Polyculture of Carps, BMP for Production of Mola and SIS along with Carps, BMP for Paddy cum Fish Integrated Farming, BMP for Beel Fisheries, BMP Quality Carp Seed Production Pond record book for Polyculture of Carps, Polyculture of carps with Mola-SIS, Record book for Paddy cum fish integrated farming, Polyculture of carps with Freshwater Prawns FPG level BMP trainings conducted

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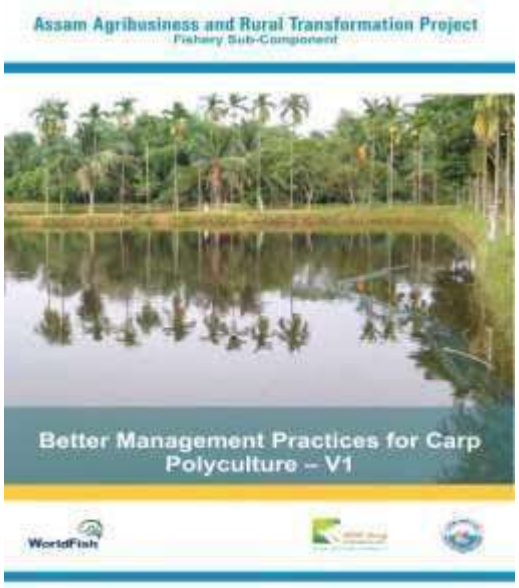
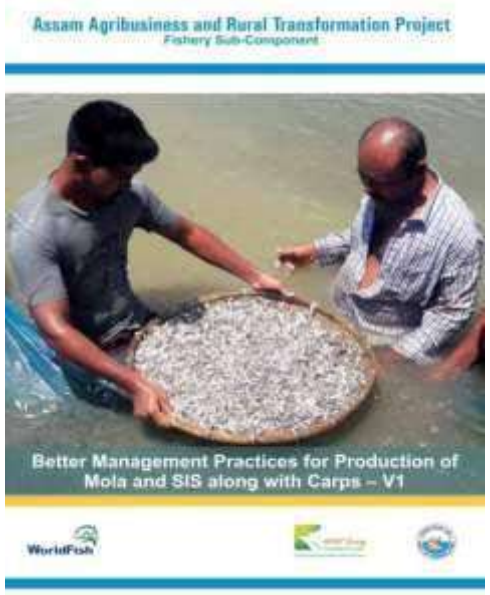
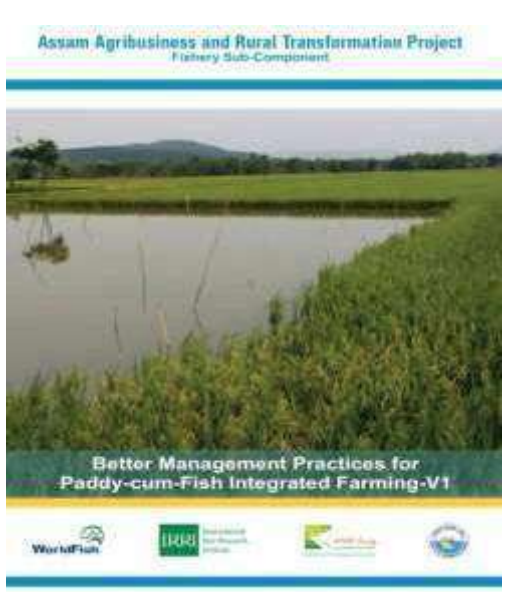
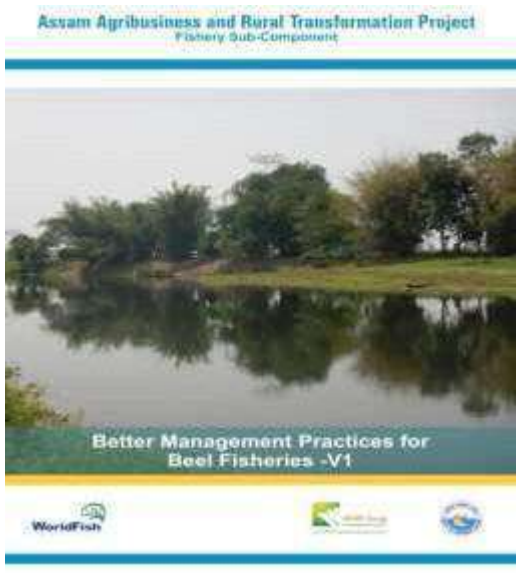
Better Management Practices









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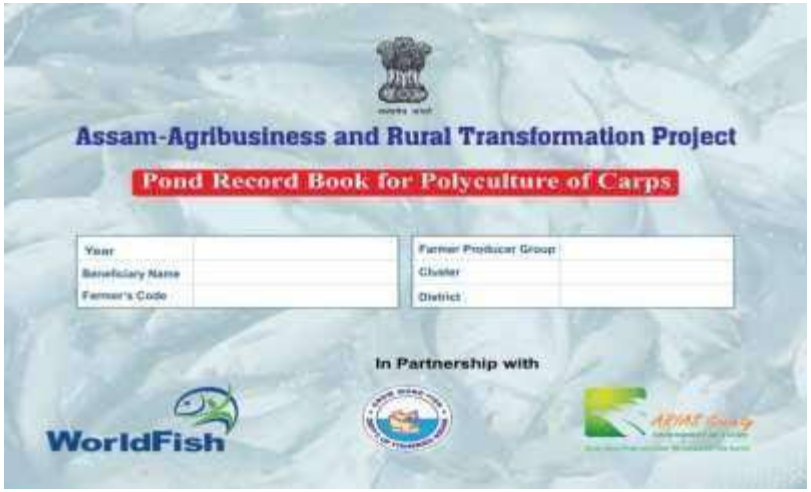
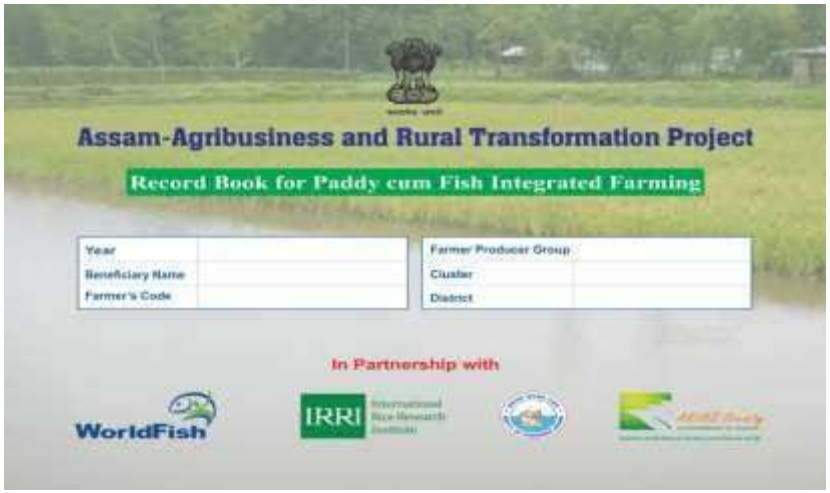
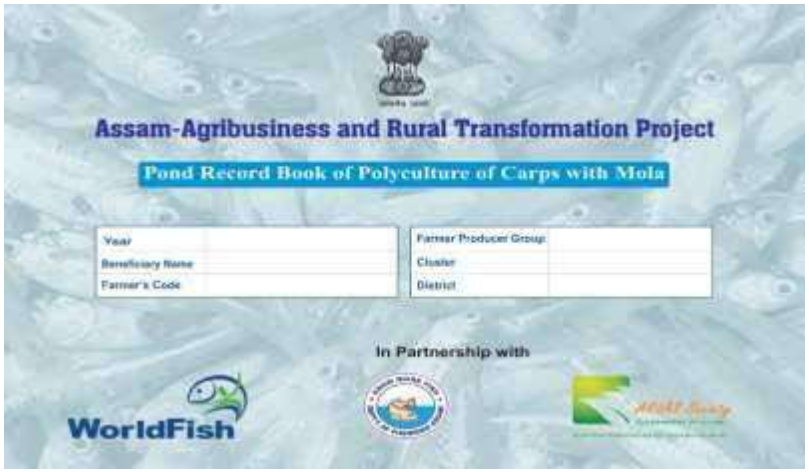
Pond Record Books







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WorldFish Activities –Hatchery Upgradation

Sl no.	Deliverables	Work done
2	**Up-gradation of Existing IMC hatcheries to produce certified seed.**	Technical support provided for selection of Department Hatcheries for upgradation to produce quality fish seeds Recommendation given for upgradation of hatcheries BMP for Quality carp seed production provided Quality Broodstock collected from Wild Tagged Civil works completed in 5 Hatcheries for upgradation Quality Seed production work in progress in hatcheries

WorldFish

WorldFish Activities –Seed Multiplication Centres

Sl no.	Deliverables	Work done
3	**Multiplication Centres (MCs) for genetically improved fish strains.**	Technical support provided for selection of Department Farms for establishment of multiplication centres. Recommendation given for establishment of multiplication centres. Genetically improved strains of Jayanti rohu and Amur carp from NFFBB, Bhubaneswar stocked for broodstock multiplication, distributed to farmers and FPCs Civil works completed in all multiplication centres.

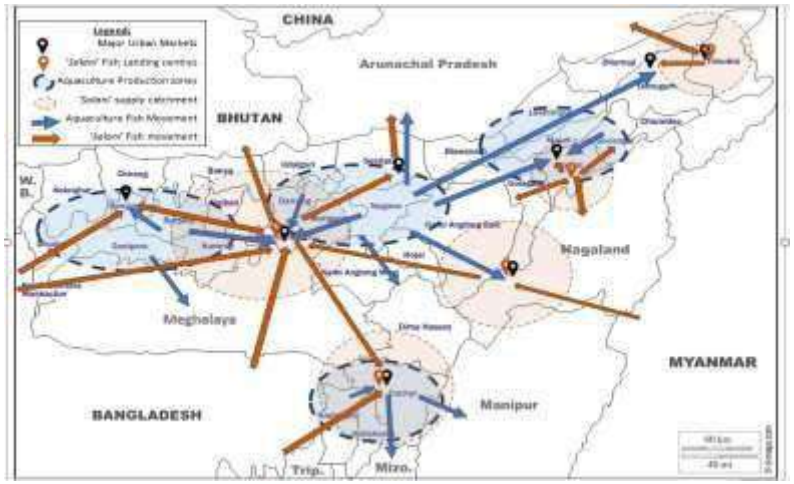
WorldFish

WorldFish Activities – Beel Fisheries

Sl no.	Deliverables	Work done
4	**Improving productivity of Beels.**	Technical support provided for selection of suitable Beels for development Baseline survey conducted in the selected beels BMP for Beel fisheries provided Specific recommendation on technical intervention and governance for the selected beels given

WorldFish Activities – Fish Value Chain

Sl no.	Deliverables	Work done
5	**Improving Fish Value Chain.**	Fish value chain study completed and report submitted Existing Fish Value Chain in Assam, Fish feed value chain and Scope for Fish products identified Virtual Workshop on Fish Value Chain in Assam conducted Provided support for enterprise development programs



Fish Movement across Assam

WorldFish

WorldFish Activities – Carp-Mola Polyculture

Sl no.	Deliverables	Work done
6	**Carp-Mola polyculture.**	Carp-Mola Polyculture promoted in 10 project Districts with 64 beneficiaries in 2019-20, 175 beneficiaries targeted in 2020-21 Training provided to DOF officials, APART staff and farmers on identification of brood stock source, harvesting of Mola and SIS, conditioning, transport, stocking and partial harvesting. Mola-SIS establishment in Polyculture system assessed. BMP for Carp-Mola Polyculture provided

WorldFish Activities – Nutritional Security

Sl no.	Deliverables	Work done
7	**Improving impact of aquaculture and Beel fisheries on human nutrition.**	Social behavior communication change materials for Nutrition promotion campaign. Social media campaign to promote fish nutrition taken up. Nutrition sensitive aquaculture promoted Fish in mid-day meal program for children and Take home ration for pregnant and lactating women and children under First 1000 days program initiated under the Odisha model in convergence mode

WorldFish Activities – Climate Resilient Technologies

Sl no.	Deliverables	Work done
8	**Promoting climate resilient smart fish production technologies.**	Paddy Fish farming as a climate resilient technology promoted in 9 districts among 297 farmers in 150 ha. In 2020-21 target for demonstration along with Mola-SIS in 300 ha. Potential area for expansion of Paddy-Fish farming in Assam identified. Joint evaluation of short-term fish culture technology taken up along with College of Fisheries, Raha. Climate resilient technologies Study is in progress.

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WorldFish Activities – Gender Integration

Sl no.	Deliverables	Work done
9	**Gender transformative approaches in support of sustainable aquaculture and Beel fisheries.**	Gender sensitization workshop conducted for Department Officials, College of Fisheries Faculty and APART Staff, Gender Scoping Study conducted in 7 project districts, Gender Integration workshop conducted for Department Officials and APART Staff, Gender strategy and Gender integration recommendations provided

WorldFish

WorldFish Activities – Capacity Building

Sl no.	Deliverables	Work done
10	**Capacity building of DoF Officers.**	Two National exposure visits for Department Officials and APART Staff to Odisha organized, One International visit to Cambodia and Myanmar for Department Officials organized Technical support for conducting three ToT programs organized by College of Fisheries, Raha Training provided to Department Officials and APART Staff on Polyculture of Carps, Mola-SIS farming, Beel fisheries, Nutrition sensitive aquaculture, Quality fish seed production, GIS in fisheries and aquaculture, Gender integration and MIS data collection Virtual meetings and Trainings provided by WorldFish Experts

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Additional Technical Inputs

MIS Support

Baseline survey of 2018-19 for Polyculture of Carps (727), Paddy-Fish Integrated Farming (91).

Endline Survey for 2019-20 and Baseline survey of 2020-21 in Progress.

WorldFish developed MIS using ODK and KoBo ToolBox (Kf.kobotoolbox.org)

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WorldFish - Communication Products

- **APART Fact Sheet**
- **Assam Fisheries Fact Sheet**
- **BMP Guidelines** – English & Assamese
  - BMP for Polyculture of Carps
  - BMP for Mola Farming
  - BMP for Paddy cum Fish Integrated Farming
  - BMP for Beel Fisheries Management
  - BMP for Quality Carp Seed Production
- **Pond Record Book** – English & Assamese
- **APART Posters** – English & Assamese

WorldFish

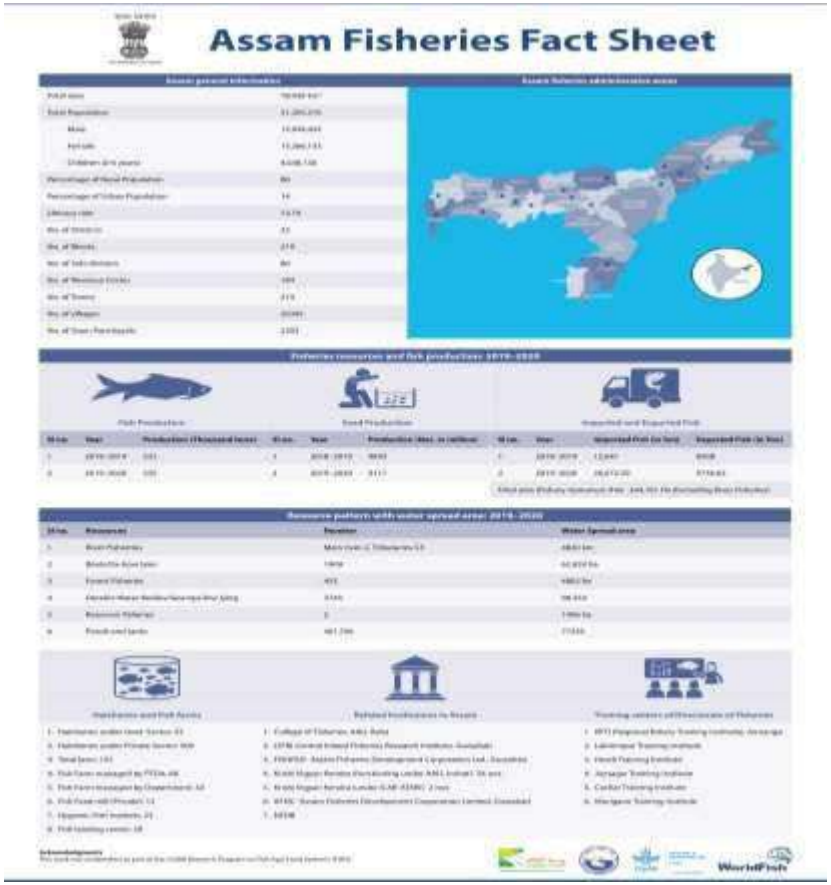
Key Activities – WorldFish Factsheet

WorldFish Fact Sheet of APART Project

WorldFish

Key Activities – Fisheries Factsheet

Assam Fisheries Fact Sheet



WorldFish Posters - Assamese

WorldFish Posters under APART – Assamese

Polyculture of Carps in Ponds

Paddy cum Fish Integrated Farming

Carp-Mola-Small Indigenous Fish Polyculture

Culture-cum-Capture Fisheries in Beels

Thank You

WorldFish

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सत्यमेव जयते

GOVERNMENT OF ASSAM

ARIAS Society

GOVERNTMENT OF ASSAM

Assam Rural Infrastructure and Agricultural Service Society

In partnership with

Scientific protocols for Quality Fish seed Production

Dr. Y. Basavaraju
Consultant , WorldFish
and former Dean, College of Fisheries, Mangalore , Bangalore

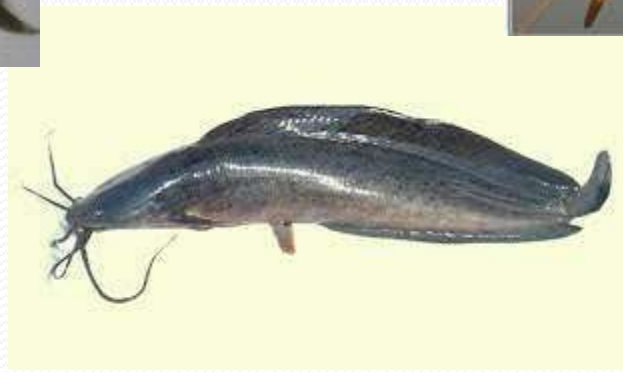
Introduction

Fresh Water Aquaculture status in India

- India is one of the largest farmed fish producing country with an area of 2.48 million ha under tanks and ponds
- 7.7 MMT of farmed fish during 2018-19, contributing to about 80 percent of the inland fish produced in and about 56 percent of the total fish production
- Multispecies based system with carps contributing nearly to 83% of FW fish production(IMC 67%; Exotic 8.62%)
- While there has been a horizontal expansion in the area under freshwater fish farming, vertical hikes have been limited, resulting in the average per hectare productivity being restricted to 3000 kg per ha

Important Aquaculture species- commonly used species

Other Potential species



Genetically improved strains

Jayanthi Rohu
Developed by CIFA

Amur common carp-
KVAFSU

Fish seed status- National

- Most of the states, except a few-Andhra Pradesh and West Bengal, are seed deficit and the imbalance in demand and supply of fish seeds is a major concern.
- The share of different cultivable carps in total seed requirement is projected as catla (30%), rohu (50%), mrigal (10%) common carp and others as 10% (personal communication, NFDB).
- The bulk of the seed produced , are used for stock recruitment in tanks and reservoirs fisheries management programmes.
- There has been a serious lacuna in supply of quality fish seed to meet the demand

Assam Fisheries

- Assam, the North East Indian is one of the states with rich aquatic resources WITH GREAT fisheries and AQUACULTURE POTENTIAL.
- Fisheries and aquaculture is one of the major source of livelihood for thousands of rural population in the state.
- The state has 1.35 lakh ha. of inland fisheries resources in the form of RESERVOIRS, TANKS & ponds and Flood plain lakes /derelict waters (beels) besides rivers and canals.
- The current fish production of the state is around 4546.00 thousand tonnes (source-Assam fisheries statistics),
- the current productivity is around 1700 kgs / ha in ponds and tanks, around 500 kgs / ha in beels which is far below the normal productivity rate compared to other states.
- Lack of availability of quality "fish seed" is considered as one of the major impediments in enhancing aquaculture production in the state.

Lack of concern for quality

Probable reasons

- Majority of hatcheries are functioning with brood stock of unknown sources and genetic makeup
- Target oriented production system: Quantity takes over quality to achieve their targeted seed production
- Non compliance to genetic norms and scientific brood stock management and spawning principles.
- Lack of awareness, insufficient skilled manpower, limited etc.,
- Prolonged use of the same breeders over the years.
- Use of brood fishes from farmers' ponds without verifying their genetic characteristics
- **Effects are**: reduced growth, high FCR and susceptibility to diseases resulting in high cost of production.
- Imbalance in demand and supply of fish seed

Importance of quality Fish seed

- Quality Fish seed is fundamental for augmenting fish production from different farming systems
- Use of quality seed is recognized as one of the key prerequisites for enhancing fish production (*(incremental 20-30% output)* and sustaining sector growth.
- *Inadequate supply of **quality seed** of Right species, in Required quantities at Right time and Right place at Right price is considered as one of the major constraints for aquaculture development*.
- As the quantity and availability of fish seed has improved to a great contest, the quality issue has come to the forefront.

What is a Good quality seed?

Fish seed that are

- Off springs of Genetically superior stocks
- Active
- Healthy
- Uniform in size
- Potential for high survival
- Better growth
- Less or No disease

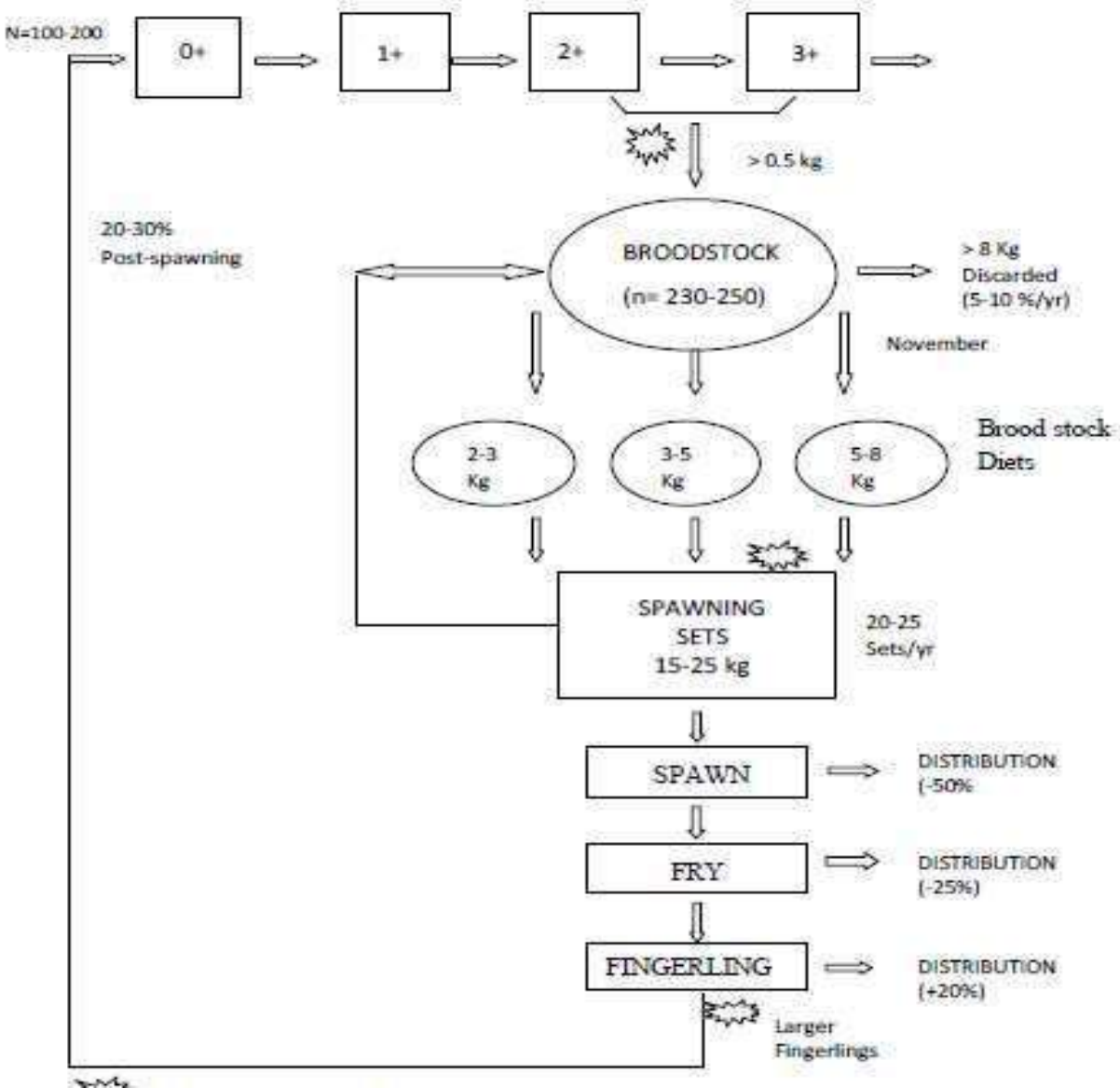
Factors affecting seed quality

- Source of brood stock
- Breeding methods/ protocols
- Brood stock replenishment and replacement strategies
- Husbandry practices (Congenial environment, proper water depth, water quality, feed and Health management of brood stock, hatchery, nursery and rearing management practices)
- Evaluation and assessment

Impact of brood stock management

- The brood stock management practices will have impact on the performance of off spring(e.g. growth rate, survival, disease resistance, and age at maturity and fecundity).
- Good Management practices will yield positive results
- Several studies carried out in the past indicate that current management of stocks in the hatcheries is likely to have negative impact on the seed quality
- Slight changes in the routine brood stock management and breeding protocols can prevent further Genetic deterioration of the present stocks.
- This can be done without major change to practices now being followed.
- What is required is the change of mind set of hatchery operators

Typical functioning of a Fish seed production farm



Brood stock management

- Genetic management :
  - Genetic make up
  - Source of brood stock
  - brood stock replenishment and replacement strategies; Inbreeding and its management

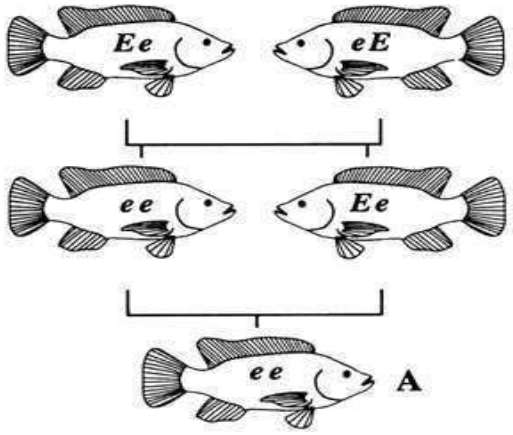
- Husbandry practices
  - Pond size
  - Pond preparation
  - Stocking density
  - Post stocking: feed and feeding strategies
  - Water quality and providing congenial environment
  - Health management

Genetic Management

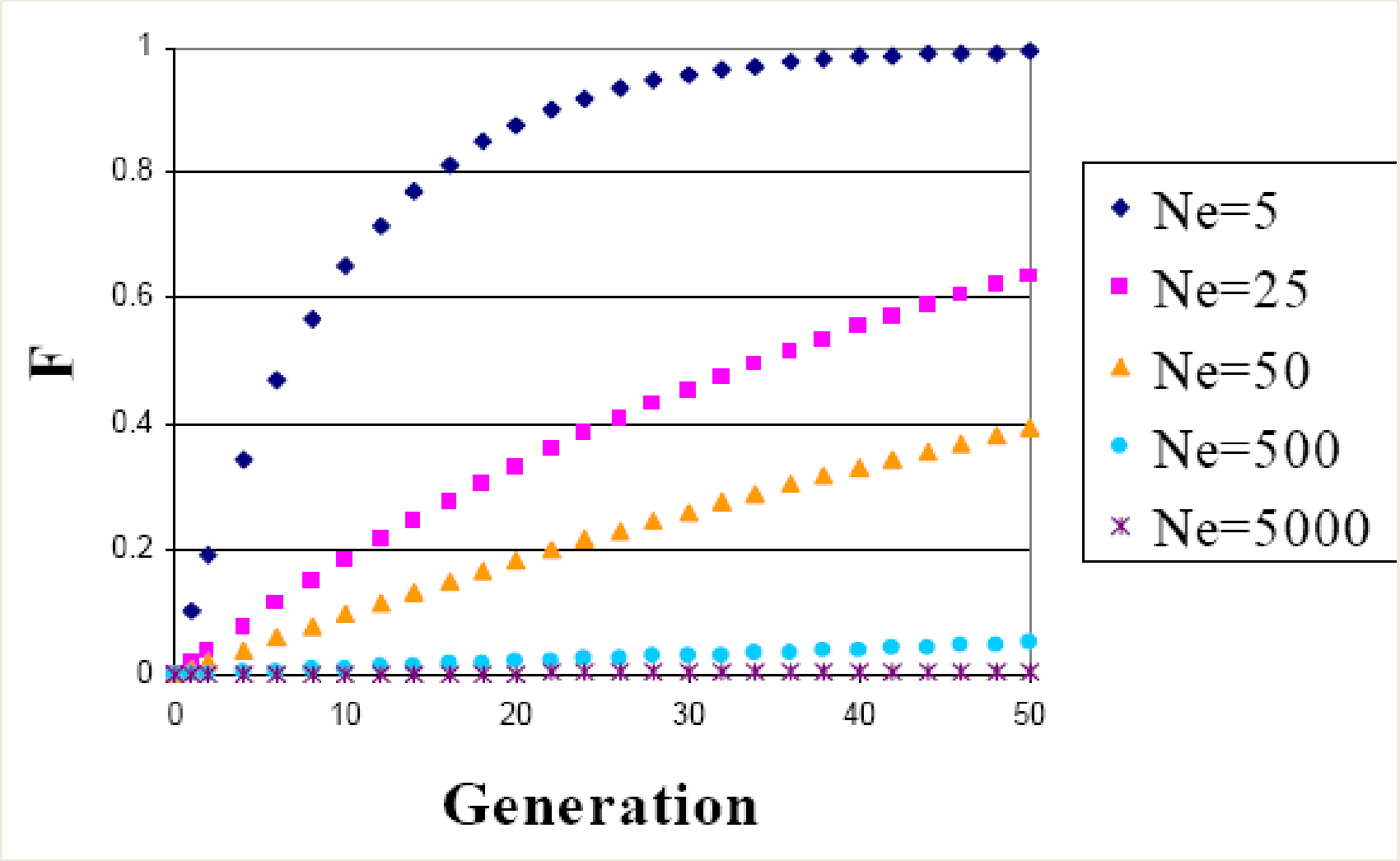
- Genetic management of brood stock is critical to ensure long term quality and requires a good understanding of the genetic structure of the species being bred.
- Poorly planned genetic management of brood stock and breeding practices can result in decline in the quality of stock over a number of generations leading to inbreeding
- Managing inbreeding is very crucial - reduced fecundity, hatching and growth rates, and an increase in the incidence of abnormalities and susceptibility to diseases.
- Importantly, brood stock management focus to prevent loss of genetic diversity and minimize inbreeding within the population

What is in breeding ?

- Inbreeding is the mating of closely related animals through ancestry- genes contained in the uniting gametes may be identical by descent
- The inbreeding is cumulative because it accumulates from one generation to next.



F rate and Ne


F
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40
50
Generation
Ne=5
Ne=25
Ne=50
Ne=500
Ne=5000

Ways to minimize Inbreeding in Hatchery Population

- Maximize number of brood stock contributing to the next generation (increase Ne)
- Random selection of equal numbers of fish from each spawning for the next generation brood stock
- *Equalization of sex ratio 1:1 male: female will reduce inbreeding considerably*
- Identify by marking/ tagging or keep separate different age classes/generations of current or future brood stock/coharts
- Maintaining the pedigree records is also equally important

Effect of sex ratio in inbreeding

- Ex: breeding population: 25 pairs
- Case 1- equal sex ratio(calculated using the formula Ne= (4*F*M)/(F +M) ie Ne= (4*25*25)/(25 +25) would be 50 and the rate of inbreeding **ΔF** estimated using formula **ΔF =1/(2*Ne) ie 1/(2*50) would be 0.01** or **1%**
- While, In the second case, the same population with un equal numbers of males(40) and females(10) the effective population using the same formula(Ne= (4*10*40)/(10 +40) would be =32 and rate of inbreeding (**ΔF = 1/(2*32) would be 0.0156 or 1.56%**

Brood stock pond management

Pond details:

- Size of the pond depends on the quantity of brood stock
- It should have a proper slope
- Bigger the size is better
- Depth of the pond should be around 8 ft with 2 ft free board to hold 6 ft water depth with drainage facility
- It should have separate water supply line on the opposite side of the out let and from the top with a control valve

Brood stock pond Management (Husbandry practices)

- **Pond preparation-***The brood stock ponds need to be prepared properly and brood stock managed 3-4 months prior to breeding time*
- *Draining and drying-bottom raking for escape of poisonous gas accumulated in the pond bottom*
- *Application of manures and fertilizers in right quantities and right combination*
- *Liming –acts as both disinfectant and correctspH-250-500kg/ha –depends*
- *Use of additional inputs based on soil character*

Pond management –key factors

- Proper water depth is very crucial -1.5-2.0 is ideal
- Stocking density -2000kg/ha
- Feed and feed management is very important(32% proteino
- Water quality management –imp parameters-DO, Ammonia, pH and nutrient management
- Fish health management
- Proving congenial environment is very important to avoid stress to brooders for better response and quality eggs

Induced breeding- selection of breeders

Select fully ripe breeders

- Females: Pectoral fin soft; swollen belly round in shape and soft to touch with reddish vent.
- Males: Pectoral fin rough with tubercles and oozing of milt with slight pressure on abdomen

Net the brooders in the morning hours and condition them for spawning

Select fish of 2 years or more of equal weight (preferably <3kg) and *equalize sex ratio by number and weight*

Condition breeders for 4 -6 hours to empty stomach and acclimatization to the new hatchery environment

Fully ripe male and female fish

Induced breeding- spawning protocols

1. Avoid mixed breeding of different species/strains together in the same pool
2. Evening hours (just before sun set-5.30—6.00 pm) is the best time for administering inducing agent
3. Weight of each male and female injected should be recorded along with numbers
4. Females may be administered inducing agent first followed by males.

- Commercially available inducing agents (Ova prim, Ovatide, WOVA-FH) may be used.

Induced breeding –inducing agents –Day 1

Fish Name	Female (ml/kg body fish weight)	Male(ml/kg fish weight)
Rohu	0.40-0.50	0.25-0.30
Catla	0.50-0.60	0.30-0.40
Mrigal	0.30.0.40	0.20-0.30

Induced breeding- precautions

1. Spawning pool should be covered with net covering to avoid possible escape of brood fish by jumping
2. Water circulation in spawning pool and hatching pool should be at appropriate speed and continuous and maintain the water temperature around 30^0 C
3. Number of breeders injected should be based on the capacity of the spawning pool and also the capacity of the hatching pools
4. Provision for power back for continuous pumping of water is essential

Collection of eggs and transferring to hatchery

1) Water hardening of eggs completes in 3-4 hours post fertilization
2) The eggs will be ready for shifting to hatching pools on the 2nd day in the morning hours.
3) Remove brood fish from the breeding pool in the morning hours and disinfect them by dipping in KMNO4 solution.
4) Record the number and weight of females fully released the eggs--calculate fecundity and fertilization success.
5) Record the number and weight of females not responded and shift them to brood tock pond for preparing them for next spawning.
6) Spawned fish or spent, both male and female may be shifted for a separate pond to nurse them for later use.

Incubation of eggs or hatching practices

1. The water hardened eggs should be transferred into the hatching pools 6-7 hours after fertilization.
2. Chinese type of hatcheries are preferred for commercial scale egg incubation.
3. Maintain water temperature around 30-32 ^{o}C through showers and bringing down water temp by using ice blocks to overhead tank, if temperature is very high
4. Dissolved Oxygen concentration in hatchery water should be maintained at 5-7 ppm.
5. Alkalinity of water should be maintained below 130 ppm-
6. Remove the dead eggs/hatchlings periodically from the hatcheries to avoid infection to other eggs/ hatchlings
7. Water circulation rate in the hatching polls should be maintained at a proper rate throughout hatching period for oxygen supply and better Survival

Day- 5 Spawn Collection

1. Normally yolk resorption completes between 72-96 hrs. after hatching and spawn will be ready by 4th day evening or 5th day morning to be shifted for nursing in nursery ponds
2. Early Morning time (before 9 am) is the best time for collection of spawn for transportation and shifting to nursery rearing
3. Measure the quantity of spawn using measuring cups of known volume (measure randomly 3-4 cups, count and then compute to get total spawn obtained .
4. Ideally Spawn should be conditioned in a small tank with water flow for one or two hours before transportation or shifting to nursery ponds where dead spawn can be removed and counting also can be done

Spawn packing and transportation

Conditioning of spawn before transportation is very important before packing is very crucial to reduce mortality during transportation

50,000 spawn per polythene bag with 4 litres of water and 4 liters volume oxygen

Spawn should be ideally transported in cool hours – morning or evening hours

Handle spawn carefully as they are very delicate

For long distance transportation use light sedative agents

Steps involved in nursery pond management

- Pond type
- preparation -draining and drying(if drainable), raking of pond bottom-oxidation of organic matter, degassing of Hydrogen sulphide and ammonia, kills the pathogenic microorganism,
- Removal of aquatic weeds
- Removal of predators
- Liming- correct pH , release of soil bound phosphorus to water and also disinfectant-Generally, ***200 – 500 kg/ha*** Liming materials include agricultural lime(optimium pH is 6.5-8.0)
- Manuring and use of fertilizers-increase pond productivity
- Testing of soil and water is also important

Nursery pond management-Pond preparation

1. Earthen ponds of 0.1 ha with a Water depth of 1.00-1.20 m or 3-4 ft are ideal for spawn nursing
2. Concrete tanks are better-high stocking density, better survival and long shellfire, is to drain and harvesting
3. Ponds should be completely drained and sun dried (if drainable), rake the pond bottom for release of accumulated poisonous gases and oxidation of organic matter, and kill harmful bacteria,
4. Removal of aquatic weeds and predators if any
5. Liming-@***200 – 500 kg/ha depending on the soil pH. Using agriculture lime*** Optimal water pH is6.5-8.5
6. Cow dung and poultry manure 7-10 days ahead of stocking at the rate of 5 – 6 tons/ha and 2 – 3 tons/ha respectively

Few common aquatic plants

Nursery pond management-Post stocking management

1. Spawn stocking density @ 4million/ha
2. Feeding 6 kg/million/day for the first 5 days. For the remaining period, 12 kg/million/day.
3. The two feed ration/day is necessary to get greater survival rate and enhanced growth rate. For first few days give powdered feed or in liquid form by spreading across the pond
4. Number of cycles per season: 5 (making allowance of 5 days for preparation)
5. Spawn nursing duration- 15-20days
6. Spawn should be stocked in nursing tank either early morning or late evening hours
7. Nursing of single species is better as segregation of species at fry level will be extremely difficult
8. Anticipated survival 40% if SOP is followed in strict sense

Rearing fry to fingerlings

- Pond preparation for rearing fry to fingerlings is same as that of nursery ponds.
- The fish are stocked @ 2-3 lakh/ha depending on the type of management practice.
- Feed with commercial fish feed/mixture of rice bran and oil cake in 1:1 ration (30% protein) @ 10% of biomass for first one month and can be reduced to 5%.
- Cover the pond with a net cover to prevent bird predation and also dropping of other external material into the pond.
- Rearing duration - 70-80 days to attain a size of 80-100mm.
- If SOP is followed strictly you can expect a survival of around 70%.

Record Keeping

This is essential!

- **Date:**

- # brooders – female, male
- # of female and male set for spawning
- # of females spawned
- Total eggs released/kg female(fecundity)
- Fertilization rate (%)
- # spawn collected
- Survival from eggs to spawn(%)
- # spawn disposed with address and purpose
- # mortalities from hatching to till selling

Monitor trends by set, species and date

- Evaluate and thoughtfully adjust system

To conclude

- *Balancing both genetic management of brood stock and following Standard operational (SOP) on brood stock management, breeding, hatchery practices and nursing spawn is very crucial for quality seed production*

Thank you







Polyculture of Carps under APART

R. Suresh, Resident Consultant

6 September, 2021

ToT Program - College of Fisheries, Raha

ARIAS Society
GOVERNMENT OF ASSAM
Assam Rural Infrastructure and Agricultural Service Society

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- Polyculture of carps with Mola
- Polyculture of carps with Freshwater Prawn
- Polyculture of carps

Benefit in Assam -

- Vast consuming demand
- Water Resources of Assam
- Demonstration of culture
- Increase the Livelihood
- Soil is enrich
- Diversified fish species in Assam

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Constraints –

- Under utilization of Resources -
- Awareness among people is less
- Quality seed production - Availability of Quality feed sources
- High cost of Feed – Raw material price is high
- Temperature for growth
- Lime application not practised by the farmers
- Annual drainage of ponds is not practised. Organic load is more in such kind of ponds.
- Stocking of ponds in Quintal
- Different sizes of fishes are stocked – Feeding will be constraints
- For different fish species Stocking ratio should be followed
- Farmers are not getting the right price of the fish production

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Steps to overcome the constraints

- Species diversity
- Genectically modified species to be cultured
- Training and demonstration through APART. Dissemination of Knowledge
- FCR – 1.5-2

Per kilo profit – Rs.50

Rice polish – Rs. 20-27/kilo

MOC – Rs. 35/kilo

- Overwintering of seeds to overcome the winter season in Assam

WorldFish

Overview

- ✓Polyculture of Carps
- ✓Polyculture of carps with Mola-SIS
- ✓Polyculture of carps with Genetically improved strains.
- ✓Polyculture of Carps with Freshwater Prawns

- ✓POP Vs BMP

WorldFish

Introduction

- ✓Polyculture is the system in which fast growing compatible species of different feeding habit are stocked together in the same water body so that all its ecological niches are occupied by fish to optimally utilize the resources for increasing fish production and productivity.
- ✓Extensive/Semi-intensive/Intensive
- ✓Polyculture of carps – Composite fish culture with IMC and Exotic carps.
- ✓Species Selection - Consumer preference, Market, Price, Profitability, Nutrition Approach
- ✓Discussion on Current Practices in Assam – Advantages and Disadvantages

WorldFish

Pond Preparation

- ✓ Drain pond; remove sludge from the bottom and let it dry. Remove silt
- ✓ Keep pond dyke clean from bushes to prevent hiding of predators.
- ✓ Repair dyke to prevent water seepage.
- ✓ Repair inlet and outlet pipes.?
- ✓ Apply lime, distribute evenly over the pond surface, at recommended rate based on soil pH.
- ✓ Consider fencing the sides of pond using nylon net/bamboo/any other locally available materials or bio-fencing.

WorldFish

Water Filling and fertilization of pond

- Fill pond ?; maintain water depth between 1.5-2.0 m. Filter water with double lined nylon nets if water from natural sources is used for filling.
- Fertilize pond, using chemical fertilizers - Urea and single super phosphate.
- Apply organic manure (Raw Cow Dung @10000 Kg/ha) in heaps in one or two pond corners enclosed with the help of split bamboo.

WorldFish

Stocking

- ✓ Pond is ready to stock once water turns green (rich in plankton – natural food for fish).
- ✓ Acquire fish seed from Department hatcheries, Multiplication centres or Registered Private hatcheries. Stocking of genetically improved Jayanti rohu and Amur common carp is highly recommended.
- ✓ Treat the fish seeds with $KMnO_4$ @1-3 ppm or NaCl @4% before stocking.
- ✓ Maintain stocking density (8000 nos/ha) as recommended.
- ✓ Maintain stocking ratio of 4:3:3 (surface feeder: column feeder: bottom feeder)
- ✓ Stock uniform size seeds of more than 10cm

WorldFish

Water quality management

- Monitor the pond regularly (early morning and late in the afternoon).
- Low DO stress is likely:
  - ✓ if the pond is dark green with Secchi disc visibility of <15 cm (DO stress occurs either very early in the morning or when the day is cloudy).
  - ✓ if pond water is dark/black coloured with foul smell (H_2S).
- Check pH after heavy rainfall and apply lime if pH is <6.5.

WorldFish

Feeding

- ✓Follow feeding options, depending on the feed availability and costs:
  - Floating pellets
  - Sinking pellets
  - Farm-made feed
  - Combination of commercial formulated feed and farm-made feed

- ✓Adjust feeding rate as recommended?
- ✓Method of feeding – Broadcasting, Feeding trays, Feed bags
- ✓How to optimise feed use?

WorldFish

Disease Management

There are a number of preventive measures farmers can use to reduce the risk of diseases and parasitic infection:

- ✓ Stock pond with healthy, disease-free seed.
- ✓ Avoid overcrowding.
- ✓ Follow proper feeding, fertilization and water quality management practices.
- ✓ Conduct routine screening for any sign of disease/stress.
- ✓ Record all clinical signs; take pictures of clinical signs, and record of number of dead fish.
- ✓ Remove all moribund and dead fish, and bury them far away from the pond.
- ✓ Bring any unusual mortality to the attention of responsible authorities and assist them to collect sick and moribund samples for laboratory testing. Follow the suggestion of the responsible authority for disease management

✓ **Prevention Better than Cure**

WorldFish

Harvesting

- ✓ Follow harvesting strategy based on culture system type – generally single stocking and multiple harvesting is recommended
- ✓ Harvesting Period – Demand based
  - Harvest fishes when they grow to 800g -1 kg size depending on the market
  - Condition fish before sending to fish market
  - Live fish marketing

WorldFish

Record Keeping

- ✓ Maintain records of all farm activities, stocking details, inputs, sampling details, harvest details, sales and also consumption.
- ✓ Use record books provided under the project for keeping records.
- ✓ Ensure the records are updated periodically by the farmers during their visit of Project staff or Department officials to the farm/farmer.

WorldFish

POLYCULTURE OF CARPS WITH GENETICALLY IMPROVED STRAINS

- Jayanti rohu and Amur common carp are genetically improved strains with higher growth efficiency developed through selective breeding.

- Morphologically Jayanti rohu is similar to normal Rohu but its growth rate is approximately 13-17 % higher than normal rohu.

- Amur common carp is approximately 27 % higher than normal Common carp and its market demand is high due to round body and slim belly compared to normal Common carp. Generally do not breed during the culture period of 8-10 months

WorldFish

Stocking

- ✓Acquire genetically improved fish seed from Department hatcheries, Multiplication centres or Registered Private hatcheries having improved Jayanti rohu and Amur common carp.
- ✓Replace the normal rohu and common Carp fish seeds with Jayanti rohu and Amur common carp fish seeds.
- ✓Maintain stocking density as recommended for normal rohu and common carp.
- ✓Advantages – Increased growth, production, income from the same area

WorldFish

POLYCULTURE OF CARPS WITH MOLA AND OTHER SMALL INDIGENOUS FISHES

- ✓Small indigenous fish species (SIS) are rich in micronutrients such as vitamin A,D,B12, Calcium, Iron, Zinc etc.
- ✓*Amblypharyngodon mola* locally called *Moa* is a nutrient dense fish
- ✓Other Small Indigenous Species in Assam?
- ✓Regular consumption of mola and SIS help to eradicate malnutrition and provide nutritional security
- ✓Culture along with Carps?

WorldFish

Identification of Mola and SIS broodfish source:

- Mola and SIS are self-recruiting fish species inhabiting rivers, streams, beels, ponds, ditches, tanks and inundated fields. It is commonly found in larger ponds connected to open rich field and ditches in the floodplains.

- The mola and other SIS brood source need to be initially identified. Ideally, fish farming clusters should have good records of mola and SIS source that can be used for collection of matured broodfish. It is also possible to use carp-mola polyculture ponds where domesticated stocks are available as a reliable source of mola and SIS brood fish

WorldFish

Hardening of Mola and SIS brood fish for live transport

- ✓ The process of repeated netting and releasing of mola in ponds is necessary for proper hardening before transportation in live condition.
- ✓ This process need to be repeated at least 2-3 times before transportation using soft seine net with continuous shower manually.
- ✓ Mola and SIS broodfishes should be fed with fine rice bran or powdered commercial feed for 3-5 days before harvesting and transportation.
- ✓ The hardening of mola is done same as the hardening of the carp fry/fingerlings – for which proper feeding and netting is required so that the fish become stronger.

WorldFish

Mola and SIS broodfish collection and transportation from ponds

- ✓Mola and SIS broodfish should be transported in low temperature. Thus, early morning and late evening are most preferable time.
- ✓Feeding must be stopped on the day prior to harvesting and transportaion.
- ✓Soft seine net shoud be used for collection of the broodfish. Large mesh screening net (Grader Net) can be used to separate the mola and SIS broodfish from large fish.
- ✓Collected mola and SIS have to be transfered into a hapa set in the collection pond

WorldFish

Mola and SIS broodfish collection and transportation from ponds

- ✓Continuous shower of water must be given throughout the collection and conditioning process.
- ✓Strong and healthy brood fishes can be identified with good swimming behavior against water current and these are collected for transportation.
- ✓The whole process of netting an d transportation should be done slowly and very carefully to avoid any injury which may result in secondary infection and mortality of the brood fish.

WorldFish

Stocking of Mola-SIS:

Pond: Stock Mola and SIS brood fish @ 50 kg/ha along with IMC.

Paddy-Fish Farming: Stock Mola and SIS brood fish @25 kg/ha along with major and minor carps.

Beel: Stocking of Mola-SIS @ 5 kg/ha in addition to the major carps and already available native fishes in the beel is recommended for optimum production of Mola-SIS from beels.

WorldFish

Harvesting

Partial harvesting of mola:

- ✓ Mola and SIS are continuous breeders and have a long breeding season (March - October).
- ✓ They attain maturity early and have high fecundity. Therefore, partial harvesting of mola and SIS is very essential; otherwise increasing density of mola and SIS will hamper the total mola-SIS production.
- ✓ After 2-3 months of mola and SIS broodfish stocking, partial harvesting can be started at regular intervals of 15-30 days.

WorldFish

Bulk harvesting of mola and SIS:

- ✓ According to production and market demand, bulk harvesting of mola and SIS can be done in two seasons depending on the size of the ponds.
- ✓ Once in November-December (before winter) and another is April-May (before monsoon).
- ✓ Grader net is used for bulk harvesting of mola and SIS live for marketing.
- ✓ Before bulk harvest, market demand and price should be analyzed.

WorldFish

Mola and SIS broodfish harvesting:

- ✓ Mola and SIS can be harvested as brood fish for stocking in another water body during May-June from the carp-mola-SIS production system.

Regular harvesting of mola and SIS for household consumption:

✓ Mola and SIS collected from the carp-mola-SIS production system can be a good supplement to meet the nutritional requirement of the household.

✓ Gill net of 0.60-0.75cm mesh size can be used for regular harvesting of mola and SIS for household consumption.

✓Cast net, lift net etc. can also be used for mola and SIS harvesting.

WorldFish

POLYCULTURE OF CARP WITH FRESH WATER PRAWN

✓ Giant freshwater prawn *Macrobrachium rosenbergii* is commonly known as “SCAMPI”

✓It is highly preferred species for freshwater aquaculture due to its high price, large size, rapid growth, good taste and high export demand.

✓ The inclusion of freshwater prawns in a polyculture system has beneficial effects

✓Freshwater prawns exhibit cannibalism, differential growth and territorial behavior

✓Scope in Assam?

WorldFish

Site selection for pond

✓Proper site selection is an important factor for successful freshwater prawn culture.

✓Culture sites where water temperature remains above 20° C for 6-8 months are suitable.

✓The water pH should be above 7. (alkaline)

✓The pond bottom soil should be clayey-loam or sandy-loam, without organic load and even for proper harvesting

WorldFish

Pond Construction

✓The pond should be preferably rectangular in shape with a size of 0.2-1 ha.

✓Provision of inlet and outlet and water control structures are recommended.

✓ Pond bottom should have suitable slope towards the outlet. Depth of water should be 1.0-1.5 m.

WorldFish

Pond Preparation

✓Apart from the pond preparation activities for polyculture of carps, additionally provision of hide-outs are necessary.

✓Prawns grow by moulting (shedding of outer shell) and are very soft and are easy prey to other prawns, earthen tiles, small tree branches and tyres are provided in the pond as hideouts to save them from predators during moulting.

✓The pond is covered with nylon net or threads to avoid bird predation.

✓Liming is done before stocking the freshwater prawn seeds

WorldFish

Stocking of freshwater prawns

- ✓For monoculture practice
  - ✓stocked @3-4 juveniles/m^2
- ✓ For All Male culture
  - ✓stocked @1-2 juveniles/m^2
- ✓polyculture practice
  - ✓ stocked @ 7500/ha along with 5000-6000/ha Catla, Rohu, Silver carp and Grass carp

WorldFish

Food and feeding

✓Feed prawns twice daily with commercial prawn/shrimp feed (2-3mm pellets) @10% of their biomass which is gradually reduced to 2% towards the end of the culture period.

✓The feed is broadcasted to the pond from the dykes.

✓ Feed can also be given in check trays placed 2-3 m away from the dyke for better feed management.

✓Feed management should be done properly to ensure better growth and environment management.

✓Feeding in Polyculture with carps?

WorldFish

Water quality management

✓The visibility should be maintained in the range of 30-40 cm to avoid water quality deterioration.

✓Provision of aerators (paddle wheel or any other such devices) is recommended especially during the final 2-3 months when the biomass in the pond is high.

✓When the oxygen level in the pond is critically low, the prawns come to the surface along the periphery which indicates the need for taking immediate remedial actions such as water exchange or operation of aerators to avoid mortality of stock.

WorldFish

Prawn harvest

✓Large prawns (>40 g) may be harvested using cast net/seine net of suitable mesh size after four months of culture, which should continue once every 3-4 weeks thereafter for the next 3-4 months.

✓The prawns may be finally harvested after 8 months of culture by complete dewatering and hand picking

✓Domestic Vs Export market?

WorldFish

Polyculture of Carps under APART

- ✓ Physical target 1200 ha.
- ✓ Production target: 2.5-3 ton/ha/yr to 5 – 6 ton/ha/yr.
- ✓ Introduction of genetically improved strains of Jayanti rohu & Amur common carp.
- ✓ Stocking of advanced fingerlings (≥ 10 cm) in grow out ponds.
- ✓ Supplementary formulated feed for carp. – 25% Protein
- ✓ Sustainable increase in fish production from pond aquaculture

WorldFish

Carp- Mola-Small Indigenous Fish Polyculture under APART

✓Increase production of mola and other small indigenous fishes along with carps in ponds, beels and paddy-cum-fish integrated farming.

✓ Mola and other small indigenous fish species to be promoted with carp polyculture.

✓ Benefit of additional production and increased income to the beneficiaries.

✓ Promote of stocking, management and periodic harvesting practices

✓Sustainable production of mola and other small indigenous fishes.

WorldFish

Annual Calendar recommended for APART

Months	Activities
July	Pond Preparation
August	Stocking
September	Growing
October	
November	
December	
January	
February	
March	
April	Harvesting
May	
June	

WorldFish

Polyculture of carps Demonstrated under APART

Sl No.	District	Year							
		2018- 2019		2019-2020		2020-2021		Total	
		Beneficiaries nos	Area (ha)	Beneficiaries nos	Area (ha)	Beneficiaries nos	Area (ha)	Beneficiaries nos	Area (ha)
1	Barpeta	71	21.2	138	40.00	45	15.00	254	76.2
2	Cachar	90	23	218	60.78	135	42.00	443	125.78
3	Darrang	42	12	95	30.00	44	13.55	181	55.55
4	Dhubri	79	19.75	--	--	113	32.00	192	51.75
5	Goalpara	14	4	35	10.65	28	10.00	77	24.65
6	Golaghat	--	--	40	12.96	49	13.85	89	26.81
7	Jorhat	13	3.25	37	16.00	45	14.25	95	33.5
8	Kamrup	98	24.5	215	68.95	--	--	313	93.45
9	Kokrajhar	14	5	48	16.00	18	7.40	80	28.4
10	Lakhimpur	34	11.5	120	30.00	46	15.00	200	56.5
11	Morigaon	44	11	185	51.80	128	33.20	357	96
12	Nagaon	99	26.25	--	--	133	42.66	232	68.91
13	Nalbari	64	18	257	70.00	129	32.60	450	120.6
14	Sonitpur	65	18.7	71	23.00	53	16.00	189	57.7
Total		**727**	**198.15**	**1459**	**430.14**	**966**	**287.51**	**3152**	**915.8**

WorldFish

Polyculture of Mola & SIS along with Carps and Polyculture of Carps with Freshwater Prawn under APART

Sl No.	District	Year					
		2019-2020		2020-2021		Total	
		Beneficiaries nos	Area (ha)	Beneficiaries nos	Area (ha)	Beneficiaries nos	Area (ha)
1	Barpeta	11	4.05	8	2.45	19	6.5
2	Cachar	5	1.25	10	2.50	15	3.75
3	Darrang	5	1.5	12	3.60	17	5.1
4	Goalpara	2	0.75	10	3.50	12	4.25
5	Jorhat	12	5.7	10	3.05	22	8.75
6	Kamrup	1	0.3	--	--	1	0.3
7	Lakhimpur	5	1.25	6	2.00	11	3.25
8	Marigaon	1	0.25	--	--	1	0.25
9	Nagaon	--	--	21	5.88	21	5.88
10	Nalbari	20	5.8	50	12.5	70	18.3
11	Sonitpur	5	2.05	3	0.80	8	2.85
Total		67	22.9	130	36.28	197	59.18

Production of Mola & SIS along with carps under APART

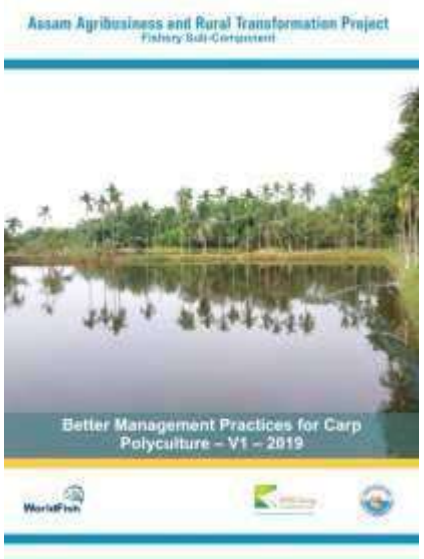
Sl No.	District	Year	
		2020-2021	
		Beneficiaries nos	Area (ha)
1	Goalpara	32	9.85
2	Kamrup	14	4.94
3	Nalbari	27	6.75
Total		73	21.54

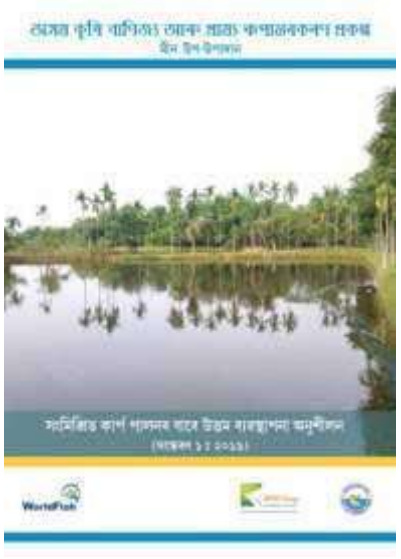
Polyculture of Carps with Freshwater Prawn under APART

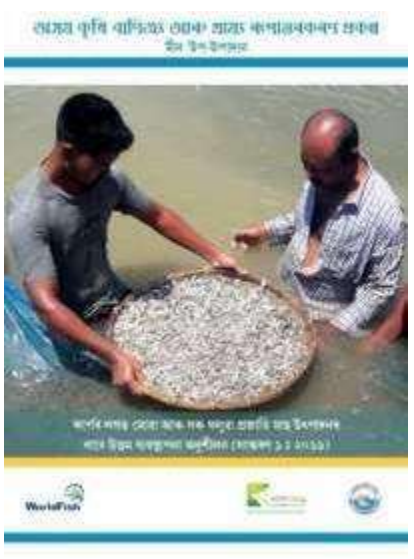
WorldFish

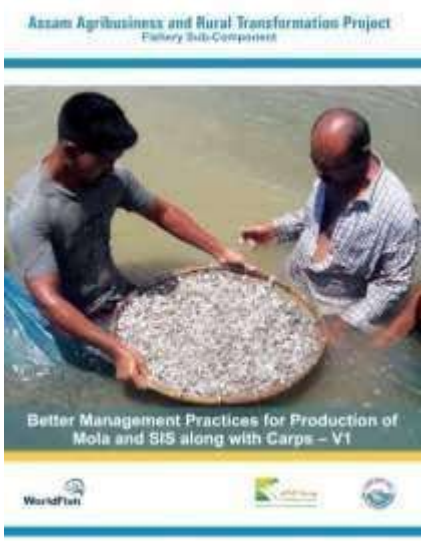
Better management Practices for Carp Polyculture and Production of Mola & SIS along with carps

Better management Practices for Carp Polyculture V1- 2019 and BMP for Polyculture of Mola & SIS along with carps in Assamese





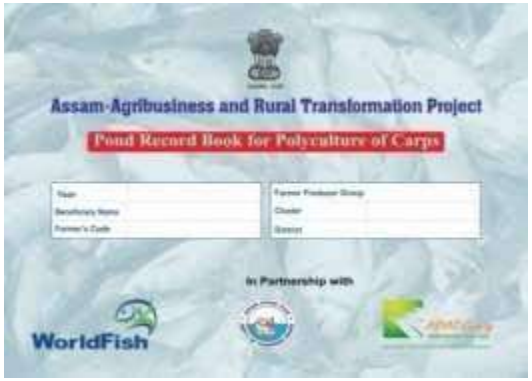




WorldFish

Record book for Polyculture of Carps, Production of Mola & SIS along with Carps and Polyculture of Carps with Freshwater Prawn

Record book both in Assamese version have been developed.



WorldFish

Polyculture of Carps along with Mola and other small indigenous fish species promotion through Social Media

WorldFish

Polyculture of Carps with Freshwater Prawn promotion through Social Media

Thank You

WorldFish

Funded by

ARIAS Society
GOVERNTMENT OF ASSAM
Assam Rural Infrastructure and Agricultural Service Society

In partnership with

GROW MORE FISH
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ASSAM AGRICULTURAL UNIVERSITY
विद्यायां लोकसेवायां च

Annexure- 3
Workshop on Fish Value Chain in Assam

REPORT

WorldFish

Department of Fisheries, Govt. of Assam

WORKSHOP ON FISH VALUE CHAIN IN ASSAM UNDER WORLD BANK FUNDED ASSAM AGRIBUSINESS AND RURAL TRANSFORMATION PROJECT (APART)

A one day workshop on Fish Value Chain in Assam was organized by WorldFish in collaboration with the Assam Rural Infrastructure and Agricultural Services (ARIAS) Society, Govt. of Assam and Department of Fisheries, Govt. of Assam under World Bank funded Assam Agribusiness and Rural Transformation Project (APART) on 7th September, 2021 at Veterinary College, Khanapara, Guwahati.

The one day workshop was organized to discuss the findings of the fish value chain study conducted by WorldFish with various stakeholders including Department of Fisheries, College of fisheries, ARIAS Society and its service providers. The fish value chain study included the fish value chain in Assam, fish feed value chain in Assam, scope of value addition, product development, marketing in the context of improving of aquaculture and beel fisheries on human nutrition with special focus on first 1000 days.

Mr. Nirmallya Mandal, Value Chain Expert, WorldFish, Mr. Kaustav Sovan Mukhapadhyay, Value Chain Expert, WorldFish & Dr. Arun Padiyar, WorldFish Expert served as Resource Persons for the workshop. The workshop was attended by the Dr. Bibekananda Saikia, Dean, College of Veterinary Science, Assam Agricultural University, Khanapara, Dr. B. K. Bhattacharjya, Head of Center, ICAR- CIFRI, Regional Centre, Guwahati, Dr. Binod Kalita, Dean (i/c), College of Fisheries, Assam Agricultural University, Raha, Mr. Jayprakash Medhi, Deputy Director, Department of Fisheries, Dr. Atul Borgohain, Associate Director of Extension Education, College of Veterinary Science, Assam Agricultural University, Khanapara, Dr. R. Suresh, Resident Consultant, WorldFish, Dr. Dhrubajyoti Sharma, Nodal Officer, APART, Directorate of Fisheries, Dr. Sanjay Sarma, Fisheries Coordinator, ARIAS Society, Dr. Sreemant Phukan, MES, APART, Dr. Arpana Barman, SSMS, APART, Dimple Sonari Das, PICS, ARIAS Society, District Fisheries Development Officers, Fisheries Development Officers, Technical Expert Fisheries (TEFs), Representative from several service providers to ARIAS Society under Assam Agribusiness and Rural Transformation Project (APART) and representative from the State Bank of India.








Dr. Dhrubajyoti Sharma, Nodal officer, APART, Directorate of Fisheries, Assam moderated the workshop and felicitated all the dignitaries were with a phulam gamusa. Mr. Jayprakash Medhi, Deputy Director, Department of Fisheries delivered the welcome address and also wonderfully sang the Assam Fisheries Department's theme song which was composed by him. Dr. R. Suresh, Resident Consultant, WorldFish explained the background and objectives of the workshop.

Dr. B. K. Bhattacharjya, Head of Center, ICAR- CIFRI, Regional Center, Guwahati shared his various research experiences and importance of fish value chain actors & other aspects for the sustainable development of fisheries sector in Assam.

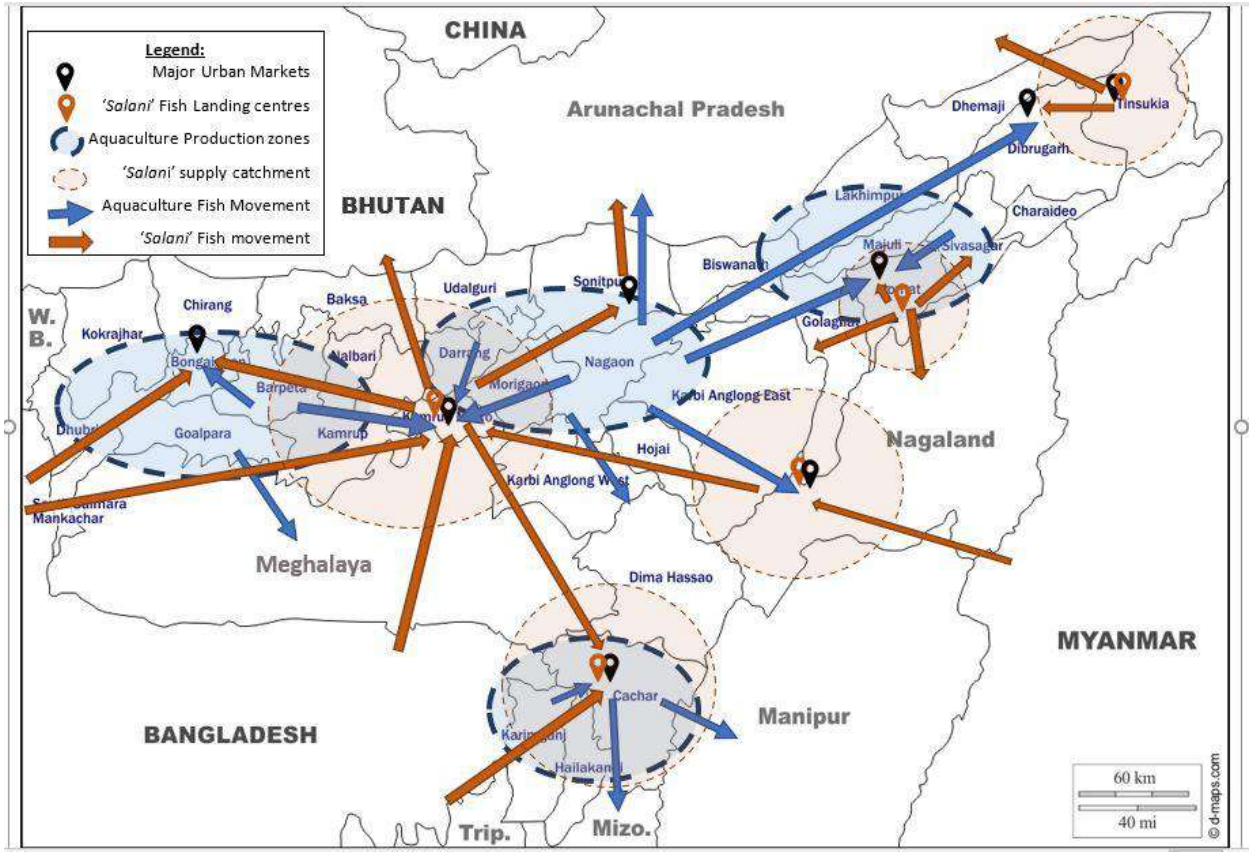
Dr. Binod Kalita, Dean (i/c), College of Fisheries, Assam Agricultural University, Raha appreciated the fish value chain study conducted by WorldFish in Assam and expressed that such kind of workshop will definitely build the capacity of the extension workers and other stake holders who are involved in the fisheries sector.

Dr. Atul Borgohain, Associate Director of Extension Education, College of Veterinary Science, Assam Agricultural University, Khanapara expressed his personal interest and attractions towards the fisheries sector and explained that the fisheries sector can play a major role in changing socio-economic status of farmers in the state.

Dr. Bibekananda Saikia, Dean, College of Veterinary Science, Assam Agricultural University, Khanapara explained the potential role of fisheries sector in Agricultural value chain and livelihood of the rural farmers and declared open the workshop.

In the technical session Mr. Nirmallaya Mandal, Value chain Expert, WorldFish presented the findings of the Fish value chain study conducted in Assam. He described the background and objectives of the fish value chain study in Assam st which were mainly focused on recommendations for improving fish value chains in Assam, fish feed value chain in Assam and a scoping analysis for value addition, product development, marketing in the context of improving impact of aquaculture and beel fisheries on human nutrition with special focus on first 1000 days. He explained about the fish consumer behavior in Assam and mentioned that overall around 87% consumers prefer local fish over *Salani* fish (imported from other states mainly Andhra Pradesh, Haryana, West Bengal etc.). He also described about the importance of fish

based nutrition to pregnant and lactating mothers, adolescent girls and minor children. He explained about the different fish production and consumption pockets in Assam and also explained about the fish movement across the Assam through pictorial presentation mentioned below.



Then he explained about the different species stocked by aquaculture farmers and mentioned that over 90 % farmers stock IMC and exotic carps. He mentioned about the different species fish seed sources and its movement across the state. He explained the fish market system of Assam and mentioned that the different markets totally depended on imported fishes and some of exclusive markets that depend on local produce and also explained the local and live fish movement across Assam state. He explained the profile of aquaculture farmers in Assam and mentioned that average annual investment per bigha is around Rs. 42000 per household while average annual revenue from sale of fish is around Rs. 76000 *i.e.* with an earnings ratio of 1.8. He explained about the women participation in local fish value chain and mentioned that 57% households have reported women engagement in pond cleaning & around 48% households have

women engagement in feed application and women engagement in harvesting, grading, packing, transport and sales is negligible. He also explained about the input application in farms by the farmers and mentioned that around 98% farmers use Mustard Oil Cake (MOC) as a major farm made feed apart from that 73% and 77% farmers reported usage of Rice Bran and Broken rice respectively as supplementary feed. He also explained about the major issues and constraints in fish feed value chain and explained the estimated demand of fish feed in Assam. At the end of his presentation he suggested some general recommendations for improvement of fish value chain in Assam which are listed below.

- Strengthening of CFCs and FPOs to spear head Fishery interventions in Assam
  - ✓ Provision of Key services: Finance, Seeds, Input supply, Feed, Marketing, Logistics, and Value addition
  - ✓ Infrastructure development at CFC level
  - ✓ Build network and linkages: Technical support, Extension, Farmer connect, Market and inter CFC connect
  - ✓ Institution Development
- Supporting various enterprises and service providers in the value chain in terms of technical knowhow, finance, capacity building etc.
- Support to Hatcheries in arranging good quality brood fish, inputs, infrastructure development including nursery ponds.
- Promote interconnectivity of fresh fish markets, facilitate easy and cost effective transport through inter department liaison.
- Promote ‘clean fish’ to ensure sanitation and hygiene across the entire value chain.
- Promote more involvement of women in all major functions of the value chain
- Prioritization of Enterprises for Fish value chain development in Assam

High	Medium	Low
❖ Financing ❖ Feed manufacturing locally ❖ Production of fish seed ❖ Purchase at farm gate ❖ Ice supply in villages & markets	❖ Retailing other inputs like Medicines, Lime, MOC, DORB etc. ❖ Supply of Synthetic fish hormone ❖ Supply branded feed ❖ Trading of Fish Seed ❖ Transportation of fish seed ❖ Water supply for live fish transport ❖ Transport of live fish ❖ Fish trading at state level markets ❖ Fish Retailing through permanent shops ❖ Supply of Oxygen for Hatcheries ❖ Small scale production of Value added Fish items	❖ Earthwork / ground boring service ❖ Supply of Water pumps and pipes ❖ Maintenance of pumps, motors etc. ❖ Supply Net and equipment ❖ Sales facilitation in markets (Commission Agents) ❖ Fish Retailing through temporary shops ❖ Fish Retailing on vehicles ❖ Production of Dry fish ❖ Retailing of Dry Fish ❖ Large scale production of Value added Fish items ❖ General Transport

At the end of the meeting, Dr. R Suresh, Resident Consultant, WorldFish delivered the vote of thanks.

Agenda for workshop on Fish Value Chain in Assam on 7/09/2021 at College of Veterinary Science, Assam Agricultural University, Khanapara under Assam Agribusiness and Rural Transformation Project (APART)

Date: 07/09/2021
Venue: College of Veterinary Science, AAU, Khanapara

Time	**Topic**	**Resource Person**
9:30 – 10:00 am	Registration	
10:00 – 10:10 am	Welcome Address	Shri N. K. Debnath, ACS, Director of Fisheries, Assam
10:10 – 10:20 am	Objective of the workshop	Dr. R. Suresh, Resident Consultant, WorldFish
10:20 -10:30 am	Speech by Dr. B.K. Bhattacharjya, Principal Scientist, Head ICAR-CIFRI Regional Center Guwahati	
10:30 – 10:40 am	Speech by Dr. Binod Kalita, Dean (i/c), College of Fisheries, AAU, Raha	
10:40 – 10:50 am	Speech by Dr. Bibekananda Saikia, Dean, College of Veterinary Science, Khanapara & Dr. Atul Borgohain, Associate Director of Extension Education	
10:50 – 11:00 am	Presidential address from Shri Binod Seshan, IAS, SPD, ARIAS Society, Govt. of Assam	
11:00 – 11:30 am	Tea Break	
11:30 – 1:30 pm	Presentation on the findings of Fish value chain in Assam	Mr. Nirmallya Mandal and Dr. Arun Padiyar, WorldFish Expert
1:30 – 2:30 pm	Discussion and Feedback	
2:30 – 2:35 pm	Vote of thanks	Dr. R. Suresh, Resident Consultant, WorldFish

LIST OF PARTICIPANTS:

Attendance sheet for the workshop on Fish value chain and Quality Carp seed production in Assam under Assam Agribusiness and Rural Transformation Project (APART) Fishery Sub- Component.

Date: 07-09-2021
Venue: Khanapara, Guwahati.

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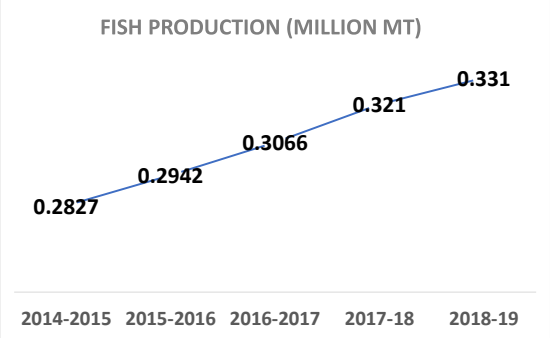
PRESENTATION BY DR. NIRMALYA MANDAL

Strengthening Fish Value chains under APART - 2020

WorldFish

Background



- Population of Assam in 2020 is around 35 Million (UIDAI) with 86% Rural and 14% Urban population. The contribution of fishery sector to GSDP is Rs. 49885 Million (2016-17) which is around 4.08%.
- Department of Fishery reports an increase of more than 10% in production of fish within 2 years. 2018-19 production is reported to be 0.331 Million MT.
- APART had already conducted an internal study on Fishery Value Chain in the state. Worldfish is providing technical support to ARIAS on fisheries under the World Bank funded APART project. This study was commissioned by Worldfish to develop further understanding of the fishery value chain (after APART's VCDP study) in Assam.
- Under APART, 44 production clusters in 44 development blocks have been identified for project intervention. 21 FPOs (11 new and 10 old) will cover 13 CSCs.

Study objectives

- Part 1 of the study provide recommendations for improving fish value chains in Assam.
- Part 2 of the study provide in depth analysis of fish feed value chain in Assam.
- Part 3 of the study provide a scoping analysis for value addition, product development, marketing in the context of improving impact of aquaculture and *beel* fisheries on human nutrition (with special focus on first 1000 days).

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Fish Consumers of Assam

Fish Demand Estimation

Particulars	Rural	Urban	Total
Fish eating population of Assam (NSSO)	80.6%	75%	
Per capita fish consumption (Kg per year)	16.52	15.84	
Population of Assam (2020) –(Million)	30.6	50	35.6
Market demand of fish (Million MTs)	0.506	0.079	0.585

Consumer Behaviour

Top 5 consumed species (Ranked)

1. Rohu
2. Catla
3. Grass Carp
4. Common Carp
5. Mrigel

Top 3 types of preparations (ranked)

1. Fresh Fish Fry / Baked
2. Fresh Fish Curry / Gravy
3. Fresh fish light stew / soup

Consumer Behaviour

FISH PURCHASE	HIGH VALUE (MORE THAN RS 700 /KG)		LARGE SIZE (MORE THAN 2 KG EACH)	
	Part	Whole	Part	Whole
Rural	44%	56%	42%	58%
Urban	67%	33%	58%	42%

- In Urban Assam 67% consumers purchase high value fish in parts and 58% purchase large size fish in parts
- Average share of Small fish (less than 250 gms each) is around 40% of the total fish consumption.
- 2/3rd consumers do not consume fish on specific days of the week while 1/3rd have no taboo.

Salani and Local fish consumption

- Overall around 87% consumers prefer local fish over Salani fish. Among urban consumers, 75% prefer local over Salani fish.
- 65% of fish consumed is 'Local'.
- "80% of consumers do not know how to judge a fish during purchase" – Fish Seller

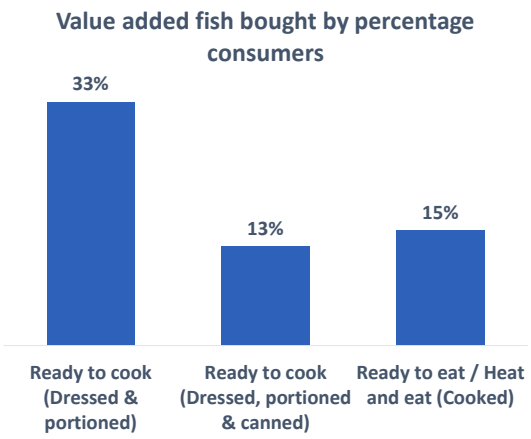
Method employed to ascertain local fish	Consumers depending exclusively on single method	Consumers depending upon multiple methods
Retailer's info	11%	63%
Physical appearance	20%	81%
Physical inspection	6%	50%
Variety	0%	20%
Overall	37%	63%

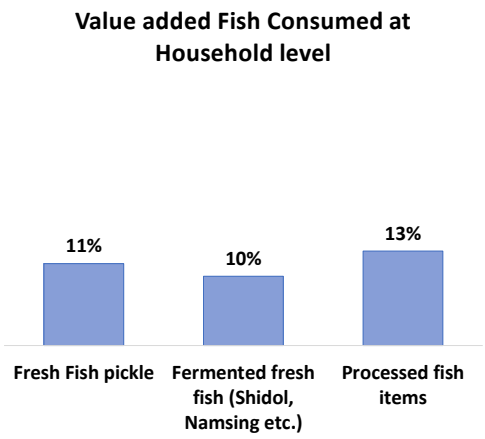
Fish based Nutrition

Food Items	Average days in a week consumed by Household
Egg	2.3
Fish	2.3
Flesh Meat	2.1
Organ Meat	1.4
Milk	4.5

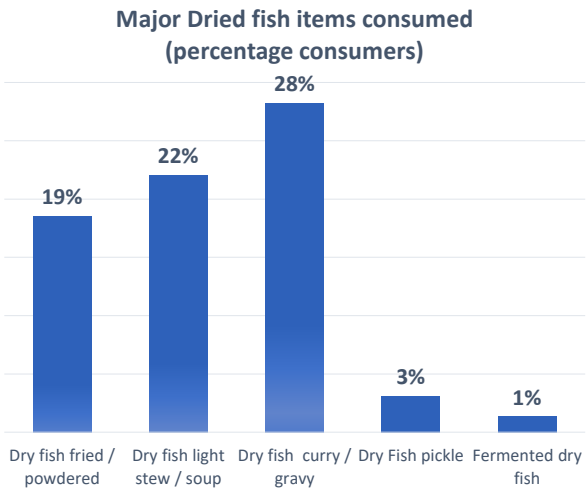
- Pregnant and Nursing mothers
  - Preferred varieties - Magur, Singhi, Tangra, Goroi
  - Consumption Frequency – Approximately 85% consumed fish at least twice weekly
- Adolescent girls
  - Preferred varieties - Tangra, Magur, Singhi, Ayre, Common carp, Rohu
  - Consumption Frequency – Over 75% consumed fish at least twice weekly
- Children
  - Age at which fish is introduced - 16.5 months (0.5-1 year: 9%, 1-2 years: 70%, >2 years: 21%)
  - Preferred dishes - Curry Gravy (92%), Dry fish items (19%), Light stew /Soup (15%)
  - Consumption at least once weekly
    - 0.5 -1 year - 85%
    - 1-3 years – 95%
    - Above 3 years – 98%

Value added Fish Consumption





Dry Fish



- 62% consumers buy Dry fish on a regular basis
- Dried fish production is largely limited to Capture fisheries since it is more of a compulsion than choice to dry fish.
- Jagiroad trades around 18000 MT of dried fish annually with less than 5% sourced from Assam.

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Fish Value Chain in Assam

Evolution of the Fishery Sector in Assam

Fish source was primarily from natural rivers and beels

- Aquaculture was non-commercial and more of domestic activity
- Maintenance of ecological balance between population and consumption

Major Fish source from other states like Andhra Pradesh and West Bengal

- The natural sources of fish were insufficient for the rising population
- Development of Market networks across the state to support regular inflow of fish from other states

Aquaculture as Commercial Activity

- Aquaculture developing fast as a major commercial activity with new local fish production clusters being developed
- Government impetus on increasing local fish production

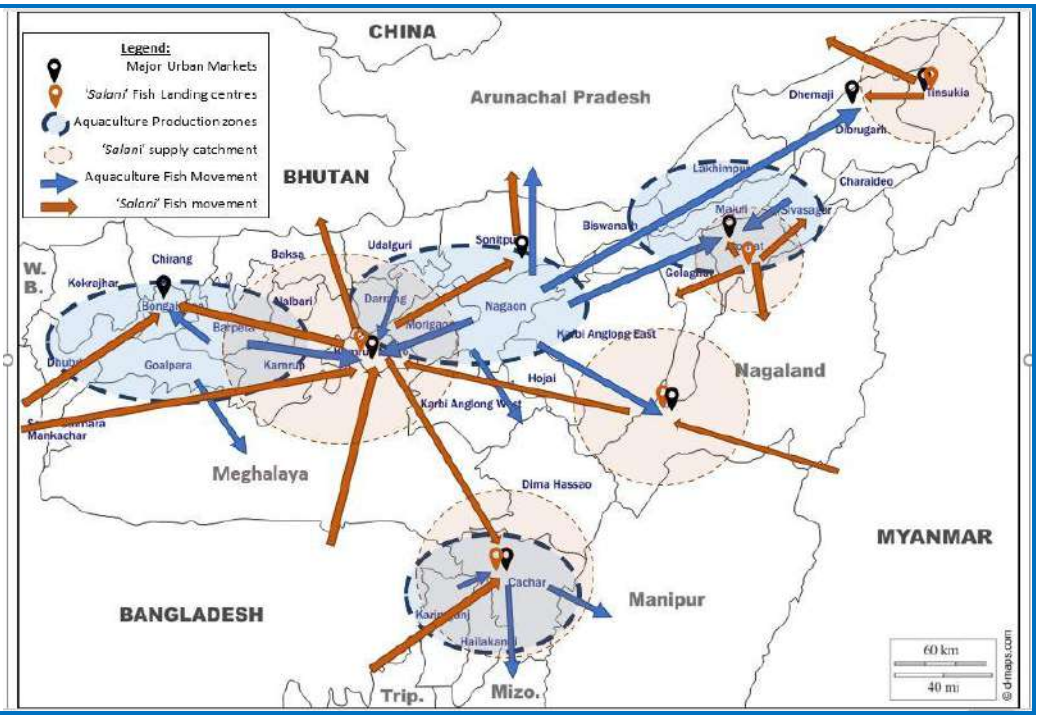
Production Zones across Assam

District	Number of Identified markets	District	Number of Identified markets
Western Zone		**Eastern Zone**	
Kamrup	36	Lakhimpur	10
Nalbari	14	Dhemaji	5
Barpeta	16	Sivasagar	8
Dhubri	16	Jorhat	5
Goalpara	15	Dibrugarh	10
Bongaigaon	7	Tinsukia	9
Kokrajhar	8		
Central Zone		**Southern Zone**	
Golaghat	9	Cachar	5
Nagaon	31	Hailakandi	5
Morigaon	5	Karimganj	6
Darrang	20	N.C. Hills	5
Sonitpur	13		
Karbi-Anglong	5		

Production and Consumption pockets

Production Zones	West	Central	East	South
Major production Districts	Dhubri, Bongaingaon, Goalpara, Nalbari Barpeta, Kamrup (R)	Darrang, Morigaon, Nagaon, Sonitpur, Golaghat,	Jorhat, Lakhimpur	Cachar, Karimganj
Number of major local Markets	112	74	56	21
Destination consumption markets	Guwahati, Bongaingaon, Kokrajhar	Guwahati, Karbi Anglong, Biswanath Chariali, Arunachal Pradesh	Nagaland, Jorhat, Numaligarh	Silchar
Population Spread	36%	30%	21%	12%

Fish Movement across Assam

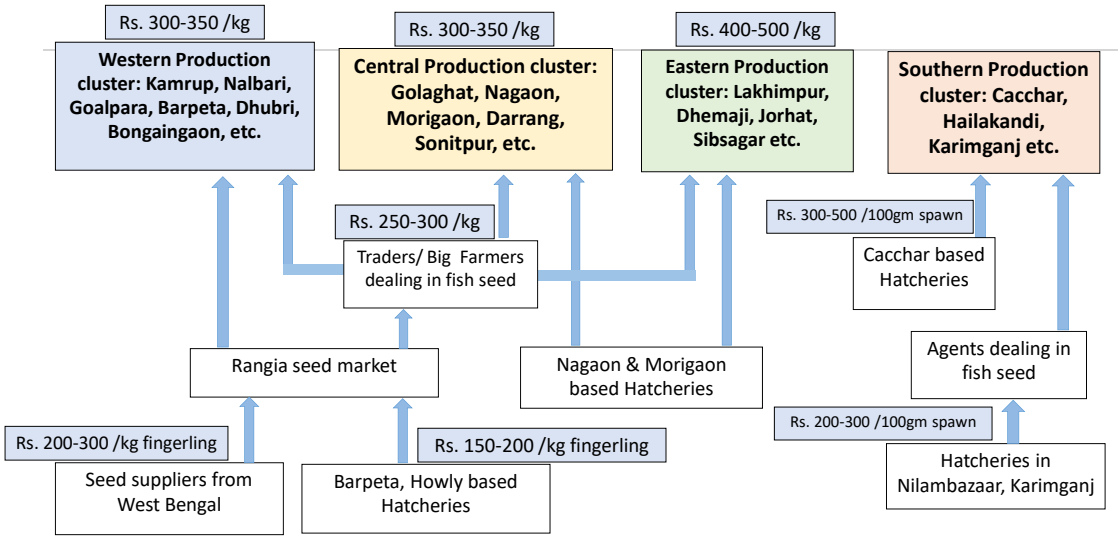


Species Stocked by Aquaculture farmers

- The focus of farmers on IMC and other carps is evident since farmers are more conversant with the management of these species and also since farmers find stability in terms of market demand and regular returns for these species.
- Fish farmers largely depend upon peer opinion for deciding on the fish seed (86%). A third of the farmers also depend on rapport with the hatchery while around half of them depend on recommendations of Non-Government Agencies.

Species	Percentage farmers stocking
Rohu, Catla, Grass Carp, Silver Carp, Common Carp	98-100
Mrigel	96
Bata, Big head	76-77
Kalbaus	17
Roopchanda, Tilapia	9
Other	Upto 1

Fish Seed Movement



Source of Fish Seed for various types of Fish (%)

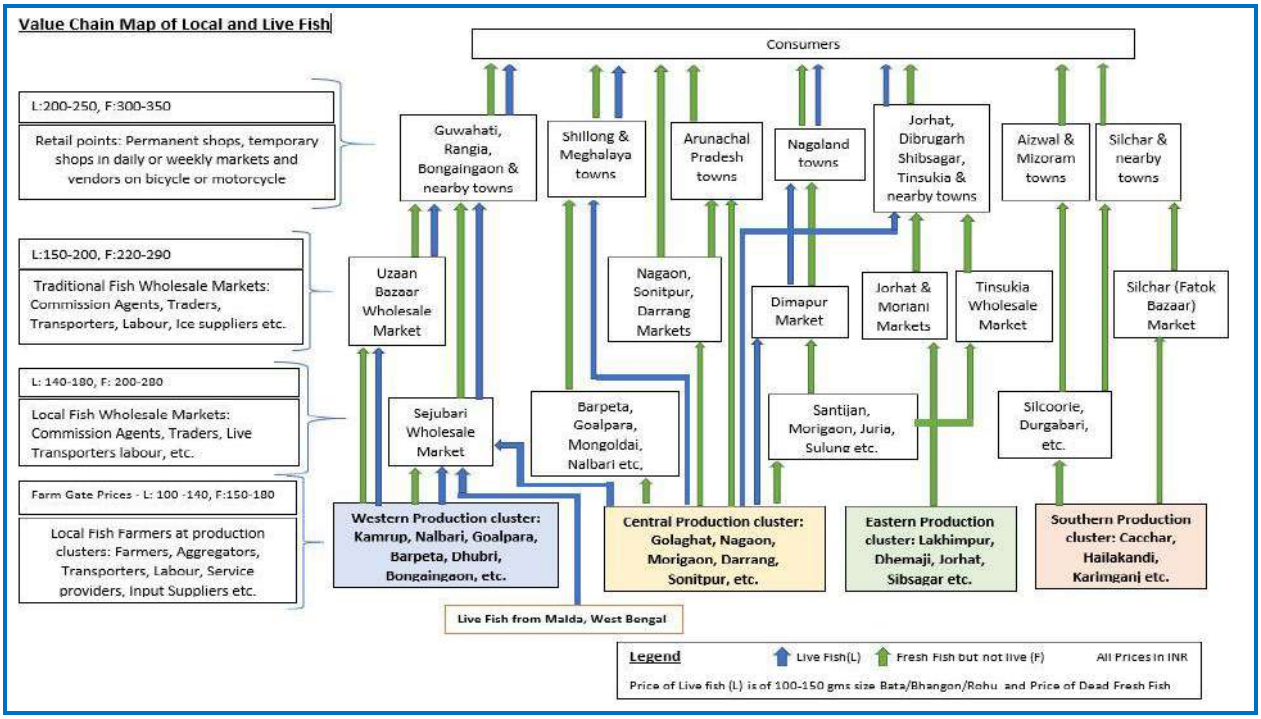
- Some aquaculture farmers buy Seed in large quantities or keep stock of fish seed to provide the same to peer farmers later.
- Local fish seed sellers and peer farmers are the major sources of fish seed for aquaculture. More than 80% farmers procure fish seeds from sources within 20 kms.
- Farmers may be preferring nearby sources to reduce transaction costs and better ability to enforce quality related accountability.

Sources of Fish Seed	IMC	Other Carps	Bata	Kalbaus	Big Head
Local Hatchery	16	13	50	4	5
Salani Seed Suppliers	17	14	77	5	18
Local Seed Supplier	32	28	75	11	22
NGO/Other Organization	1	1	0	0	0
Peer Farmer	33	43	66	31	55

Farmers interested to pay premium on good quality Fish seed (%)

- Less than 2% fish farmers consider the seed quality they are using to be poor or very poor while over 98% farmers across all species consider the fish seed quality as very good or good. This signifies a major difference in perception with that of enablers.
- Majority of the fish farmers are interested to pay a premium of up to 15% for good quality seeds of different fish species. This indicates that any further improvement in fish species may have to be undertaken within a cost bracket of 15% from its existing rates.

Premium on Price paid	Rohu	Catla	Mrigal	G. Carp	S. Carp	C. Carp	Bata	Kalbaus	Big Head
Up to 10%	34	35	43	27	50	41	59	32	47
10-15%	55	46	33	34	34	36	26	46	44
15-20%	8	14	19	35	14	16	13	11	8
>20%	2	4	4	4	1	7	2	11	1



Fish Market Systems

New age fish wholesale markets	Traditional fish wholesale markets
Example: Sulung, Santijan, Borkhola (Durgabari), Silcoorie etc.	Example: Nagaon, Silchar, Jorhat, Mariani, Tinsukia etc.
• Located near the production clusters and away from major consumption pockets	• Located mostly in District headquarters and nearer to consumption pockets
• Infrastructure is mostly basic. Most of these markets operate on leased or private land driven by entrepreneurs from the fisher's community. • Some new markets are being created by the government under various schemes. The market locations are spread across urban centers as well as production clusters.	• Infrastructure is mostly old and located on Government or Municipality land under designated urban marketplace. Development of these markets are difficult due to paucity of space in the nearby areas.

Fish Market Systems

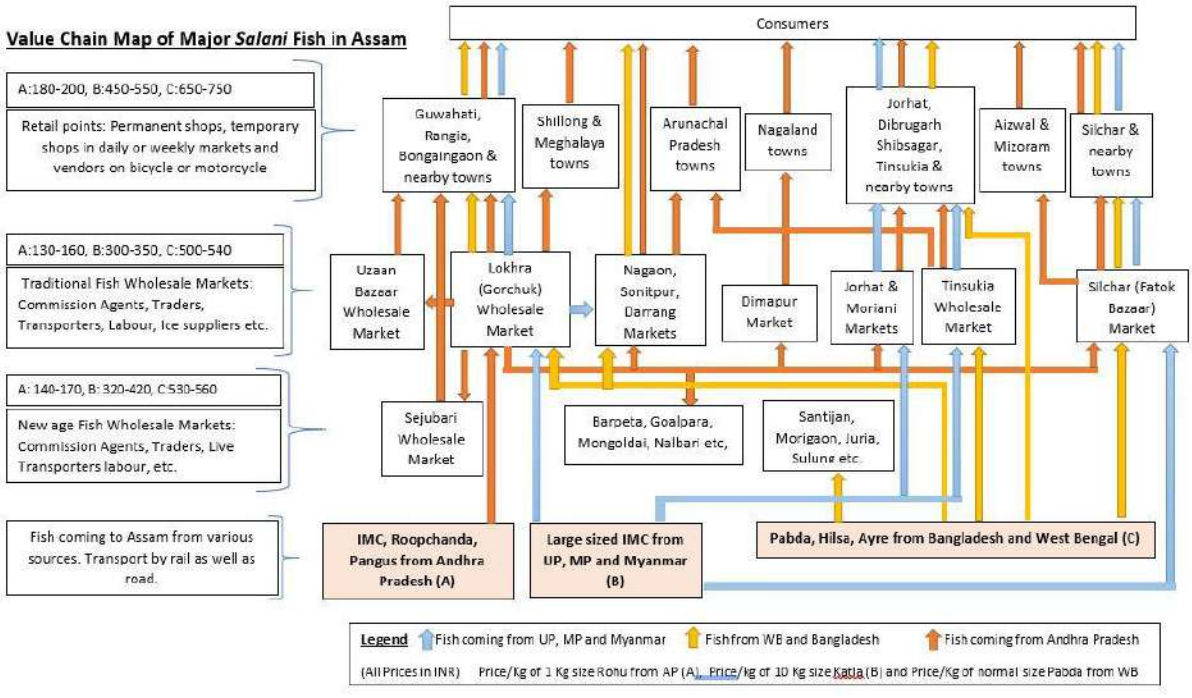
New age fish wholesale markets	Traditional fish wholesale markets
• Markets deal in local fish more and focused around the ease of farmers to sell their produce.	• Markets deal in Salani fish more and is focused around ease of retailers buying the fish and carrying to their retail points. Retail markets are closer to the traditional markets
• Commission rates are lesser than traditional markets to woo more market players	• Commission rates are higher than new age wholesale markets and operations costs are generally higher than the new age markets.
• Business services like ice suppliers, transport, storage, packing, skilled labour, etc. are still being developed adequately.	• The business ecosystem across support service for buyers as well as sellers is well developed.
• Quantity and variety arrivals lack predictability and information exchange is rudimentary . No inter market transactions reported.	• Quantity and variety of fish arrivals are well planned and communicated among market players. There are intermarket transactions.
• Operation hours are limited and not very well suited for female buyers	• Operation hours are longer durations and for at least six days a week.

A snapshot of different Markets

Name of Market	Avg. Number of Commission Agents	Daily turnover of fish in Quintals	Average percentage of local fish	Fish supplied to other states
Gorchuk, Guwahati	80	1000-1200	0	Meghalaya (10%)
Sejubari Guwahati	20	250-400	80	Meghalaya (5%)
Uzaan bazaar, Guwahati	16	80-100	50	-
Santijan, Nagaon	15	150-170	80	Nagaland (10%), Arunachal Pradesh (10%)
Sulung, Nagaon	25	350-450	60	Nagaland (10%), Arunachal Pradesh (10%)
Nagaon	30	200-300	20	-
Jorhat	24	300-400	10	-
Mariani	14	60-80	5	Nagaland (20%)
Tinsukia	43	400-450	5	Arunachal Pradesh (20%)
Silchar	20	160-200	5	Meghalaya (20%) Mizoram (10%)
Silcoorie	18	80-100	70	Mizoram (50%)
Durgabari	10	10-12	80	-

Salani Fish Categories

Category	Channel	Avg. Size of fish	Approx. Proportion (%) by weight
IMC, Pangus, RoopChanda, from Andhra Pradesh	Road	1.5 – 3 kgs	80
Pabda, Hilsa, Shrimps Khaira from West Bengal	Rail	400-500 gms Pabda	10
Large sized Rohu and Catla from Kanpur, Telengana, MP and Gujarat.	Rail	8-15 kgs	5
Large sized Catla from Myanmar via Manipur, Dimapur and Jiribam	Road	8-15 kgs	1
Pabda, Ayre and seasonal Hilsa from Bangladesh via Tripura	Road	250-300 gms Pabda	1
Chital, Wallago, Pontius from Andhra Pradesh	Road	3-5 kgs Chital	1
Live Bhangon, IMC and Bata from West Bengal	Road	100 -200 gms Bata, 400-500 gms IMC	2



Profile of Aquaculture farmer

- Average area under aquaculture is 5.9 bigha (~ 2 acres) per household. Overall, a third of the water bodies used for aquaculture are seasonal in nature.
- An average of 2-3 persons are engaged in aquaculture in every household.
- Average annual investment per bigha is around Rs. 42000 per household while average annual revenue from sale of fish is around Rs. 76000 i.e. an earning ratio of 1.8.
- Around 95% households have fishing nets and pump sets. 25% Households have transport vehicle while 45% have tractor or power tiller.
- Over 95% is into IMC and other carp Polyculture
- Over 80% of farmer practice multiple stocking.
- Over 80% farmers consider Diseases as a prominent hazard affecting their aquaculture while 60% suffer from Flood Hazard and 52% suffer from Pest and Prey.

Usage of Inputs other than feed

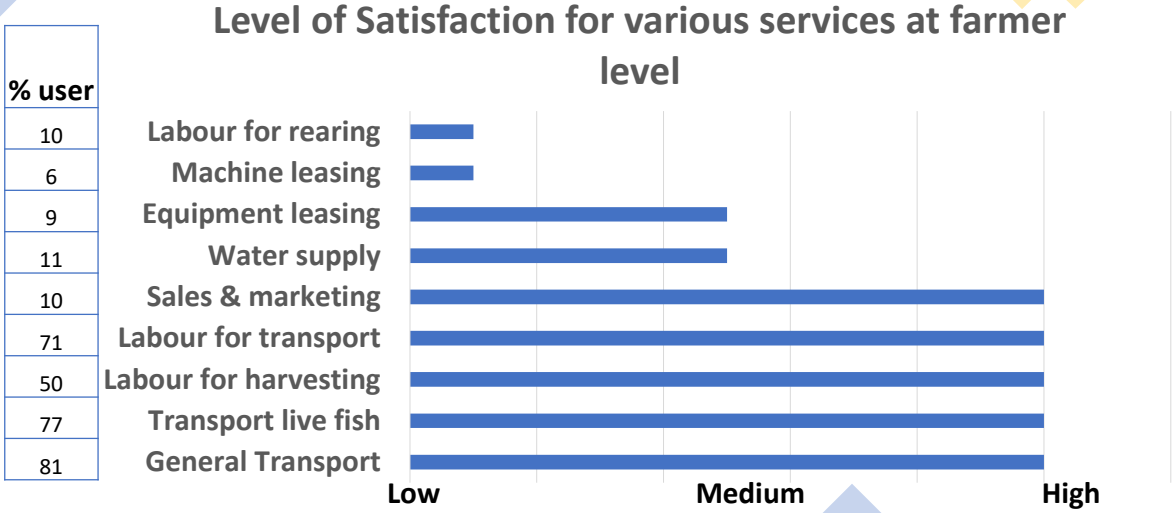
- Around 97% of the respondent farmers had stocked their respective ponds/tanks within the last 12 months.
- Usage of important inputs like Lime, Manure, Mineral Mixture etc. is low among aquaculture farmers.
- Majority of the used inputs are sourced from nearby areas

Input	Percentage farmers buying input
Cow Dung /Manure	20
Lime	14
Zeolite	3
Urea	96
DAP	71
Super Phosphate	57
Detergent /Soap	1
Oil	0
Mineral Mixture / Vitamin Mix	40
Medicines	84

Sale of fish by aquaculture farmers

- Farmers earn around 85% of their revenue from sizes between 50 grams and 1 Kg.
- Majority of farmers do not have a proper production planning.
- Though most farmers undertake sale of live fish, overall proportion of live sale to total sales is less than 25%.

Size of Fish	Percentage of planned sale	Percentage of Farmers sale actual	Percentage of revenue	Percentage farmers selling Live	Percentage of weight sold live
Spawn	-	4	23	-	-
Fry (till 2 gms)	4	6	19	-	-
Fingerling (20 to 25 gms)	19	33	17	-	-
50 to 100 gms	77	87	16	86	17
100 to 200 gms	81	92	19	87	20
200 to 500 gms	69	96	24	96	24
500 gms – 1 kg	67	96	26	98	26
More than 1 Kg	66	92	19	95	15



Women's participation in local fish value chain

- 57% households have reported women engagement in pond cleaning.
- 48% households have women engagement in feed application.
- 1/4th households have women decision makers and record keepers.
- Women engagement in harvesting, grading, packing, transport and sales is negligible.
  - Trade timings ill suited for women due to security issues and domestic responsibilities
  - Women not considered suitable for heavy labour like lifting bulk packs
  - Socio-cultural barriers due to large scale engagement of specific communities in fishery activities.
  - Current status of market infrastructure is not designed to promote women participation

Major issues and Constraints highlighted by Farmers

- **Stocking of fish**
  - High seed costs - 84%
  - High transportation cost - 66%
  - Availability of labour - 40%
- **Inputs**
  - High cost of inputs – 74%
  - High transportation cost - 71%
  - Labour issues - 61%.
  - Lack of Storage space - 28%
- **Marketing**
  - Market information – 53%
  - Labour issues – 49%
  - Difficult Road infrastructure – 47%
  - Transport issues - 40%

Production related issues and Constraints (Other stakeholders)

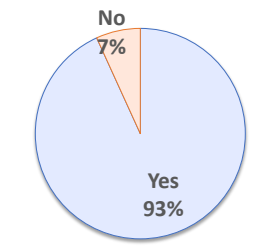
- Quality of brooder fish
  - Poor growth during rearing
- Inadequate infrastructure in private hatcheries
  - Arbitrary mix of seeds.
- Availability, quality & price of synthetic hormones
  - No local source
- Low insistence on quality of seeds by farmers
  - Fish reared up to 1 kg mostly
- Arbitrary use of inputs and feed by farmers
  - Contextualized PoPs and technical support not widely available
  - Low awareness of technical parameters (pH, diseases, DO_2 etc.)
- Unavailability of robust enterprises in local fish value chain.
  - Private initiative driven enterprise formation at nascent stage

Major issues and Constraints (Marketing)

- Unlinked and uncoordinated 'local' fish markets.
  - Glut in one market while shortage in another.
- Scope of improvement in the transport of live fish
- Difficult road conditions and high cost of transportation
  - Added cost and time due to extortion: Additional expense of 60% over transportation charges for selling fish in Dimapur by Nagaon farmers
- New age markets operate on limited land and infrastructure
  - Pace of market development by govt. needs to be faster.
- Fish handling, storage and display is largely unhygienic across most major markets.
  - Low awareness and intent among traders and labourers
  - Regulatory oversight is inadequate
- Women engagement in market functions is minimal.
  - Market timings, amneties and systems not gender supportive.

Analysis of Fish Feed Value Chain

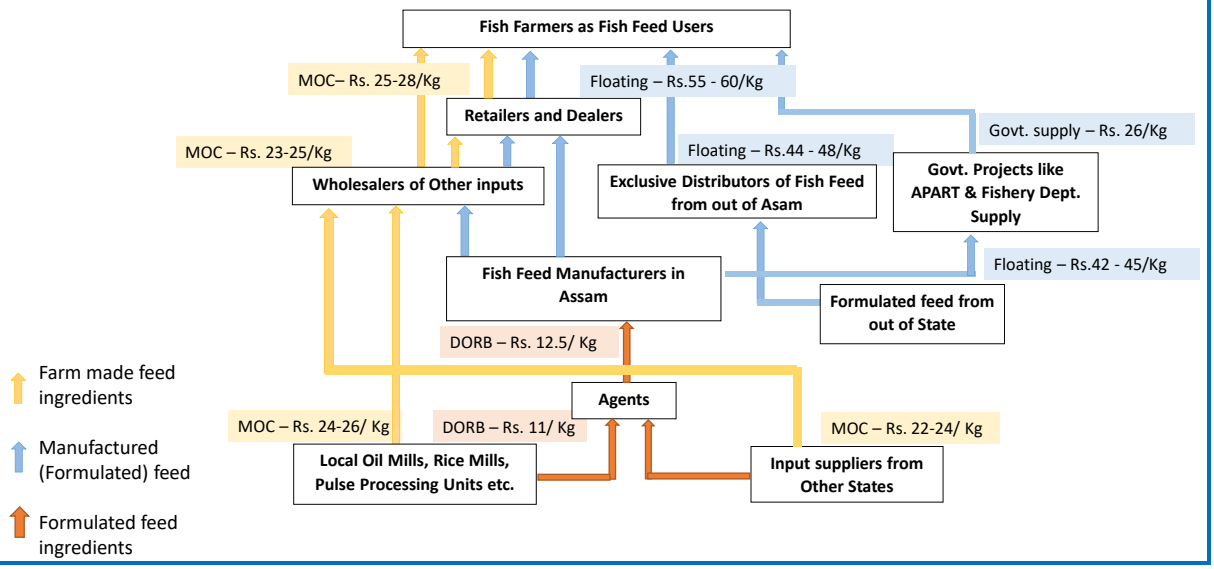
Feed Usage by Aquaculture Farmers



Major Farm Made feed	Percentage Farmers use
Mustard Oil Cake	98
Rice Bran	77
Rice Polish	20
Broken Rice	73
Manufactured Feed	**88**

- Average fish feed bought at a time is around 400 kgs. Only 10 farmers buy less than 200 Kgs feed at a time. Average cost of feed over the year is around Rs 27000.
- 60% of the farmers purchase feed on cash while around 40% purchase feed on both cash and credit. Only credit sales of feed is negligible.

Movement of Fish Feed



Farm Made Feed

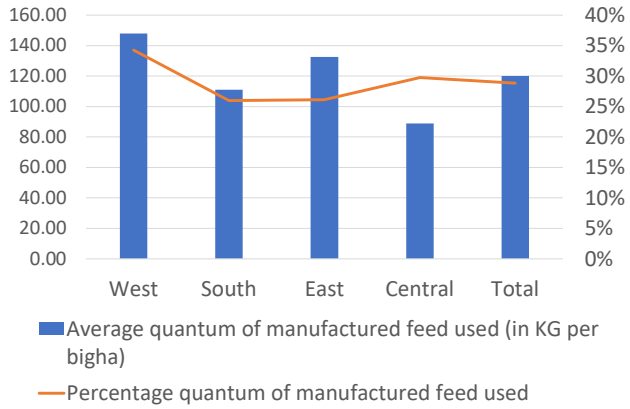
- Around 98% farmers use Mustard Oil Cake (MOC) as a major farm made feed. MOC's contribution to cost of feed is also maximum.
- 73% and 77% farmers reported usage of Rice Bran and Broken rice respectively.
- A smaller 20% farmers reported usage of Rice polish.
- Traditional farm made item prepared in Eastern cluster

Ingredient for Fish feed	Source of product
MOC and DMOC	Rajasthan, Bihar (Gulab bagh) and West Bengal based oil mills along with local oil mills in Darrang, Morigaon, Kamrup etc. areas.
Rice Polish, Rice bran and DORB	From within Assam, West Bengal
Maize	Purnea and Gulab Bagh in Bihar, Siliguri in West Bengal
Soybean	Rajasthan, Madhya Pradesh
Wheat Polish, Straw	Chopra, Uttar Dinajpur, West Bengal

Local Fish Feed Mill

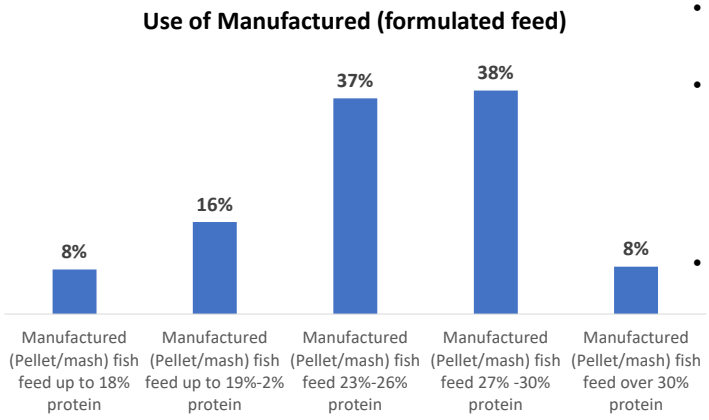
Category of local fish feed mill	Installed Capacity	Raw Materials Used	Average investment (Rs)	Average price of feed at factory gate	Marketing Channels
Small	~5 quintals per day	3-4 major raw materials including DMOC, DORB, Rice polish, Maize, wheat refuse powder	1.5-2 Million	Rs. 26-28	Direct sales at Production locations
Medium	~1 tons per hour	All of the above and additionally fish meal/ bone meal /blood meal for specialized products	20 Million	Rs. 21-23	Wholesalers and retailer network
Large	>10 tons per hour	DMOC, DORB, Maize, vegetarian protein sources like Soybean dust etc.	70-80 Million	Rs.20-21	Wholesaler and retailer network

Manufactured or Formulated feed



- Around 88% aquaculture farmers have reported using manufactured feed.
- The share of manufactured feed to the total feed use is around 29% with an average of 120 kgs per *Bigha* (a third of an acre) application per year.
- Fast growing State level market of manufactured feed to the tune of 12000 MT in 2019-20

Manufactured or Formulated feed



- No fish feed miller in the state was found to be manufacturing floating feed
- Around 95% of the aquaculture farmers reported usage of floating feed among formulated feed. 33% and 46% farmers also reported using sinking pellets and mash feed, respectively.
- Use of manufactured feed among aquaculture farmers is more in the product segments with protein percentage ranging from 23%-26% and 27%-30% protein.

Manufactured or Formulated feed

Cost per Acre of manufactured or formulated feed

Proposed as per a leading Fish Feed manufacturing Company	As per a progressive farmer in Nagaon- Morigaon production cluster	As per average respondent aquaculture farmers
Rs. 225,000	Rs. 30,500	Rs.13,000

- For every kg of manufactured feed used by the farmer, 3.5 kgs of farm made fish feed are used.
- For every rupee spent on manufactured feed, Re.1.66 is spent on farm made fish feed.

Major issues and Constraints of Fish Feed Value Chain

Issues identified by farmers regarding use of formulated feed

- High cost of feed - 94%
- High transportation cost - 44%
- Labour Issues - 33%
- Storage issues - 29%
- No other issues significantly reported by farmer

Issues identified by other stakeholders

- Lack of knowledge and skill among farmers regarding benefits and use of fish feed.
- Low investment capacity among farmers
- Difficult road infrastructure and limited transportation facility
- Inconsistency related to quality, price and supply of raw materials for manufacturers.
- Unavailability of protein rich raw materials at reasonable prices.

Fish Feed Demand Estimation

Particulars	Quantity of manufactured feed currently used per hectare in MT	Available Area for commercial aquaculture in Assam (Ha)	Total feed required as per present demand (MT)	Feed required if demand grows by 20% (MT)	Feed demand if demand grows by 50% (MT)
Assuming 100% utilization of area for commercial aquaculture	0.9	73065	66000	79200	99000
Assuming 80% utilization of area for commercial aquaculture	0.9	58500	53000	63600	79500
Assuming 50% utilization of area for commercial aquaculture	0.9	36500	33000	39600	49500
Assuming 20% utilization of area for commercial aquaculture	0.9	14600	13000	15600	79200

Feasibility Analysis of Fish feed mill using local ingredients

Produce	Area (Ha)	Production (MT) in Assam (2017-18)	Output ratio (%)	Ingredients for fish feed using output ratio	Protein % in each ingredient	Total Quantity of Ingredients (MT)
Maize	31537	98783	90	Grounded Maize	9	88,904.7
Paddy	2433711	5283713	3.6	DORB	13	190,213.7
			15	Broken Rice	2.7	792,557
Wheat	12.2 Lakh MT wheat processed in Assam (2016-17)		20	Wheat Bran	16	244,000
			2	Refuse	0	24,400
Total Pulses		115760	5	Husk and Broken grains	25	5,788
Rape & Mustard	290285	185564	58	De oiled MOC	35	107,627.1

- Targeted protein content - 27%
- DMOC – 65%
- 7% each of the other ingredients of Maize, DORB, Broken rice, wheat bran and Husk and broken grains of pulses, respectively.

Feasibility Analysis of Fish feed mill using local ingredients

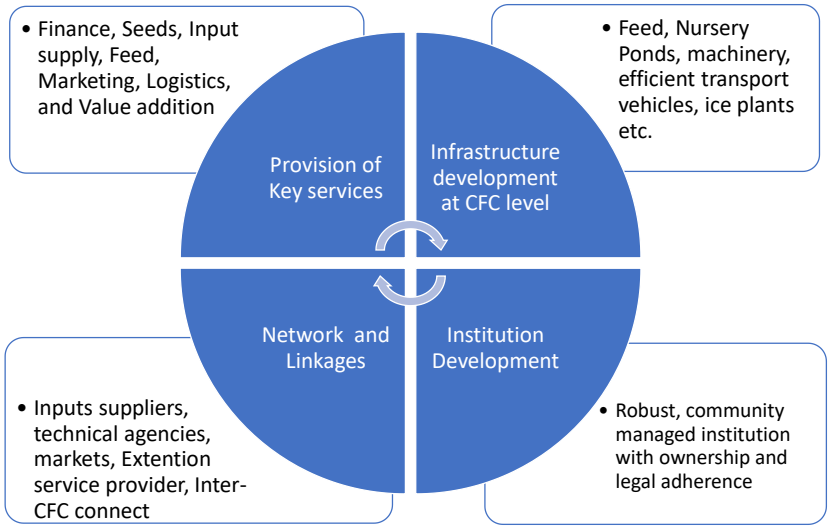
Ingredients for fish feed	Total Quantity of Ingredients (MT)	% quantity used in feed (27% CP)	Required quantity for fish demand across various scenarios			Adequacy of ingredients for respective Scenarios		
			Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Grounded Maize	88904.7	7	910	1092	5544	1%	1%	6%
DORB	190213.7	7	910	1092	5544	0%	1%	3%
Broken rice	792557	7	910	1092	5544	0%	0%	1%
Wheat bran	244000	7	910	1092	5544	0%	0%	2%
Husk and Broken grains (pulses)	5788	7	910	1092	5544	16%	19%	96%
DMOC	107627.1	65	8450	10140	51480	8%	9%	48%

- Scenario 1: 20% of the ponds and tanks in Assam are used as commercial aquaculture and the demand for feed is as per existing consumption
- Scenario 2: 20% of the ponds and tanks in Assam are used as commercial aquaculture and the demand for feed is increased at 20% per annum.
- Scenario 3: 20% of the ponds and tanks in Assam are used as commercial aquaculture and the demand for feed is increased at 50% per annum.

General Recommendations

- Strengthening of CFCs and FPOs to spear head Fishery interventions
  - Provision of Key services: Finance, Seeds, Input supply, Feed, Marketing, Logistics, and Value addition
  - Infrastructure development at CFC level
  - Build network and linkages: Technical support, Extension, Farmer connect, Market and inter CFC connect
  - Institution Development
- Supporting various enterprises and service providers in the value chain in terms of technical know how, finance, capacity building etc.
- Support to Hatcheries in arranging good quality brood fish, inputs, infrastructure development including nursery ponds.
- Promote interconnectivity of fresh fish markets, facilitate easy and cost effective transport through inter department liaison.
- Promote 'clean fish' to ensure sanitation and hygiene across the entire value chain.
- Promote more involvement of women in all major functions of the value chain

FPO and CSC level Intervention



Significance of Skilled Labour

Labour Categories	More Workforce required	Capacity Building required
Labour for pond preparation		
Labour for Netting of fish		
Labour for transporting fish seed		
Labour for Harvesting fish		
Labour for transporting live fish		
Labour at wholesale markets for carrying headload, carting, packing etc.		
Specialized fish dresser at retail outlets for dressing fish		
Transport agents (Sardar) at railway stations		

Enterprise Promotion for local Fish value chain development

Enterprise Activities	Investment (Rs)	Technical Skill	Business Skill	Promotion level		
				CSC / FPO	Individual	DoF/Fishfed/AFDC
Earthwork / ground boring service	50-75 Lakh	High	Medium			
Supply of Water pumps and pipes	10-15 Lakhs	Low	Medium			
Maintenance of pumps, motors etc.	40-50 Thousand	Low	Low			
Financing	50-75 Lakh	High	High			
Feed manufacturing locally	2 crores	High	High			
Supply branded feed	30 lakhs	High	High			
Retailing other Feed, Medicines, Lime, MOC, DORB etc.	5 Lakhs	Medium	High			
Supply Net and equipment	5-7 Lakhs	High	High			

Enterprise Promotion for local Fish value chain development

Enterprise Activities	Investment (Rs)	Technical Skill	Business Skill	Promotion level		
				CSC / FPO	Individual	DoF/Fishfed/AFDC
Production of fish seed	35 Lakhs	High	High			
Trading of Fish Seed	5 Lakhs	High	High			
Supply of Synthetic fish hormone	1-2 Lakhs	Medium	High			
Supply of Oxygen for Hatcheries	1-2 Lakhs	Medium	High			
Transportation of fish seed	10 Lakhs	High	High			
Transport of live fish	10 Lakhs	High	High			
Water supply for live fish transport	1-1.5 lakhs	Low	Medium			
Purchase at farm gate	1-1.5 Lakhs	Medium	High			
Sales facilitation (Commission Agent) in markets	20-30 Lakhs	High	High			
Fish trading at state level markets	10-12 Lakhs	High	High			
Ice supply in villages & markets	9-10 Lakhs	Medium	High			
General Transport	35-40 Lakhs	Medium	High			

Enterprise Promotion for local Fish value chain development

Enterprise Activities	Investment (Rs)	Technical Skill	Business Skill	Promotion level		
				CSC / FPO	Individual	DoF/Fishfed/AFDC
Fish Retailing through permanent shops	10-15 Lakhs	High	High			
Fish Retailing through temporary shops	10 Thousand	High	High			
Fish Retailing on vehicles	10 Thousand	High	High			
Production of Dry fish	1 Lakh	Medium	High			
Retailing of Dry Fish	10-20 Thousand	Medium	High			
Small scale production of Value added Fish items	Up to 2 Lakhs	High	High			
Large scale production of Value added Fish items like Bottled / Canned fish items	1 crore	High	High			

Prioritization of Enterprises for Development

High	Medium	Low
• Financing • Feed manufacturing locally • Production of fish seed • Purchase at farm gate • Ice supply in villages & markets	• Retailing other inputs like Medicines, Lime, MOC, DORB etc. • Supply of Synthetic fish hormone • Supply branded feed • Trading of Fish Seed • Transportation of fish seed • Water supply for live fish transport • Transport of live fish • Fish trading at state level markets • Fish Retailing through permanent shops • Supply of Oxygen for Hatcheries • Small scale production of Value added Fish items	• Earthwork / ground boring service • Supply of Water pumps and pipes • Maintenance of pumps, motors etc. • Supply Net and equipment • Sales facilitation in markets (Commission Agents) • Fish Retailing through temporary shops • Fish Retailing on vehicles • Production of Dry fish • Retailing of Dry Fish • Large scale production of Value added Fish items • General Transport

Thank You

WorldFish

Annexure- 4
Workshop on Quality Carp Seed Production in Assam

REPORT

WorldFish

Department of Fisheries, Govt. of Assam

WORKSHOP ON QUALITY CARP SEED PRODUCTION IN ASSAM UNDER WORLD BANK FUNDED ASSAM AGRIBUSINESS AND RURAL TRANSFORMATION PROJECT (APART)

A one day workshop on quality carp seed production in Assam was organized by WorldFish in collaboration with the Assam Rural Infrastructure and Agricultural Services (ARIAS) Society, Govt. of Assam and Department of Fisheries, Govt. of Assam under World Bank funded Assam Agribusiness and Rural Transformation Project (APART) on 7th September, 2021 at Veterinary College, Khanapara, Guwahati.

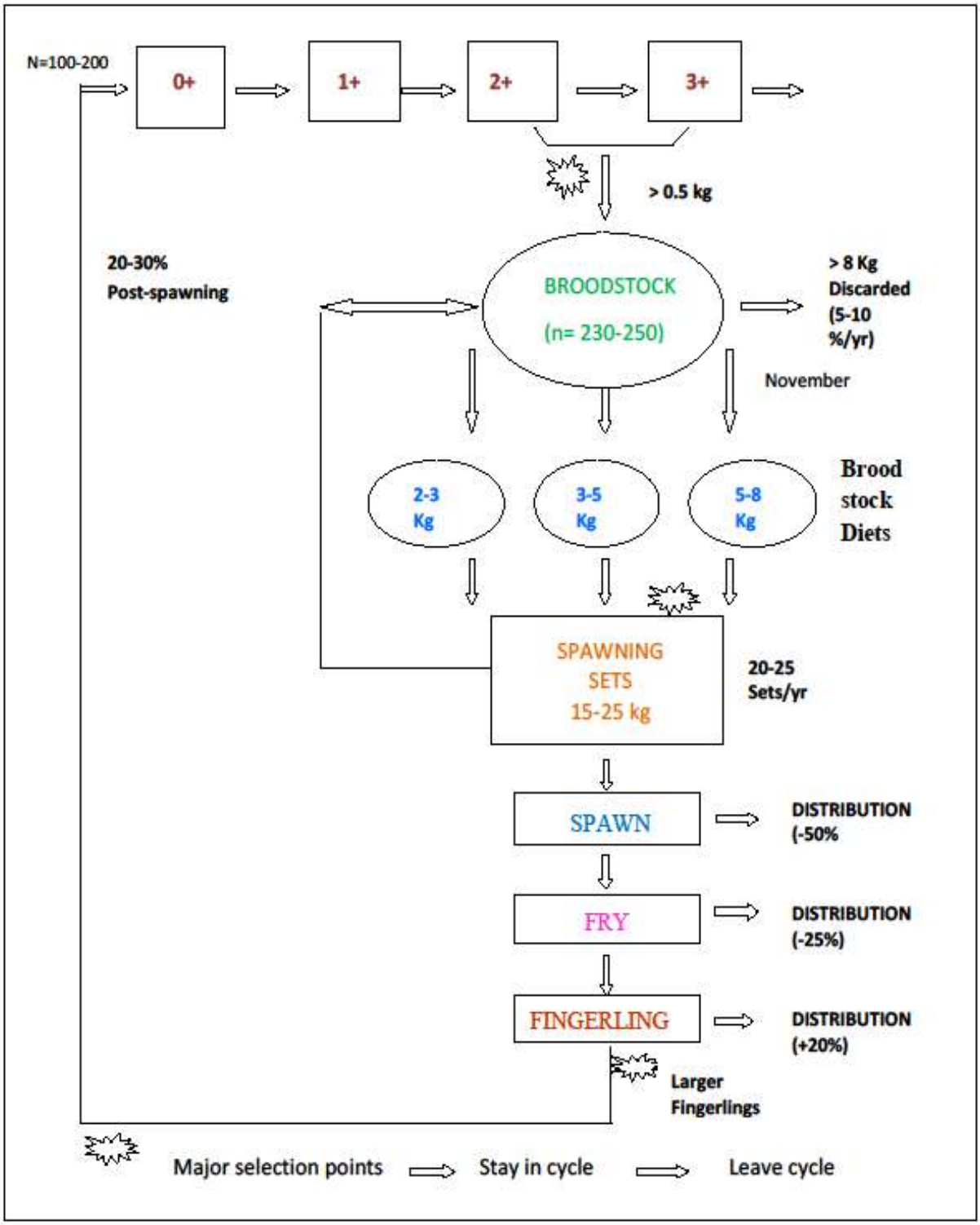
The one day workshop was organized to discuss the concept of brood stock management including sourcing quality brood stock, nourishing brood stock, water quality and health management and use of improved strains for quality carp seed production and the need for both Govt. & private hatcheries of Assam to improve their efficiency while maintaining the quality of the seed.

Dr. Yaraguntappa Basavaraju, Fish Genetics & Breeding Expert, WorldFish & Dr. Arun Padiyar, WorldFish Expert served as Resource Persons for the workshop. The workshop was attended by the Dr. B. K. Bhattacharjya, Head of Center, ICAR- CIFRI, Regional Centre, Guwahati, Dr. R. Suresh, Resident Consultant, WorldFish, Dr. Dhrubajyoti Sharma, Nodal Officer, APART, Directorate of Fisheries, Dr. Sanjay Sarma, Fisheries Coordinator, ARIAS Society, District Fisheries Development Officers, Fisheries Development Officers, Technical Expert Fisheries (TEFs), Representatives from several service providers to ARIAS Society under Assam Agribusiness and Rural Transformation Project (APART) and representative from the State Bank of India.

 Scientific protocols for Quality Fish seed Production	
	
	
	

Dr. Dhrubajyoti Sharma, Nodal officer, APART, Directorate of Fisheries, Assam moderated the workshop, felicitated all the dignitaries were with a phulam gamusa and delivered the welcome address. Dr. R. Suresh, Resident Consultant, WorldFish explained the background and objectives of the workshop.

In the technical session Dr. Y. Basavaraju, Fish Genetics & Breeding Expert, WorldFish gave a presentation on Quality carp seed production in Assam and the strategies that can be adopted for quality carp seed production. ***"What you sow is what you reap"*** which means seed is the most important & fundamental component of aquaculture activities either small scale or commercial. He mentioned that inadequate supply of quality seeds at right time is considered as one of the major constraints for aquaculture development in most of the states. He explained briefly about the different aspects of quality fish seed, various issues in fish seed quality, factors affecting seed quality, role & responsibilities of stakeholders in quality seed production. He mentioned that seed producers and suppliers have a bigger role to play in quality seed production. He also mentioned that adoption of best brood stock management practices (Genetic and husbandry) with ethical code of practice is mandatory to produce quality seed (spawn, fry and fingerlings). He mentioned about the role of research and development institution, NGOs and governance or regulations in seed production value chain. He briefly described about the genetically improved fish strain such as Jayanti rohu and Amur common carp development process through selection and also described about the typical breeding and broodstock replenishment practices that currently practiced in most of hatcheries with a flowchart diagrammatic representation.


N=100-200
0+
1+
2+
3+
> 0.5 kg
20-30%
Post-spawning
BROODSTOCK
(n= 230-250)
> 8 Kg
Discarded
(5-10
%/yr)
November
2-3
Kg
3-5
Kg
5-8
Kg
Brood
stock
Diets
SPAWNING
SETS
15-25 kg
20-25
Sets/yr
SPAWN
DISTRIBUTION
(-50%
FRY
DISTRIBUTION
(-25%)
FINGERLING
DISTRIBUTION
(+20%)
Larger
Fingerlings
Major selection points
Stay in cycle
Leave cycle

He explained inbreeding, inbreeding depression and how to find out the inbreeding rate and how to manage the inbreeding rate in seed farms. He mentioned that inbreeding is cumulative and irreversible and prevention is the key for inbreeding management. He also shared his observations on last three days field visits to different private and government carp hatcheries in different districts of Assam and also provided suggestions for improving the activities. Some of the suggestions are listed below:

- Upgradation of few selected private hatcheries on scientific norms in different regions to serve as source of quality seed.
- Linking these upgraded hatcheries to seed growers and fish producers through networking program.
- Trained personnel at seed farms is the key for quality seed production.
- Adoption of scientific methods to identify a good strain, brood stock sourcing, BMP in brood stock management, breeding protocols for quality seed production.
- Adoption of Standard Operating Procedure in nursing spawn to fry and fry to fingerlings.
- Educating Hatchery operators and seed growers on dos and don'ts for quality seed production
- SOP should be followed to raise the GIFS to raise fingerlings to brood stock.
- Multiplication centers exclusively for GIFS.
- Marking/tagging will help in better management of brood stock.
- Keep only required number of breeders.
- It is very important that dedicated trained technical staff with required supporting staff needs to be posted to function effectively following recommended SOP in state owned hatcheries

Dr. Arun Padiyar, WorldFish Expert, explained the master plan for quality seed program of Odisha and also mentioned how it can be implemented in Assam while considering the local

factors. He mentioned that lots of fish seeds are imported from nearby state of West Bengal to Odisha only because West Bengal is able to produce the fish seed 3 months earlier than in Odisha. He explained that proper brood stock development and management is the ultimate solution for early breeding of Indian major carps which enables the breeders to produce carp seed prior to regular breeding season. He also mentioned that sufficient rearing space for growing fish seed is very much crucial for year around availability of fish seed which is lacking in Assam. For such a situation development of seed grower cluster in each district of Assam can be a suitable way for regular supply of fish seeds to farmer's needs.

At the end Dr. R Suresh, Resident Consultant, WorldFish delivered the vote of thanks.

Agenda for workshop on Quality carp seed production in Assam on 7/09/2021 at College of Veterinary Science, Assam Agricultural University, Khanapara under Assam Agribusiness and Rural Transformation Project (APART)

Date: 07/09/2021
Venue: College of Veterinary Science, AAU, Khanapara

Time	**Topic**	**Resource Person**
1:30 – 2:00 pm	Registration	
2:10 – 2:20 pm	Welcome Address	Dr. Dhrubajyoti Sarmah, NO Director of Fisheries, Assam
2:20 – 2:30 pm	Objective of the workshop	Dr. R. Suresh, Resident Consultant, WorldFish
2:30 - 4:00 pm	Presentation on the Quality carp seed production in Assam	Dr. Y. Basavaraju, Fish Genetics & Breeding Expert, WorldFish
4:00 – 4:30 pm	Quality carp seed production in Odisha	Dr. Arun Padiyar, WorldFish Expert
4:30 – 5:00 pm	Discussion and Feedback	
5:00 – 5:15 pm	Vote of thanks	Dr. R. Suresh, Resident Consultant, WorldFish

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Quality fish seed production

Y. Basavaraju
Consultant, WorldFish
Formerly Dean, College oF fisheries, Mangalore

Introduction

- **'What you sow is what you reap'**
- Seed is a fundamental requirement for all type of fisheries and aquaculture activities , either small scale or commercial.
- It is an important and first component in fish value chain
- In fisheries –fish seed means stocking material- fingerlings
- Critical stages of quality seed production are

  Sourcing of good breed

  BMP in brood stock management, breeding and hatchery practices

  BMP in seed rearing and seed transportation
- Inadequate supply of quality seed at right time is considered as one of the major constraints for aquaculture development in most of the states.

What is a Good quality seed?

Fish seed that are

- From a genetically superior parents
- Active
- Healthy with out external injuries
- With out deformities
- Uniform in size
- Potential for high survival
- Better growth
- Less or No disease

Issues in Seed Quality

- Factors attributing to quality
- Assessment of seed quality
- Monitoring and evaluation system
- Ensure production and supply at right time
- Role of different stake holders
- Governance-regulations,guidelines

Factors affecting seed quality

- Source of brood stock and breed type
- Breeding methods/ designs
- Brood stock replacement strategies/ practices
- Husbandry practices (water quality, feed and Health management of brood stock, hatchery, nursery and rearing management practices)
- Record keeping

Stakeholders in quality seed

- Fish producers-main clients
- Hatchery owners- producers and suppliers
- Research and development Institutes/NGOs
- Government- Governance/ regulation

Stakeholders and their responsibilities

- Fish growers :

- Understand the concept of seed quality to select the good quality of seed.
- Follow best post stocking management practices for better growth
- Do not blame seed for all post stocking failures

Seed producers and suppliers

- Have a bigger role to play
- Follow best brood stock management practices (Genetic and husbandry) to produce quality seed(spawn, fry and fingerlings)
- Adhere to ethical code of practice
- Enter in to regular consultation with farmers to understand their needs

R and D Institutes/NGOs

- Be in constant touch with different stake holders to understand the problem
- Address need based specific problems through research and demonstration
- Training programs, awareness building
- Act as a link between different stakeholders

Government- Governance/ regulation

- Understand the importance of fish seed quality and its impact on fish production.
- Act as facilitator of the process not just as regulators
- Implementation of polices and regulations through confidence building
- Develop institutional linkage between stake holders
- Provide infrastructure facilities to seed producers and seed traders
- Maintain quality in state owned seed production centers-learning for private hatcheries

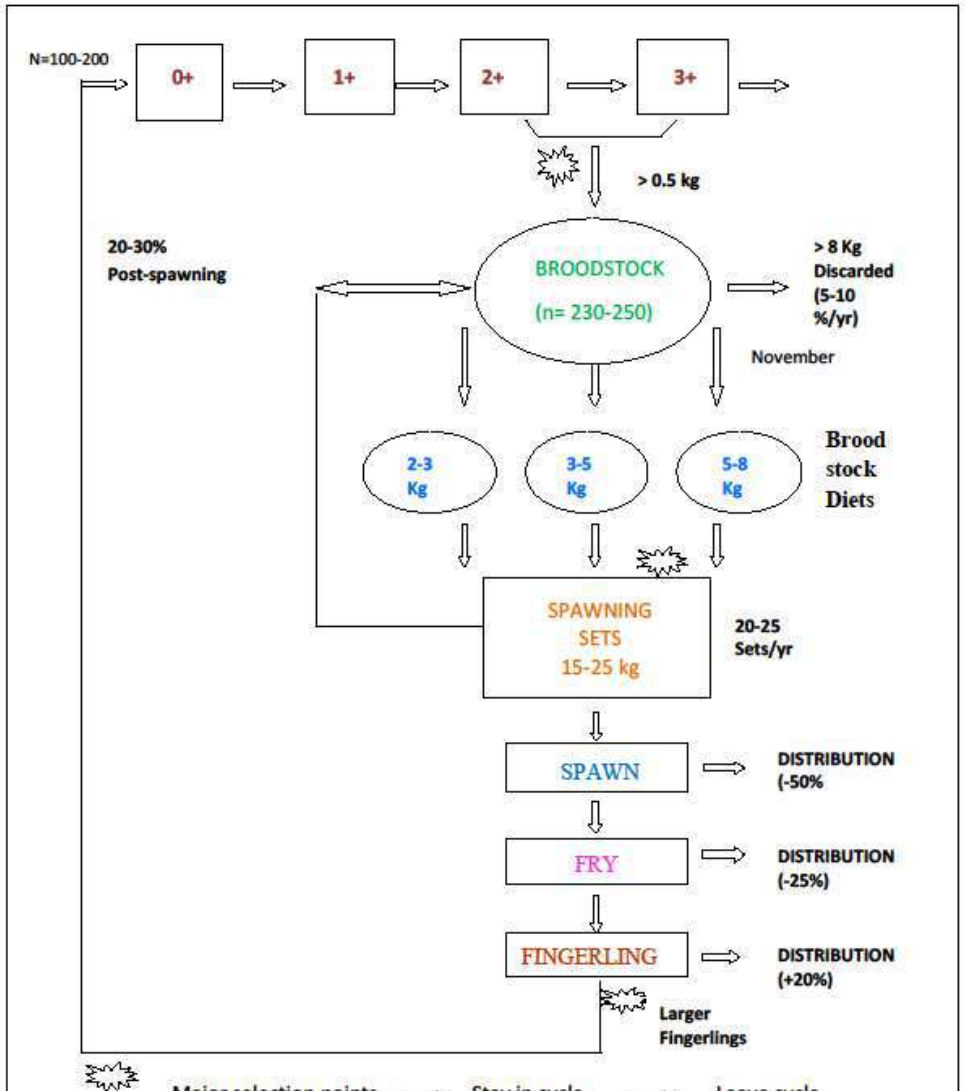
Important Aquaculture species- commonly used species

Genetically improved strains

Jayanthi Rohu
Developed by CIFA

Amur common carp-
KVAFSU

Typical breeding and brood stock replenishment practices currently practiced in most of the hatcheries

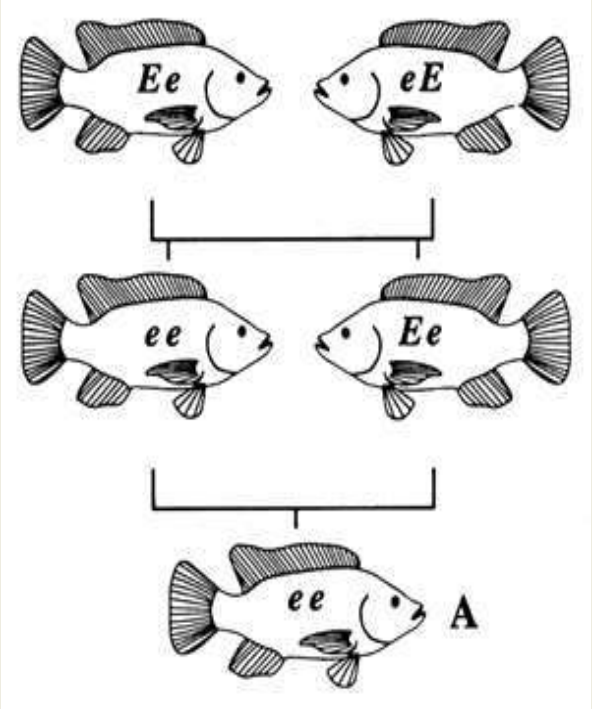


Status of fish seed production in Assam

- The fish seed production in Assam is dominated by private hatcheries 517 against 21 state owned
- State receives seed from WB during (30%) during summer months(Feb-April). Quality is not assured
- Equal number is sent to neighboring states during Sep-Nov (promote stunted fish fingerlings from these and make them available for early stocking to prevent import of seed from WB)
- Emphasis is more on quantity than quality
- All the centers are functioning as reproductively isolated units
- Same stocks are bred over generations with out proper brood stock replacement/replenishment strategies
- Seed is produced in most traditional way
- This process on long run leads to ***inbreeding*** which is cumulative and irreversible – prevention is the key

What is inbreeding

Inbreeding is the mating of animals related through ancestry, so that genes contained in the uniting gametes may be identical by descent



Inbreeding

- **The rate of inbreeding in a population is inversely related to the effective size of the population;**

  i.e., it is low in large populations and high in small populations

- **Inbreeding is cumulative and not reversable**

Factors Affecting Inbreeding

Two major factors

- **Effective Population size: The number of breeding individuals in the population that contribute next generation**

- **The sex ratio**

Female to Male (Sex) Ratio:

- Consider two hatchery populations of 50 individuals.
- In the first population (with equal numbers of males and females)
- the effective population size =
- Ne= (4*25*25)/(25 +25) = 50
- $\Delta F = 1/(2*50) = 0.01 = 1\%$

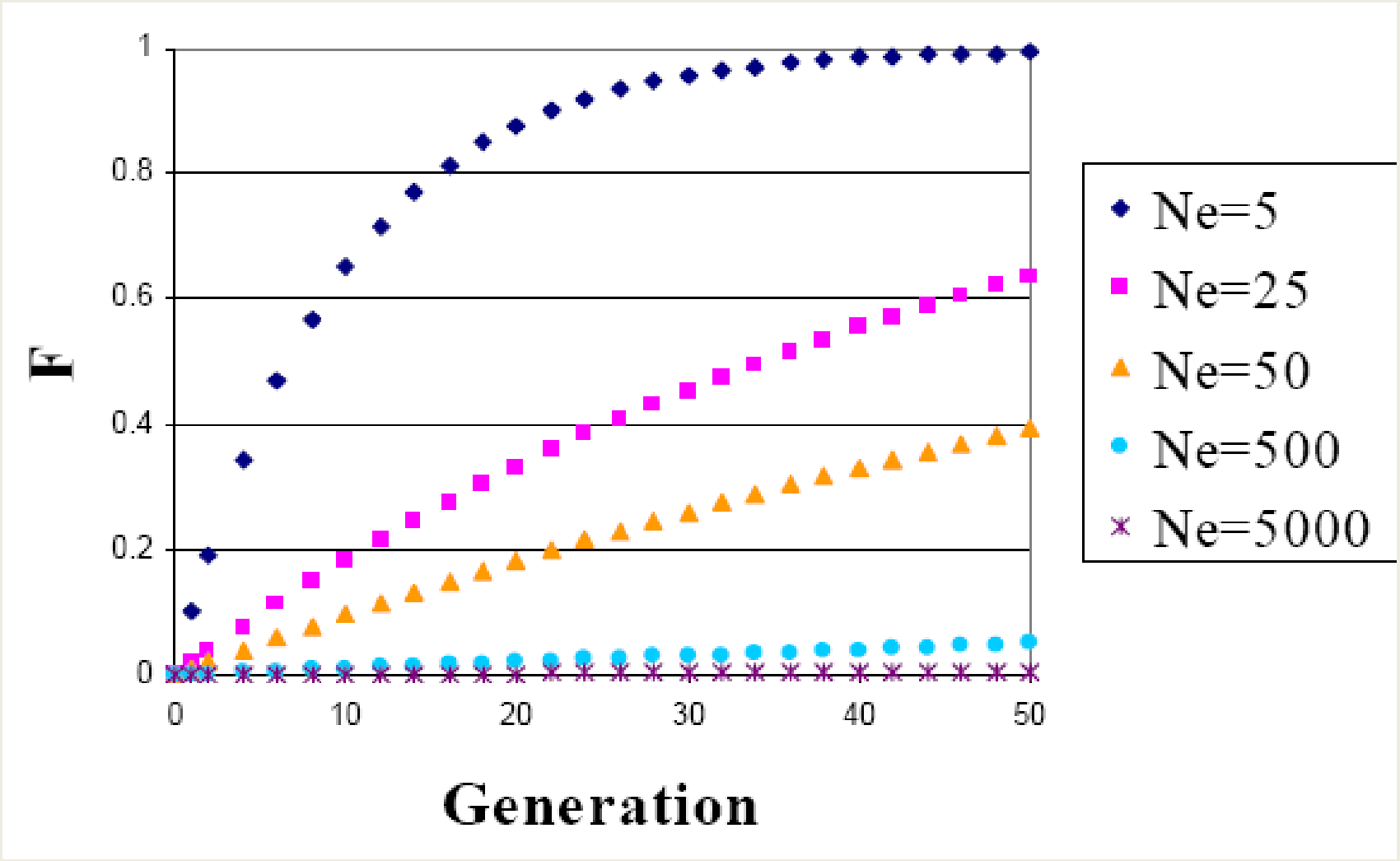
Female to Male (Sex) Ratio:

In the second population (with un equal numbers of males(40) and females(10))

- **the effective population size =**
- **Ne= (4*10*40)/(10 +40) =32**
- **ΔF = 1/(2*32)= 0.0156= 1.56%**

The unbalanced sex ratio reduced the effective population size by 36 percent and increased the rate of inbreeding by 60%.

F rate and Ne


F
1
0.8
0.6
0.4
0.2
0
0
10
20
30
40
50
Generation
Ne=5
Ne=25
Ne=50
Ne=500
Ne=5000

Inbreeding depression:

Any given inbred animal generally has several, but not all, of these defects. These defects include:

- **Slower growth rate**
- **Smaller adult size**
- **Increased susceptibility to diseases and reduced ability cope with stress**
- **Reduced fertility both in egg numbers and in sperm viability**
- **Low hatchability**
- **High mortality in spawns and at all age groups**

General observations on recent visits to few hatcheries

- Visited 3 Govt Fish seed farms , 3 Private fish seed farms and 1 Private Exclusive fish seed rearing farm
- IMC are the major species bred as in more demand
- Most of ponds are very large, not drainable and have access to natural water-water and local fishes find entry to these ponds
- Fishes from general stocking ponds are used
- Water from these ponds is used for breeding and hatching
- Breeding facilities are imbalanced-in few cases hatching pools are used for both spawning and hatching –
- Seed rearing is done in very large ponds-some times spawn stocked in general ponds with other fish of different age/size groups
- In most cases the spawn are directly grown to fingerlings
- Record keeping is not practiced

Suggestions

- Upgrade few selected private hatcheries on scientific norms in different regions to serve as source of quality seed
- Link these to seed growers and fish producers through net working program
- Trained personnel at seed farms is the key for quality seed production
- Follow scientific methods to identify a good strain, brood stock sourcing, BMP in brood stock management , breeding protocols for quality seed production
- Follow SOP in nursing spawn to fry and fry to fingerlings
- Educating Hatchery operators and seed growers on dos and don'ts for quality seed production

Suggestions contd…

- SOP should be followed to raise the GIFS to raise fingerlings to brood stock
- Multiplication centers exclusively for GIFs
- Marking/tagging will help in better management of brood stock
- Keep only required number of breeders
- It is very important that dedicated trained technical staff with required supporting staff needs to be posted to function effectively following recommended SOP in state owned hatcheries

Government Fish seed farm

Date	Name of the hatchery	Govt/private	Observations	suggestions
2.9.2021	Ulubari fish seed farm	Govt. Seed farm	1.Govt. seed farm upgraded under APART project 2.GIFS-Jaynathi Rohu and Amur common carp are maintained along with other species. Fish seed of IMC production	1.GIFS need to me marked if it is not possible to maintain separately or should be exclusively for GIFS 2.Record keeping on breeding activities to assess quality

Thank you





Annexure- 5
Discussion on Fish Processing, Value addition and Nutrition Promotion in APART

ARIAS Society
GOVERNMENT OF ASSAM
Assam Rural Infrastructure and Agricultural Services Society

অসম চৰকাৰ
GOVERNMENT OF ASSAM

WorldFish

Assam Agribusiness and Rural Transformation Project (APART)

Discussion on Fish Processing, Value addition and Nutrition Promotion in APART

Organized by

WorldFish

In Collaboration with

ARIAS Society, Govt. of Assam

Department of Fisheries, Govt. of Assam

Date: 22nd September, 2021 **Venue: SIPC, Guwahati**

REPORT

WorldFish

Department of Fisheries, Govt. of Assam

DISCUSSION ON FISH PROCESSING, VALUE ADDITION AND NUTRITION PROMOTION IN APART

A discussion on fish processing, value addition and nutrition promotion was organized by WorldFish in collaboration with the Assam Rural Infrastructure and Agricultural Services (ARIAS) Society, Govt. of Assam and Department of Fisheries, Govt. of Assam under World Bank funded Assam Agribusiness and Rural Transformation Project (APART) on 22nd September, 2021 at SIPC, Guwahati.

The discussion was organized to understand the scope for fish processing by salting, smoking, drying and fermentation of fish products, prospects of entrepreneurship through preparation of processed/ value added fish products fish in Assam and to share the Odisha Experience on fish based nutrition in ICDS Supplementary Nutrition Programme (SNP).

Dr. B.A Shamasundar, WorldFish Expert and Dr. Baishnaba Charan Ratha, Project Manager (Nutrition), WorldFish, Odisha served as Resource Persons during the discussion. The program was attended by Mr. Inam A. Hussain, Asst. Professor, College of Fisheries, Assam Agricultural University, Raha, Dr. R. Suresh, Resident Consultant, WorldFish, Nitin Singh, FSS, ARIAS Society, Amarjit Lahkar, Agri Department, PWC, Bornali Sarma Boruah, Founder and CEO of Easy Heat Pvt. Ltd, Pankaj Bezbaruah, G.T Consultant, Entrepreneurs, Technical Expert Fisheries (TEFs) and Project Associate (PA).


ILRI

At the beginning, Dr. R Suresh, Resident Consultant, WorldFish gave Welcome address and explained the background and objectives of the meeting.

Dr. B.A Shamasundar, WorldFish Expert gave a brief presentation on fish processing by salting, smoking, drying and fermentation of fish products. He discussed and explained post-harvest management; proximate composition of fish**,** traditional fish preservation methods (salting, smoking, drying and fermentation) and indigenous fish products of NE India (fermented fish products, Smoked fish products, Smoked fermented fish products and dried fish products). He explained different methods of salting, drying, smoking and fermentation. He also explained quality issues in fish products, ethnic fish products (Salted dried/smoked/fermented) of Assam (Chucha, Shidal, Hukoti, Lashim, Naduba siyam, Nah-grain and Namsing).

Dr. Baishnaba Charan Ratha, Project Manager (Nutrition), WorldFish, shared Odisha experiences on Fish Based Nutrition in ICDS Supplementary Nutrition Programme (SNP). He described the importance of fish based nutrition to children, pregnant, lactating mothers and adolescent girls. He spoke on prioritizing actions for reducing under nutrition, importance of fish for fast-track reduction of micronutrient deficiencies, types of childhood malnutrition, availability and accessibility of fish from different sources, fish in school meal program, convergence with WCD & MS under nutrition sensitive initiatives, fish farming in Gram Panchayat Tanks for Women SHGs, SOP for ICDS & health functionaries, SBCC materials distribution for ICDS functionaries, hot cooked meal to children, take home ration to pregnant & nursing women & adolescent girls, feeding in Anganwadi center (AWC). He also talked about the fish consumption among the tribal children and other category of children. He also described about awareness to WSHGs on importance of hygienic dried fish and fish based products and also explained about the polyhouse solar tunnel dryer installed in Odisha. He discussed about the importance of the involvement of WSHGs during basement preparation, hygienic solar dryer fish produced and marketed by SHGS and dried fish packing.

Mr. Inam A. Hussain, Asst. Professor, College of Fisheries, Assam Agricultural University, Raha gave a presentation on different types of fish products developed by College of Fisheries, Assam Agricultural University, Raha like fermented fish product (Shidal, Ngari, Hukuti etc**.**), fish pickle from locally available fishes, minced based fish products (fish balls, fish fingers, fish sausages, fish bhujia and sausage rings) and fish surimi cubes. He also talked about the

interventions taken up by the College of Fisheries, Assam Agricultural University, Raha for promoting hygienic fish products production. He then described the 4 solar mechanical driers installed by College of Fisheries, Raha in Baksa and Barpeta districts for hygienic dry fish.

At the end, Dr. R Suresh, Resident Consultant, WorldFish gave vote of thanks to the resource persons and participants who attended the meeting.

List of Participants:

Sl. No	Name	Designation	Contact No.	Email
1	Dr. B. A. Shamasundar	WorldFish Expert	9448250057	bashamasundar@gmail.com
2	Dr. Baishnaba Charan Ratha	Project Manager, WorldFish	9438001964	b.ratha@cgiar.org
3	Dr. R. Suresh	Resident Consultant	9489787374	r.suresh@worldfishcenter.org
4	Mr. Sondhan Deka	Businessman	6001460084	sondhandeka1983@gmail.com
5	Mr. Gunajit Barman	Businessman	9954260979	gunajit29ghy@gmail.com
6	Mr. Nitin Singh	FSS, ARIAS	9015576044	nitinsingh@arias.in
7	Mr. Amarjit Lahkar	Agri Dept. PWC	9864145442	amarjit.lahkar@pwc.com
9	Mrs. Bornali Sarma Boruah	Founder and CEO Easy heat Pvt. Ltd	8486038173	bornalisboruah@gmail.com
10	Mr. Pankaj Bezbaruah	Consultant, G.T	9085055215	pankajbezbaruah@in.gt.com
11	Mr. Inam A. Hussain	Asst. Professor, CoF, Raha	9954253533	inamakt@gmail.com
12	Ms. Neeta Bayppi	TEF, WorldFish	8011975016	neetawfassam@gmail.com
13	Ms. Nabamika Sonowal	TEF, WorldFish	9101062946	nabamikawfassam@gmail.com
14	Ms. Ajimoon Nissa	PA, COF	8848597252	ajimoonank01@gmail.com

Presentation by Dr. Baishnaba Charan Ratha

Odisha Experience: Fish Based Nutrition in ICDS Supplementary Nutrition Programme (SNP)

Dr. Baishnaba Charan Ratha (PhD)
Project Manager, Nutrition, Odisha WorldFish Project

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USAID IPP Summary

USAID funded Project: Scaling Nutrition-sensitive Fisheries Technologies through Partnerships in Odisha

- 3.50 Years
- October 2017 to March 2021

Objectives:

1. Increasing the availability and accessibility to nutritious Small Fish
2. Increasing the consumption of nutritious small fish
3. Sharing the experiences and lessons to other states and countries

WorldFish

Activities undertaken for Increasing the Availability, Accessibility and Consumption of Small Fish

1. Introduction of Nutrition-sensitive Carp Mola Polyculture in freshwater tanks for household level consumption
   - Backyard tanks – 789 tanks
   - Community tanks (Gram Panchayat tanks) – 22 tanks
2. Demonstration of Hygienic Solar Drying of Fish by Women Self Help groups for Open Market & Government ICDS Supplementary Nutrition Program – 10 Solar Driers
   - Marine small fishes such as Anchovies, sardines
3. Piloting of Fish inclusion in ICDS Anganwadi Supplementary Nutrition Program of Government – 50 Anganwadi Centers

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Carp-Mola Polyculture in Backyard Tanks (Women Empowerment)

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Fish harvested by members of WSHG

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Fish Farming in Gram Panchayat Tanks by Women SHGs (6000 WSHGs)

Prioritising Reduction in Undernutrition

- Odisha, a state on the eastern coast of India, has a population of 45 million
- 29% of the children below 6 are stunted *(CNNS 2017-18)*
- Reduction of undernutrition is a priority of the state
  - 4.24 million children (below 6) and pregnant & nursing women are registered under Supplementary Nutrition Program
  - Hot Cooked Meals and Take Home Ration provided to the beneficiaries

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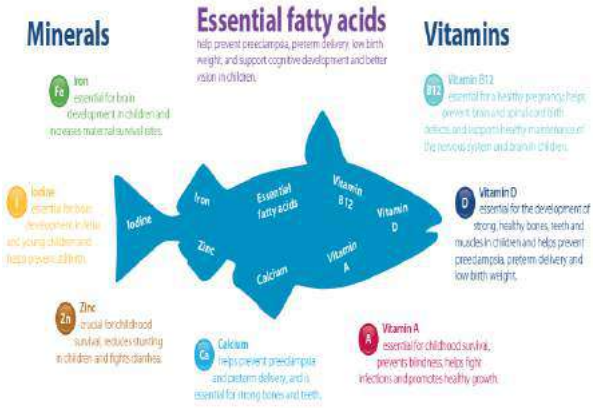
Odisha has recognized Importance of Fish for Fast-tracking Reduction of Micronutrient Deficiencies



- 90% people in Odisha consume fish
- Per capita consumption 16 kg/year
- Fish in abundance in marine and inland waters justifies inclusion of fish in state nutrition program
- 4th largest fish producing state:873,000 MT
- Scope for producing more fish:
  - 480 kms coastline
  - 1.10 million hectares tanks, reservoirs, lakes, rivers, estuaries etc

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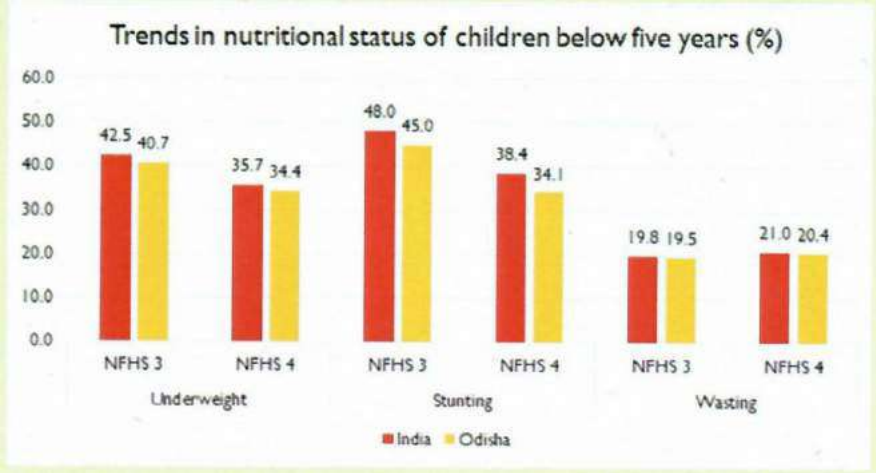
Current status of malnutrition in Odisha



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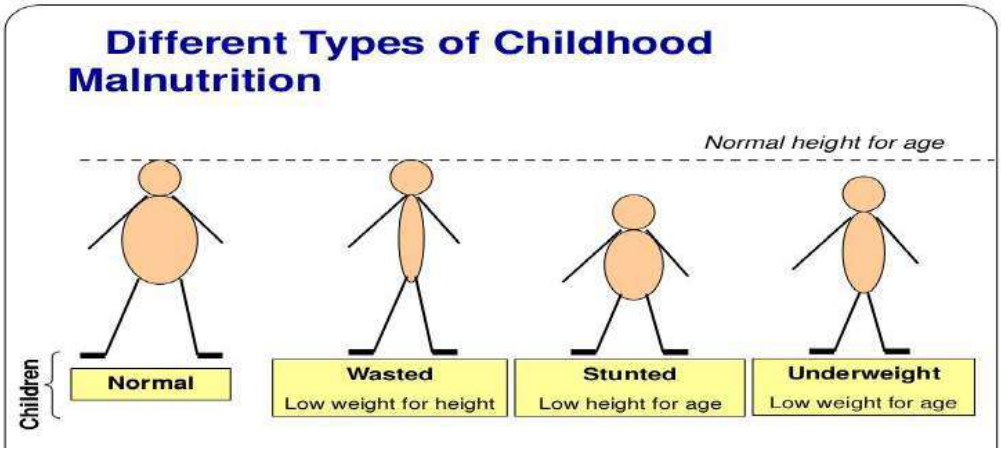
Types of Childhood Malnutrition



Feasibility study for inclusion of small fish

Sl. No.	Type of School / Institution	Department	District Presence	Total no of School	Total No of Children	Fish need_ tonnes@ 50gm/Head
1	Kasturba Gandhi Balika Vidyalaya	School & Mass Education	23	182	18400	0.92
2	Special School (GoI & GoO)	Social Security & Empowerment of Persons with Disabilities	27	148	8614	0.43
3	Child Care Institution	Women & Child Development and Mission Shakti	30	267	11776	0.59
4	ST SC Residential / ashram School	ST SC Development	30	1645	355079	17.75
5	School & Mass Education	School & Mass Education	30	59414	6198025	309.90
	Total			**61656**	**65,91,894**	**330**

Availability and Accessibility of Fish from different sources in Odisha

Fish Farming

- Carp-Mola Polyculture in Backyard tanks & GP tanks
- Suitable for household consumption

Marine Fisheries

- Anchovies and other small Fish
- Suitable for mass feeding programs

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Inclusion of Fish in School Meal Program

Sl. No.	District	Special school	Child Care Institution	No of children feeding on small fish
1	Cuttack	3	6	685
2	Khordha	8	2	862
3	Puri	1	2	542
4	Jagatsinghpur	1	1	247
	TOTAL	**13**	**11**	**2,336**

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Paradeep,Astaranga Puri Marine Fish Catch Point (Anchovy)

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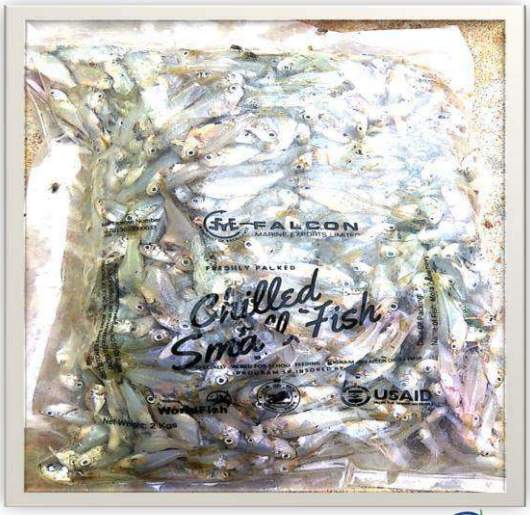
Branded Fresh Fish and Fish Products

Falcon Marine Exports Ltd has Branded "Falcon Chilled Small Fish"

- Hygienically handled and packed marine small fish (Anchovies)
- Regularly supplying the small fish to school meal program
- Also, selling at Falcon Chilika Fresh Retail Outlets in Bhubaneswar



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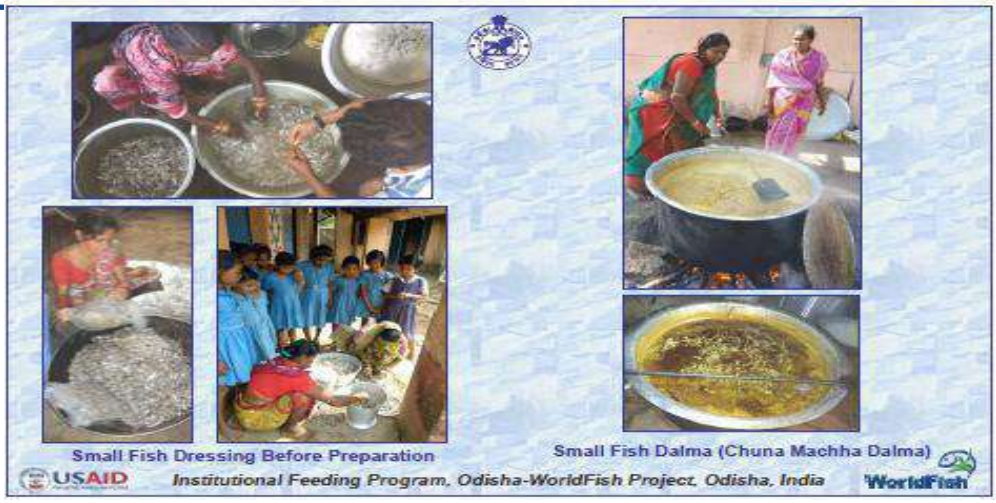
School Feeding Initiative



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School Feeding Initiative

Frying and Grinding of fish

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Mola included in mid day meals of Govt.Primary School, Sidhal,JSPur (USAID Project Area)

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The New Indian Express (Front Page)

Small fish as nutrition add-on in midday meal

HEMANT KUMAR ROUT @ Bhubaneswar

IF things go as per plan, school students across the State will soon have small fish in their noon meals. Odisha is said to be the first State in the country to have mooted a proposal in this regard.

The Fisheries and Animal Resources Development (FARD) department has been directed to conduct a feasibility study and submit a report. The project will be launched in technical collaboration with WorldFish, an international organisation.

Project Manager (Nutrition) Baishnab Charan Rath said small fishes are rich in micronutrients, including Vitamin A, calcium, iron and zinc, which are highly essential for the first 1000 days of human life for cognitive development.

"Besides children, we are promoting consumption of nutritious small indigenous fish species like anchovie (mohurali) and lesser sardines by pregnant and lactating women amongst the vulnerable communities in the State," he said.

Initially, the small fish species will be introduced in meals in State-run schools, especially in residential, Sevashram, Utkal Balashram and other schools managed by the ST and SC Development and Women and Child Development departments. Later, it will be provided in schools that come under the School and Mass Education department.

P6

Mohurali fish

Small fishes are rich in micronutrients, including Vitamin A, calcium, iron and zinc, which are highly essential for the first 1000 days of human life for cognitive development

Baishnab Charan Rath, Project Manager (Nutrition)

Small fish as nutrition add-on in midday meal

FROM P1....

The Director of Odisha Primary Education Programme Authority (OPEPA) has been asked to provide information on Kasturba Gandhi Balika Vidyalayas, Utakal Balashrams and Deaf and Dumb schools in all 30 districts, number of children enrolled and frequency and quantity of non-vegetarian meals provided.

Rath said 'mohurali' is being served in five schools, including the two run by Basundhara, two Utical Balashrams, Deaf and Dumb school and Blind school on a pilot basis since October 3.

"We are also providing the fish to pregnant destitute lactating women in a Swadhar Home. Seven more schools will be included in the project from next week. We are satisfied with the outcome as children are finding it easy and tasty to relish," he said.

Small fish species are highly nutritious as they can be eaten whole including the heads, organs and bones. The Government is also focusing on production of the fish species to meet the demand. "Farming of the fish species has been started in six blocks of Balasore, Mayurbhanj and Jagatsinghpur districts. Apart from individual ponds, SHGs are being encouraged for farming in community ponds. The project will take care of fresh fish supply, food safety and fish product development through acclaimed specialists," Rath added.

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Scientific Evidence in "Nature Journal"

Harnessing global fisheries to tackle micronutrient deficiencies

Christina C. Hicks[1,2*], Philippa J. Cohen[2,3], Nicholas A. J. Graham[1,2], Kirsty L. Nash[4,5], Edward H. Allison[3,6], Coralie D'Lima[3,7], David J. Mills[2,3], Matthew Roscher[3], Shakuntala H. Thilsted[3], Andrew L. Thorne-Lyman[8] & M. Aaron MacNeil[9]

Micronutrient deficiencies account for an estimated one million premature deaths annually, and for some nations can reduce gross domestic product[1,2] by up to 11%, highlighting the need for food policies that focus on improving nutrition rather than simply increasing the volume of food produced[3]. People gain nutrients from a varied diet, although fish—which are a rich source of bioavailable micronutrients that are essential to human health[4]—are often overlooked. A lack of understanding of the nutrient composition of most fish[5] and how nutrient yields vary among fisheries has hindered the policy shifts that are needed to effectively harness the potential of fisheries for food and nutrition security[6]. Here, using the concentration of 7 nutrients in more than 350 species of marine fish, we estimate how environmental and ecological traits predict nutrient content of marine finfish species. We use this predictive model to quantify the global spatial patterns of the concentrations of nutrients in marine fisheries and compare nutrient yields to the prevalence of micronutrient deficiencies in human populations. We find that species from tropical thermal regimes contain higher concentrations of calcium, iron and zinc; smaller species contain higher concentrations of calcium, iron and omega-3 fatty acids; and

frontier has been complicated, in part because the nutrient composition of fish varies considerably among species and data remain sparse for most species[5].

Here we determine the contribution that marine fisheries can make to addressing micronutrient deficiencies. First, using strict inclusion protocols, we developed a database of 2,267 measures of nutrient composition from 367 fish species for 43 countries for 7 nutrients that are essential to human health: calcium, iron, selenium, zinc, vitamin A, omega-3 fatty acids (n-3 fatty acids) and protein. We then gathered species-level environmental and ecological traits that capture elements of diet, thermal regime and energetic demand in fish[9,10] to develop a series of Bayesian hierarchical models that determine drivers of nutrient content (see Methods).

Our models successfully predicted nutrient concentrations, with posterior predictive distributions consistently capturing both the observed overall mean and individual values of each nutrient[11] (Extended Data Figs. 1, 2 and Methods). We show that calcium, iron and zinc—nutrients that are critical in preventing public health conditions such as stunting and anaemia[7,12]—were found at higher concentrations in tropical fishes (Fig. 1). Tropical soils are often zinc- and calcium-deficient,

Fish based Products Trials
at Kalinga Institute of Social sciences (KISS), Bhubaneswar

- Solar Dried Fish (Marine catch) supplied by Kalinga Marine Exports was used
  - Sardine (*Sardinella spp*)
  - Anchovy (*Stolepherous spp*)
- 2 types of Fish products used
  - Whole Dried Fish
  - Fish Powder
- Recipe and Cooking method standardised at KISS, Bhubaneswar during April-June 2018-19
- Taste Panel Test was conducted at KISS with Management Staff, Teachers and Students
- Dalma with High Fish Powder (5%) made from Anchovy recorded best score

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Small Fish in KISS Mega Kitchen

- Kalinga Institute of Social Sciences (KISS) is a residential institute for 27,000 tribal students based in Bhubaneswar.
- Small fish (fresh fish / Fish Powder) feeding trials were done with KISS management and senior students during 2018.
- KISS has agreed to include small fish in their regular meal with support from project.

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Kalinga Institute of Social Sciences (KISS) Campus

KISS feeding Programme

Interaction with WorldFish scientists for:

- **Policies and Programs to promote nutrition-sensitive fish production systems**
- **Promotion of fish consumption in vulnerable communities**

KISS feeding Programme

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Interaction with WorldFish scientists for:

- **Policies and Programs to promote nutrition-sensitive fish production systems**
- **Promotion of fish consumption in vulnerable communities**

Convergence with WCD & MS under Nutrition Sensitive Initiatives

WorldFish under the Odisha State Nutrition Secretariat is a key member to the **Technical Expert Advisory Group on Nutrition (TAG).** Project to support Govt. of Odisha for initiatives like:

- ❑"SOPAN"(Strategy for Odisha's Pathway to Accelerated Nutrition), targeting 125 nutritionally challenged hard to reach blocks, **"ODISHA 2020-25"**under Women & Child Development and Mission Shakti (WCD & MS) in promoting nutrition-sensitive approaches and linking agriculture, health & nutrition.

- ❑ **"Pushtikar Panchayats"** lead by OLM under the Dept. of Panchayati Raj and Drinking Water (PR-DWD) towards the mission of making all the gram panchayat free of malnutrition.

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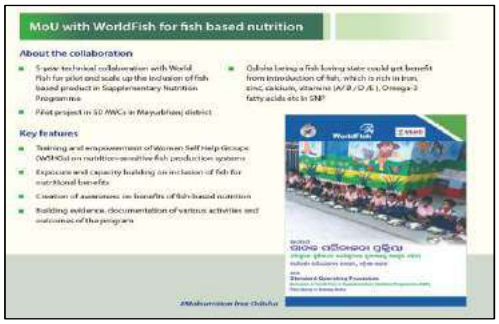
Fish Based Nutrition State Nutrition Strategy – SOPAN



WorldFish is a member of Technical Expert Advisory Group (TAG) on Nutrition

MoU Signing Ceremony between Govt of Odisha and WorldFish on 10th November 2020

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MoU Signed with WorldFish in Nov,2020 for Inclusion of Fish based Nutrition in SNP

MoU Signing Ceremony

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Piloting of Fish Inclusion in SNP

In 50 Anganwadis (Child Care Centers) in Mayurbhanj District

Purpose of the Pilot & Expected Outcomes

Purpose

- To improve the dietary diversity and micronutrient intakes of women & children covered in SNP
- To test the acceptability of dried fish products (eg. taste, ease-of-use) by tribal community & Angwandi Workers

Expected Outcomes

- Enhanced dietary diversity
- Enhanced micronutrient intake
- Community need-based intervention
- Promotion of healthier eating habits
- Promotion of local and culturally appropriate foods

Basic Information for initiating the pilot

- **District:** Mayurbhanj
- **Block:** Kaptipada
- **Sector Name:** Bisol (39 AWCs) & Kaptipada (11 AWCs)
- **Coverage GP:** 04 (Badabisol, Badagudgudia, Mankadapada & Kaptipada)
- **Total AWCs:** 50
- **Time Line:** 6 months duration (1st April to 30th Sep 2021)

Beneficiaries (Kaptipada block)	Total Sample
▪ **Children 3 – 6 years**	1208
▪ **Pregnant/lactating Mother**	470
▪ **AGs (Out of School Age 14 – 18 Years)**	329
Total	**2007**

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Target Beneficiary

	Hot Cooked Meal	Take Home Ration
Beneficiary	3-6-year old children	14-18-year old AG (Out of school & college going) 19-49-year old PLW
Product	Fish powder	Dried small fish
Quantity entitled	15 g / child / day	40g / 14-18-year old AG / day 40g / 19-49-year old PLW / day
Days entitled	5 days / week / child	3 days / week / person
Method of intake	Anganwadi Centre to add fish powder to children's daily curry as part of the Hot Cooked Meal.	Anganwadi Centre to distribute dried small fish to PLW and AG with Take Home Ration.

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Hygienic certified dry fish packet

Hygienic certified fish powder

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Capacity Building of ICDS Functionaries & Community members

- **202** Anganwadi workers, Anganwadi Sahayika, Jaanch committee, Mothers committee members, lead WSHG, female health workers and ASHA of the pilot area and Supervisors, Programme Officer, CDPO and Block Fisheries Officer were trained on the **SoP** for inclusion of small fish SNP programme during 24th-28th February 2021.
- Community level awareness programme were conducted in all **50 AWCs** during the month of March 2021.

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Training on SoP for ICDS & Health functionaries




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Theme of the Training

ICDS Staffs were trained on:

1. The health benefits of fish as part of a diversified diet

2. How to include fish in the HCM

serving sizes, storage recommendations, revised menu and cooking process

3. How to include fish in the THR

packet sizes, instructions for use, and recommended recipes for PLW and AG

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SBCC materials used for training

- **Tiki Mausi Mascot video** on Fish Based nutrition in first 1000-day of human life
- **Video** on benefits of small fish consumption.
- **Video** on Fish and Nutrition
- 2 **Audio jingles** on Benefits of small fish consumption
- **Standard Operating Procedure (SOP)** for inclusion of dried small fish in Supplementary Nutrition Programme (SNP)-in Odia
- **Brochure** on “Small fish Big Benefits”
- **Calendar** on Fish based nutrition product
- **Video** on Small fish Recipe demonstration

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SBCC materials distribution among ICDS functionaries

Baba Aleswar Shakti Group
THR producing WSHGs, Kaptipada

Starting of piloting programme

- Piloting was started from **1st April 2021** (Utkal Diwas) in 50 AWCs.
- The hygienically certified (**FSSAI**) dry fish and dry fish powder were procured from **ICAR-CIFT**, Kochi, Kerala.
- The product was transported to the AWCs through Baba Aleswar WSHG (THR producing WSHG) of Kaptipada block, Mayurbhanj.
- All AWCs were provided with Serving spoons, 50 L containers with polythene, for storage of the fish products.

CDPO Kaptipada distributing THR Dry fish packet

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THR distribution on 1st April 2021

The **THR** containing hygienically certified dry fish were distributed to pregnant women, lactating mother and adolescent girls.

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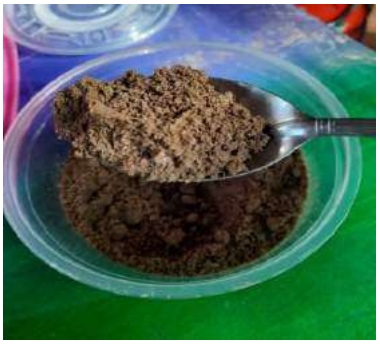
Hot Cooked Meal to 1200 children;

Take Home Ration to 800 pregnant & nursing women & adolescent girls

Based on the outcomes & experiences, Government would take steps to upscale this program across the state

Dried fish packets in Take Home Ration

40 grams/day/adult;
3 days a week



Fish powder used in Hot Cooked Meal

8 grams/day/child,
5 days a week

Fish powder used in Hot Cooked Meal in ICDS AWCs

8 grams/day/child,
5 days a week

Hot Cooked Meal to 1200 children;

Take Home Ration to 800 pregnant & nursing women & adolescent girls

Based on the outcomes & experiences, Government would take steps to upscale this program across the state

Dried fish packets in Take Home Ration

Fish powder used in Hot Cooked Meal in ICDS AWCs

Baseline, Mid Line & End Line study

- **MS Swaminathan Research Foundation (MSSRF)**, Chennai has been given third party contract to evaluate the pilot programme
- The organization have completed the baseline study as per the SOP by 31st March 2021
- Mid Line Study completed in Month of September 2021
- End Line in month of October 2021

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Fish Product received from CIFT (Kochi) at Cuttack Railway Station, Odisha

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Storage container for dry fish products in AWC level

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During Home Visit: Lactating Mother showing THR storage Dry Small fish

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During Home Visit: Dry fish consumption by Pregnant women at home

Project Monitoring by Govt Staffs

Observations-THR

Highly accepted among the community (pregnant women, Lactating mother and adolescent girls

The product sometime consumed by other members of the family, but the project motivating the target beneficiaries during the home visits

Feeding in Anganwadi center (AWC) level

Observations-HCM

From 1st week to 2nd week of April 2021 following observations were made:

- **Good consumption** is observed among the tribal children
- **Less plate waste** is seen compared to 1st week
- In 2nd week, use of little spice in curry has enhanced the **taste and acceptance** among children
- When powder is mixed with curry, the consistency of curry becomes thick with strong odor/smell of fish which posed difficulty among children to consume. Therefore from 2nd week the quantity of powder was reduced 50% (7 to 8 gm per child) with soupy consistency with the spices (spice pouches provided from project) which has increased the acceptance.
- Using some **drops of lemon juice** in curry also enhanced the taste of the curry
- Some centers have good Sahayikas who cook better curry acceptable to children

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Observations-HCM

From 2nd week to 3rd week April 2021 following observations were made:

- As per complain/difficulties in taste by children received from different AWCs in 1st two weeks, we all field staffs visited the AWCs and interacted with AWC staff and Community about the way of preparation followed by other AWCs for better curry acceptable to children.
- **Good consumption** is observed among the tribal children and also among other category of children.
- **Less plate waste** and parents convinced and guided their children to their children during feeding at AWC level.
- **Competition started among AWCs, about fish power consumption by their children.**
- By the end of April, acceptance of fish power was very good in more than 90 present AWCs because of regular absent of AWC staff, less children in AWCs, etc.

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Convergence with WCD & MS under Nutrition Sensitive Initiatives

WorldFish under the Odisha State Nutrition Secretariat is a key member to the Technical Expert Advisory Group on Nutrition (TAG). Project to support Govt. of Odisha for initiatives like:

- ❑"SOPAN"(Strategy for Odisha's Pathway to Accelerated Nutrition), targeting 125 nutritionally challenged hard to reach blocks, "ODISHA 2020-25"under Women & Child Development and Mission Shakti (WCD & MS) in promoting nutrition-sensitive approaches and linking agriculture, health & nutrition.

- ❑ "Pushtikar Panchayats" lead by OLM under the Dept. of Panchayati Raj and Drinking Water (PR-DWD) towards the mission of making all the gram panchayat free of malnutrition.

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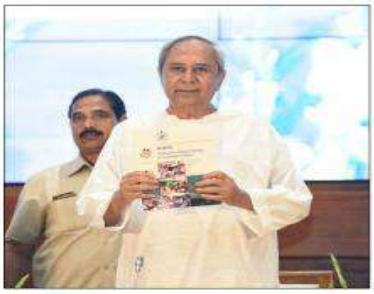
Fish Based Nutrition was incorporated in 5-year State Nutrition Strategy – SOPAN which was released by the Honourable Chief Minister of Odisha in March 2020



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USAID Project Closure Workshop 28th May 2021

Scaling Nutrition-sensitive Fish Agri-Food Systems in Partnership with Government of Odisha

@

Global Action Network of UN Food Systems Summit-2021

30 April 2021

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Fish Based Nutrition For Children & Women in Odisha, India

Mrs. Anu Garg, IAS, Principal Secretary, Women & Child Development Department, Government of Odisha, India

MARE Conference, 02 July 2021

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WorldFish CGIAR

Planning to Produce Hygienic Dried Fish and Fish based Products in Odisha

Present Practices:
Un-Hygienic Fish Drying Practices in Noliasahi, Puri Distirct

Present Practices:
Fish Drying Practices in Paradeep, Jagatsingpur

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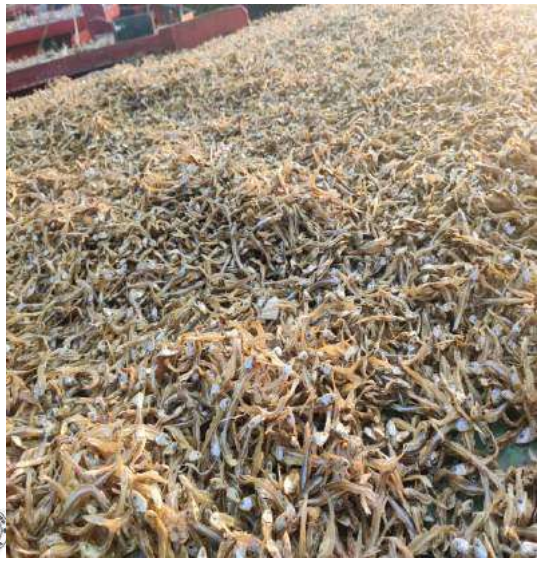
Present Practices:

Un-Hygienic Fish Drying Practices in Paradeep, Jagatsingpur



Fish Drying on Elevated Bamboo Platforms in Chilika area

Awareness to WSHGs on importance of hygienic dried fish and fish based products

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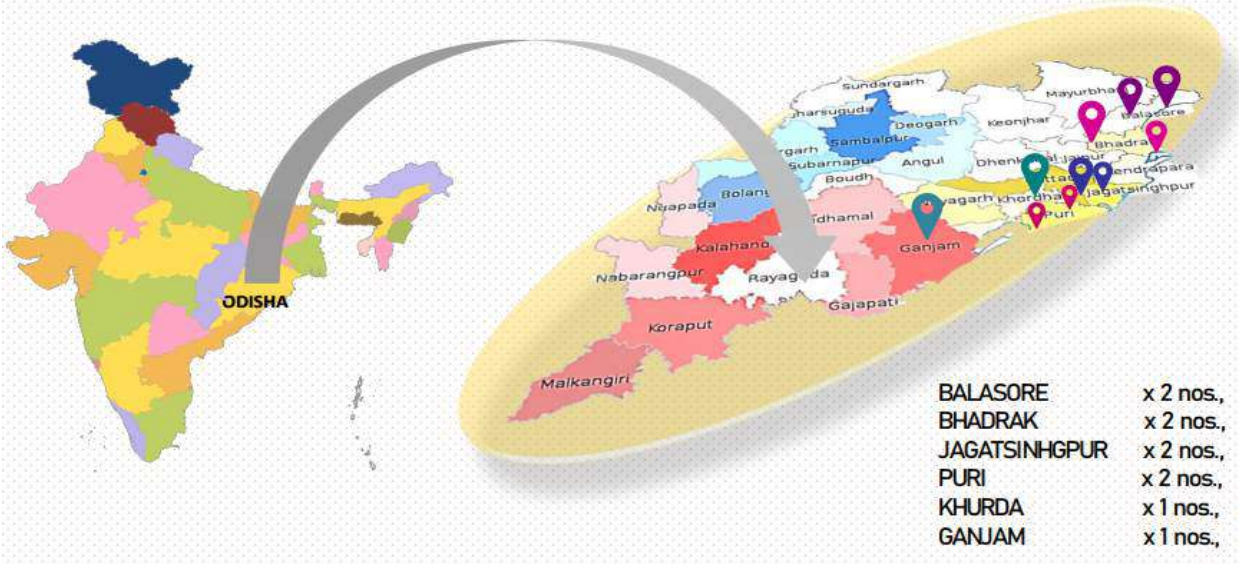
POLYHOUSE SOLAR TUNNEL DRYER INSTALLED LOCATIONS IN ODISHA



BALASORE	x 2 nos.,
BHADRAK	x 2 nos.,
JAGATSINHGPUR	x 2 nos.,
PURI	x 2 nos.,
KHURDA	x 1 nos.,
GANJAM	x 1 nos.,

Involvement of WSHGs during Basement Preparation

Installation of 10 Solar Polyhouse Fish Driers

Hygienically Solar Dried Marine Fish Produced and Marketed by Women SHGs

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Inside the Polyhouse Fish Driers

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ICAR-CIFT Model Polyhouse Solar Drier

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Dried Fish Packaging

WorldFish

Salting, smoking, drying and fermentation of fish products

Dr. B.A. Shamasundar
Former Professor and Head
Department of Fish Processing Technology
College of Fisheries, Mangalore

FISHERIES WEALTH OF INDIA IS HUGE

OFFERS FOOD / NUTRITIONAL SECURITY

FISH IS AN IDEAL HEALTH FOOD WITHIN THE REACH OF COMMON MAN

Increase food supply

Generate Employment

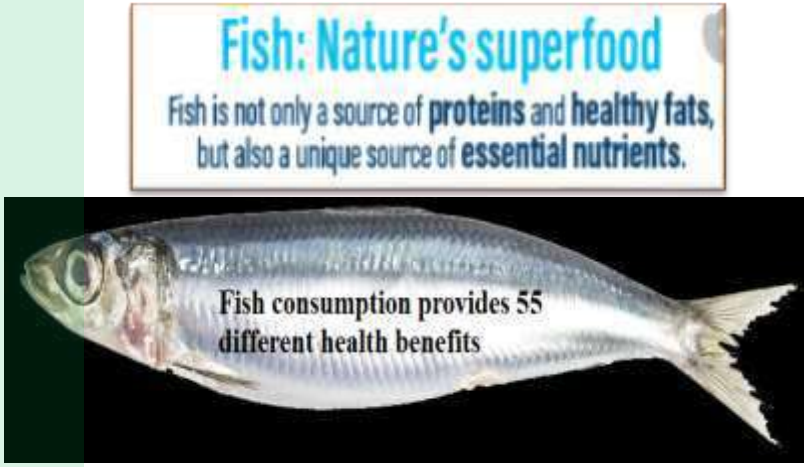
Post Harvest Management

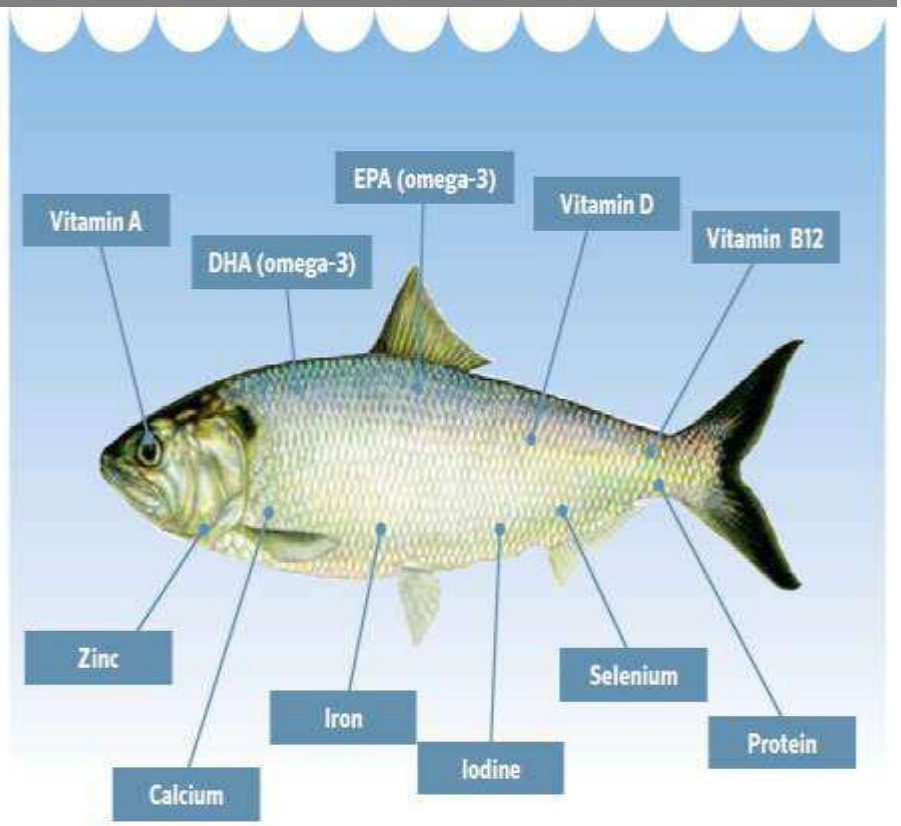
Value Addition

Rural Industrialization

How good the fish is….

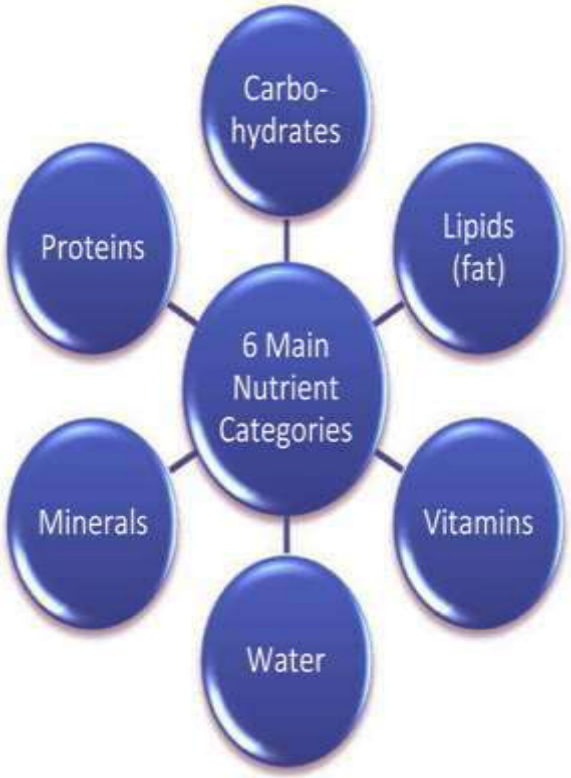
800 million -people depend on fisheries and aquaculture for their livelihoods.





Proximate composition of fish

Constituent	Value (%)		
	Min	Normal variation	Max
Protein	6	16-21	28
Lipid	0.1	0.2-25	67
Carbohydrate		<0.5	
Ash	0.4	1.2-1.5	10.5
Water	28	66-81	96



There are 6 essential nutrients

Fish is highly perishable

- Low connective tissue content
- Low glycogen reservoir
- Quick onset of post mortem changes
- Near neutral post-mortem pH
- Lipid oxidation
- Autolysis
- High water content
- Nutrient richness
- Microbiological factors

Intrinsic and extrinsic factors contribute to fish spoilage

Fish need to be preserved…

- Low temperature preservation-chilling, freezing
- Thermal processing – Canning, Pasteurization
- Irradiation
- High pressure processing
- Hurdle technology
- Traditional Preservation Methods
  - Salting
  - Smoking
  - Drying
  - Fermentation

SALTING

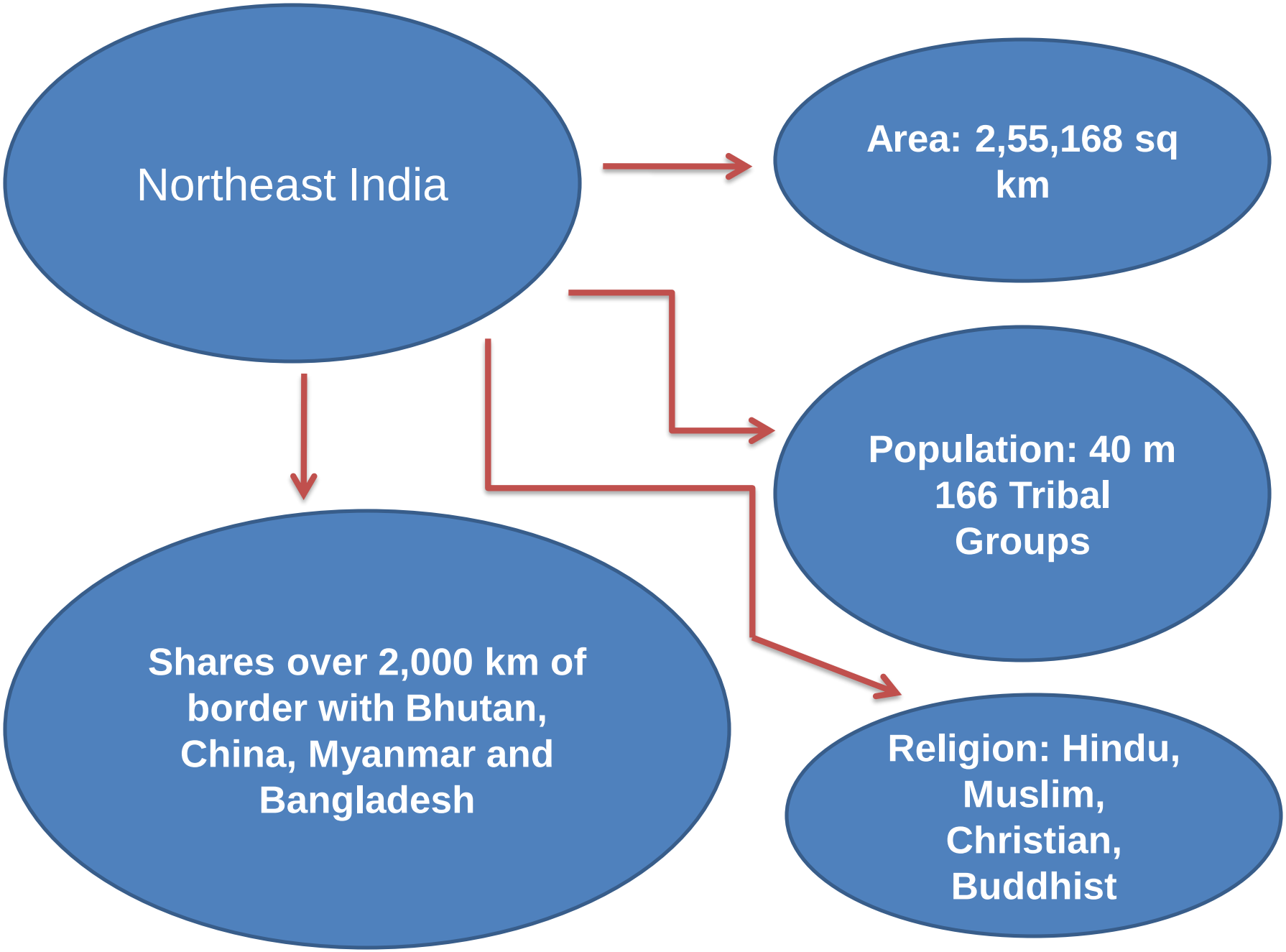
DRYING

SMOKING

MARINATION

CANNING

IRRADIATION


Northeast India
Area: 2,55,168 sq km
Population: 40 m
166 Tribal Groups
Shares over 2,000 km of border with Bhutan, China, Myanmar and Bangladesh
Religion: Hindu, Muslim, Christian, Buddhist

Northeast Tribes

Indo-Mongoloids, Tibeto-Burmese and proto-Austrioloids

Own distinct culture & unique cultural identity

Food culture, taste & flavour differs from rest of the country

Non-vegetarian & fond of spice

Ethnic populace of the NE leads an intimate life with nature in perfect harmony depending on forests and environment surrounding them

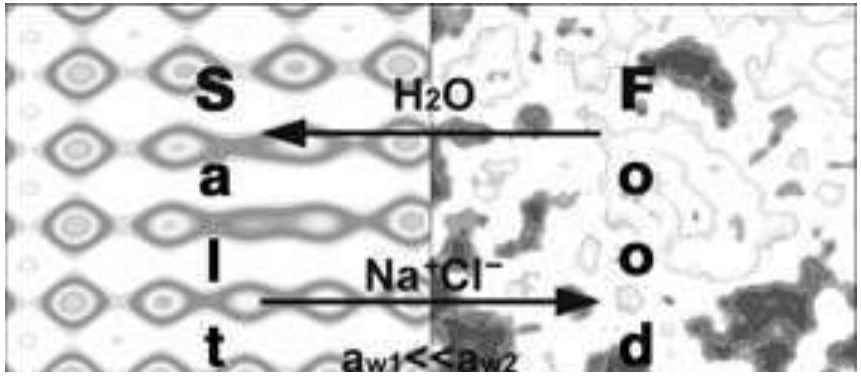
NE is a cultural bridge between India on one side and South-East Asia, China and Inner Asia and Burma on the other by ethnic and linguistic angles

Indigenous fish products of NE India is dominated by different types of

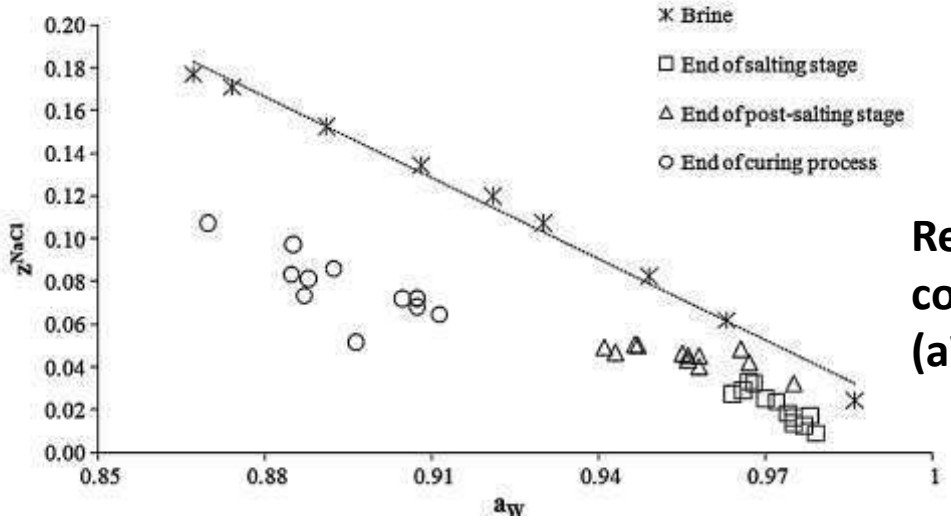
- **Fermented fish products**
- **Smoked fish products**
- **Smoked fermented fish products**
- **Dried fish products**

Salting –Mechanism of Action

Salting is the process that lowers the moisture or water content of fish and other fishery products to a point where microorganisms cannot live and grow.



Mass-flux during salting



Relationship between liquid-phase salt concentration (NaCl) and water activity (aW), at the inner zone (close to the bone)

Salt partially dehydrates the fish and kills the bacteria.

Salting –Mechanism of Action

- Alone as a preservation method
- As a pre-treatment to drying/smoking
- The oldest of the techniques -dating back over 20,000 years
- Salting and drying -good example of 'hurdle technology',
- Give rise to a variety of flavours and textures in the final products, imparting variety into the diet.

Water activity (a_w)	Micro-organisms inhibited	Curing applications
1.00	None	Fresh fish
0.95	Gram rods-negative (*E. coli*), Bacillaceae spores	7.5% salt (NaCl) solution
0.91	Most cocci, lactobacilli, Bacillaceae vegetative cells	12.5% salt solution
0.85	Most yeasts	15% salt solution
0.80	Most moulds, *Staphylococcus aureus*	Air-dried fish
0.75	Halophilic bacteria	26% salt solution; kench-cured cod before drying
0.65	Xerophilic moulds	5% moisture content fishmeal; stockfish
0.60	Osmophilic moulds	Dried kench-cured cod

Methods of salting

- Dry salting
- Wet salting
- Pickle salting
- Kench salting
- Mona curing
- Pit curing
- Colombo Curing

Process-Dry salting- the most common method used

- Fish (any size, except fatty fishes
- Gutted, beheaded
- ventrally split open
- viscera removed
- washing
- Scoring (if the flesh portion is thick)
- Addition of salt as layers (1:3 to 1:5; Salt to fish based on weight)
- Stacked in clean cement tanks or Suitable containers
- Layered with salt
- Weight is applied on top
- Kept for 24-48 hours --->. washed in mild brine to remove adhering salt --> drained.
- Dried to a moisture content of less than 25%
- Yield of the product - 35-40%
- Storage stability – 3-4 months.

Note: If we dry to less than 12 % moisture, the shelf life is extended to 6 months. Proper packing and storage is essential for enhanced shelf life

Salting of soles

Salting of soles

Arranging of salted soles

The picture can't be displayed.

Salt: Sources

- Solar salt: prepared by the evaporation of sea or salt lake waters by the action of sun and wind.
- Brine evaporated salts: produced from underground salt deposits which are brought to the surface in solution form and is heat evaporated.
- Rock salt: obtained as natural deposits from interior rock mines which are ground to varying degrees of fineness without any purification.

Today more than 12 different types of salts are available.

Salt properties and quality issues

- Best quality salt containing upto 99.9 % sodium chloride
- Low quality salt may only contain 80 % sodium chloride
- Impurities - calcium and magnesium chlorides and sulphates, sodium sulphate and carbonate, and traces of copper and iron, as dust, sand and water
- Calcium and magnesium chlorides

  - slow down the penetration of salt into the flesh

  -increase in the rate of spoilage
- Magnesium chloride - hygroscopic

  -making the fish more difficult to dry and to keep dry.
- Calcium and magnesium salts
  - give a whiter colour
  - -impart a bitter taste.

Salt properties and quality issues

- Small quantities of calcium and magnesium compounds in the salt are usually considered desirable.
- Trace quantities of copper in salt – Surface browinng
- Microbiological quality
  - salt tolerant bacteria (halophiles)
  -red or pink bacteria
  - reddening of wet or partly dried salt fish
- Rock salt
- - Halophilic molds
- -dried fish
- - dark patches called 'dun'.
- Fine grain salt –
  - a rapid removal of water from the surface
  -prevents the penetration of salt to the inside of the fish, ('salt burn‘).
- Dry salting, a mixture of large and small grain sizes of salt - recommended

Drying of fish

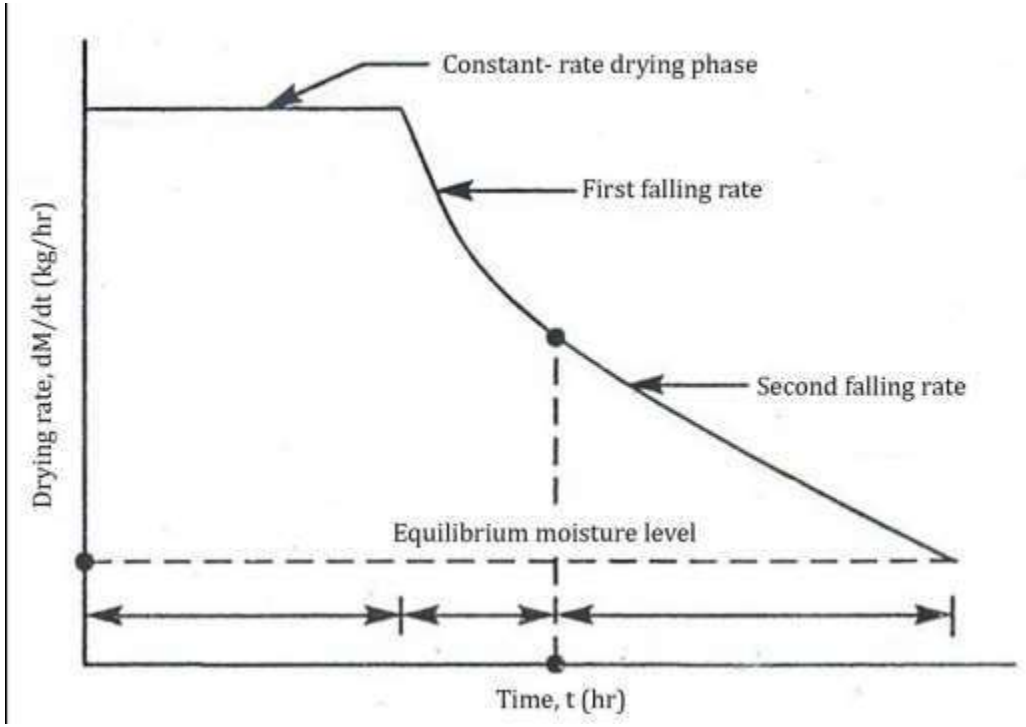
- ‘Drying' implies the removal of water by evaporation
- In fish, 70-80% water
- Water - essential for the activity of all living organisms
- Water removal -facilitate retardation of microbial and autolytic activity
- Water removal -requires an input of thermal energy. Energy -obtained from a variety of sources, e.g., the sun or the controlled burning of oil, gas or wood, electrical heating etc.
- The thermal energy can also be supplied directly to the fish tissue by microwave electromagnetic radiation or ultrasonic heating.

Mechanism of fish drying

- Evaporation from the surface
- Water diffusion from deeper layers to surface
- Two distinct phases

✓ Constant rate period

✓ Falling rate period



Constant rate period

- Air Velocity,
- relative humidity,
- Air temperature
- Surface area

Falling rate period

- Nature of the fish
- Thickness of the fish
- Temperature of the fish
- Water content
- Rate of moisture diffusion

Methods of drying/Type of dryers used

Natural or sun drying:

- Drying on the ground
- Rack Drying
- Solar drying
- Solar tent dryers,
- Solar cabinet dryers

Artificial / Mechanical Dryer

- ❖ Hot air dryers
- ❖ Cabinet dryer
- ❖ Tunnel dryer
- ❖ Multi deck tunn
- ❖ Contact Dryers
- ❖ Vacuum dryers
- ❖ Rotary dryers
- ❖ Drum dryers

Solar driers

Cabinet driers

Solar biomass hybrid dryer-Developed

Proximate Composition of Salted Soles Dried using Solar-Biomass Hybrid Dryer

	Soles (Salted)
Moisture (%)	9.60
Crude Protein(%)	45.61
Total Lipids (%)	7.8
Total ash (%)	37.71

Dried fish products quality issues

- Molds and fungi
- Rancidity
- Pink/Red halophiles
- Insect infestation
- Fragmentation

Smoking of fish

- An ancient process of preservation from good times to lean periods
- introducing new flavours
- Some societies still value the strong flavours of smoked fish

Preservative effect

- derived from reduced water activity (enhanced by salting)
- physical barrier represented by the dried fish surface
- antimicrobial and antioxidant properties of the phenolic compounds released during the wood smoke.

Smoke source and properties

Smoke source

Wood

Saw dust

Wood smoke

by burning the appropriate wood

hard woods being preferred as they yield more phenolics and flavour, e.g. oak, apple, beech, cherry and hickory.

Wood burning is common in traditional systems

often any species of wood will be used.

Wood burning generates heat and less smoke so the fish will be charred unless careful rotation of the fish is done.

Saw dust smoke

Sawdust burns slowly (due to a lack of oxygen) and at a lower temperature but generates more flavours.

- All wood should be dry and completely free of moulds and preservatives, which can be carried onto the fish.

Smoke source and properties

Smoke components

- The components of wood smoke are many and varied
- Organic acids, alcohols, carbonyl compounds, phenolics and hydrocarbons

Concern

- Some of these compounds are known carcinogens
- modern smoking procedures are aimed at achieving a good flavour and colour without deposition of these carcinogens.

Types of smoking of fish

- **Hot smoking**
- **Cold smoking**
- **Liquid smoking**
- **Electrostatic smoking**

Types of smoking of fish

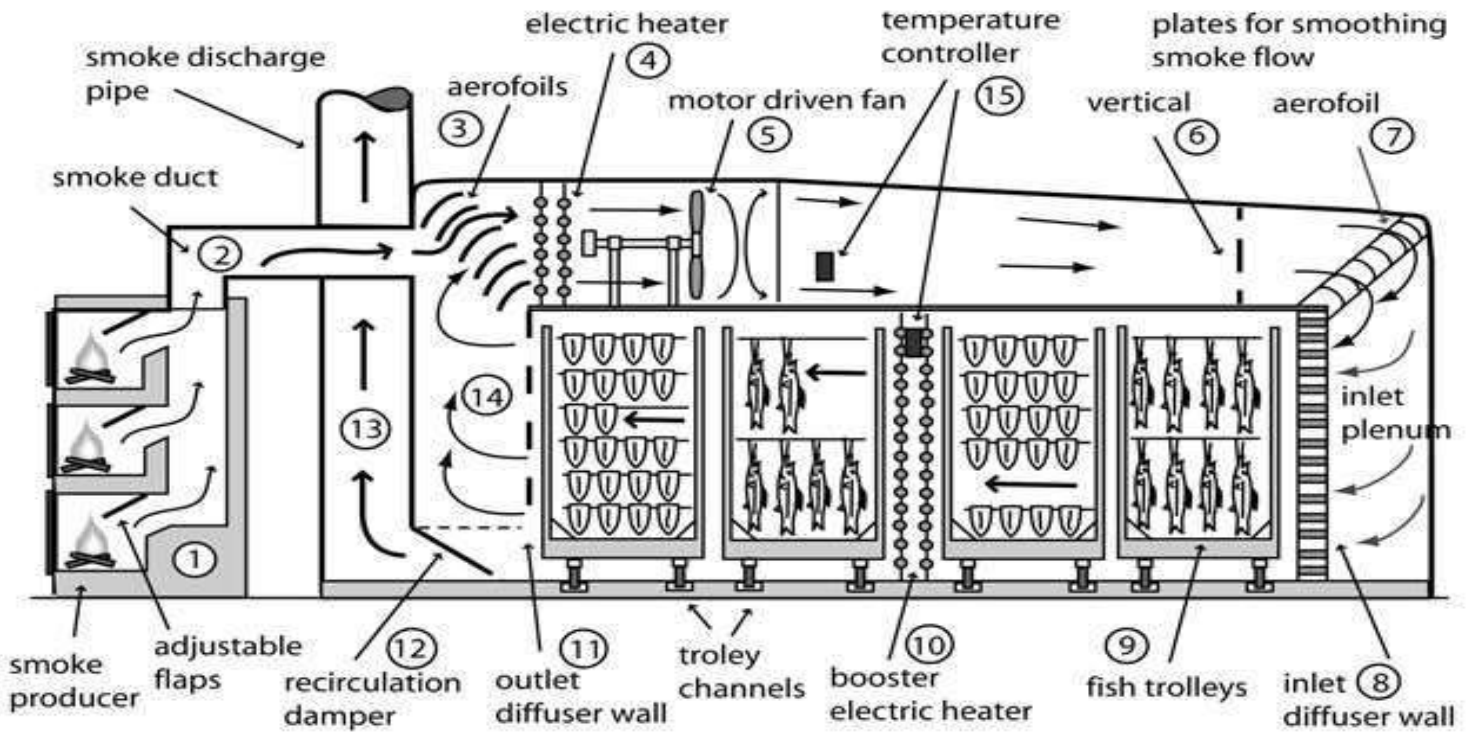
Cold smoking

- below 30°C throughout the process to allow some drying as well as preservation by the deposition of smoke component
- cold smoked fish are often cooked before eating.

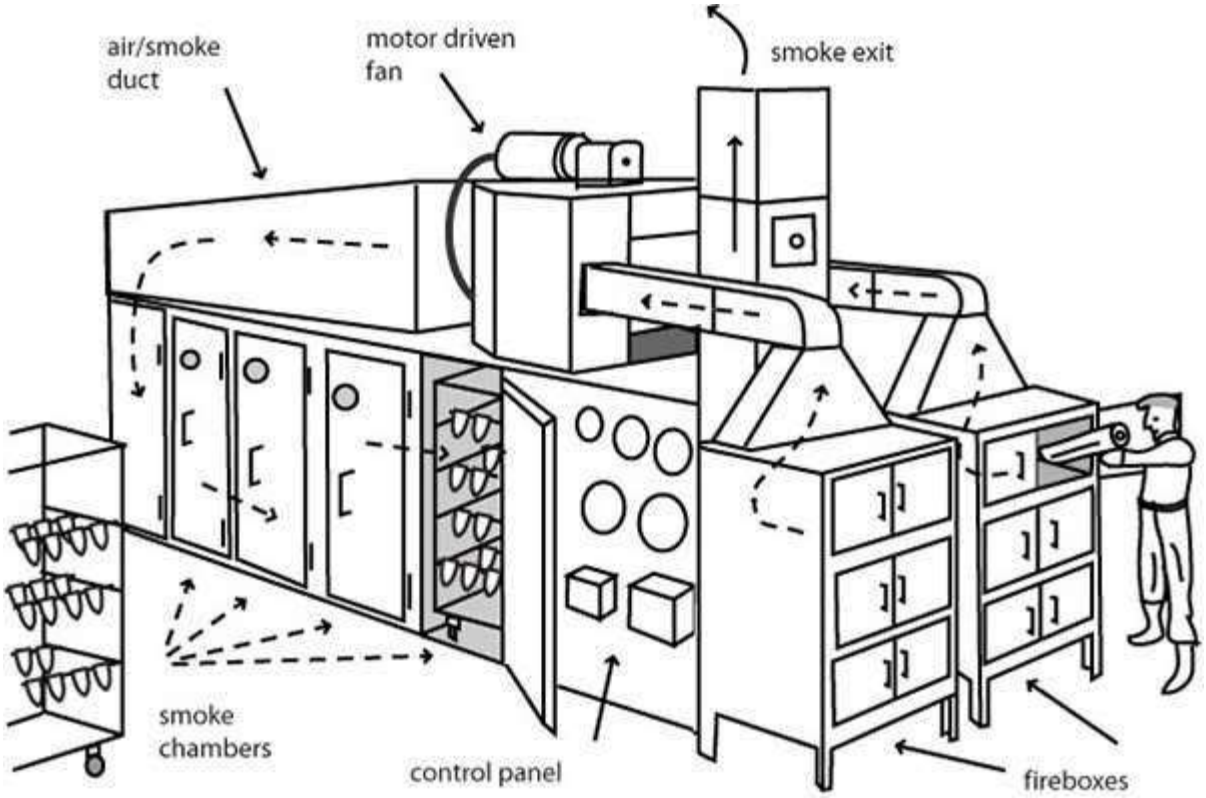
Hot smoking

- mostly at 70–80°C, or even 100°C, such that the fish is cooked and can be eaten without further heating.

Illustration of the hot smoke airflow in the Torry smoking kiln



Smoking kiln



Smoking of fish

- Fresh fish
- Dressing
- Salting
- Washing
- Fire and smoke generation
- Arranging in trays
- Smoking and drying

(Golden colour dried skin and firmer flesh)

Smoked Tuna-Masmin

Traditional methods of smoking over the fire hearth

Locally available smoked fish in the market

Fresh fish after dressing ready to be smoked

Arranging fish on trays

Ready to eat smoked fish

Farmers tasting the product

Quality and safety issues

Biological hazards

- *Listeria monocytogens*
- *Clostridium botulinum*

Chemical hazards

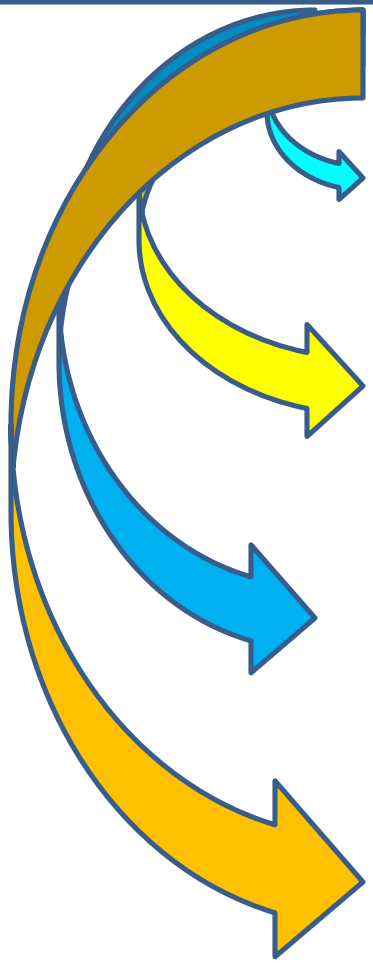
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Histamine
- Biotoxins

Physical hazards

Fermented fish products

- Fermentation involves the breakdown of proteins in the raw fish to simpler substances
- Products are stable at normal temperatures of storage.
- In some processes breakdown of protein is controlled by adding salt.
- Only a partial breakdown of the protein takes place
- Partial breakdown gives desired type of flavour

What is a fermented fish product?



Oldest example of 'biotechnology'

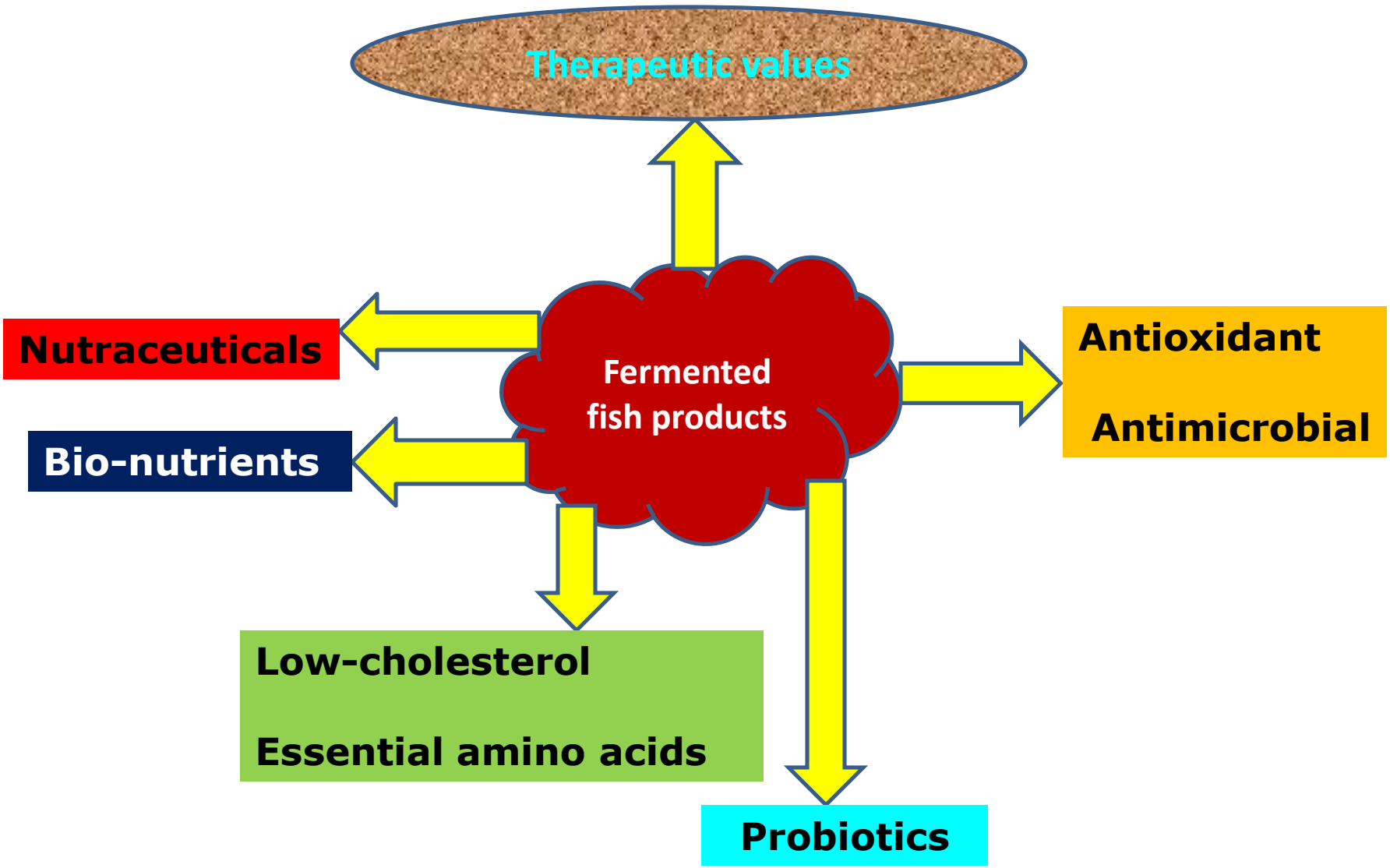
Age old fish preservation method

Very popular and well liked by the general populace in Asia

Despite popularity, R & D on fermented fish is meager

Traditional fish fermentation industries are rural, seasonal, labor intensive, informal, and capital deficient

Microorganisms bring about essential biotransformations in fermented foods

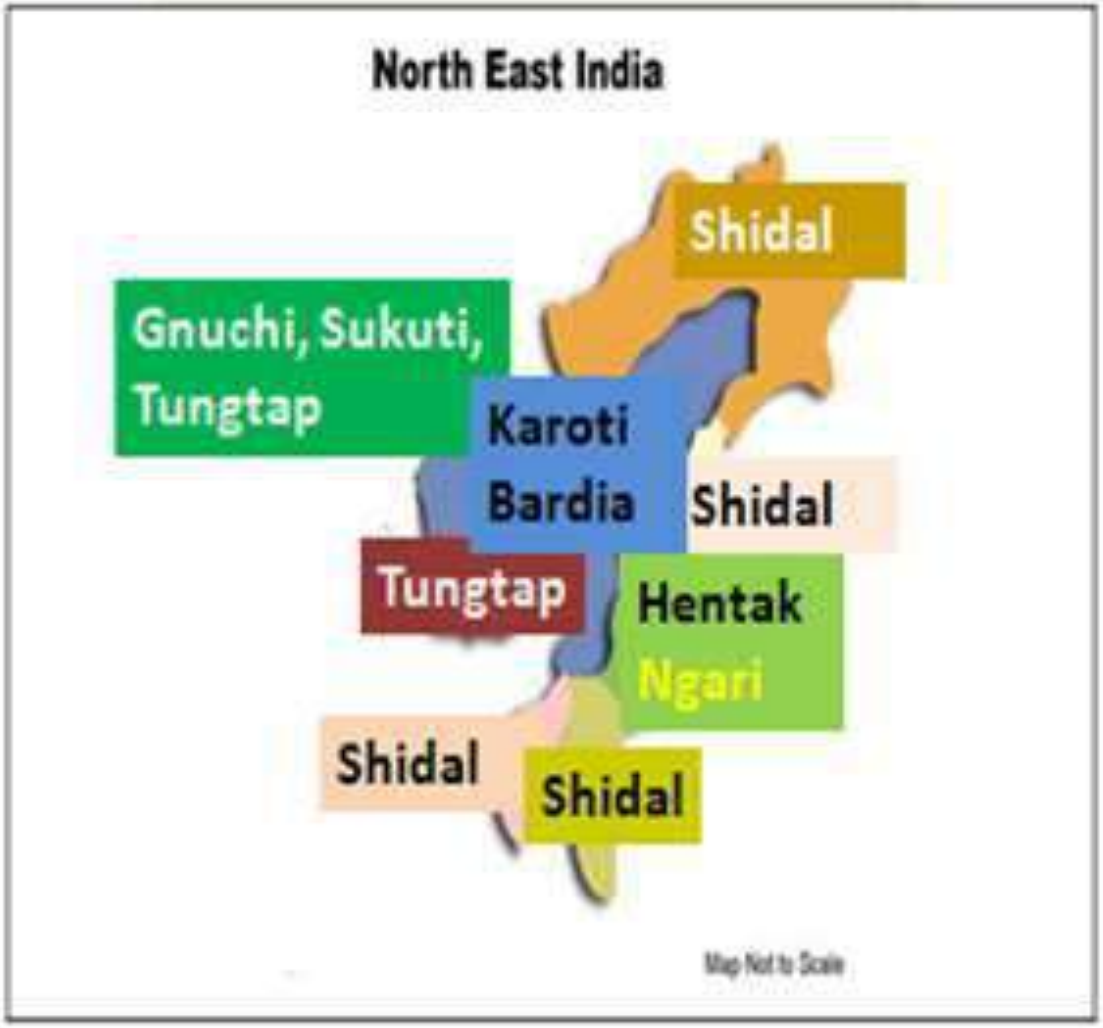


Fermented fish products

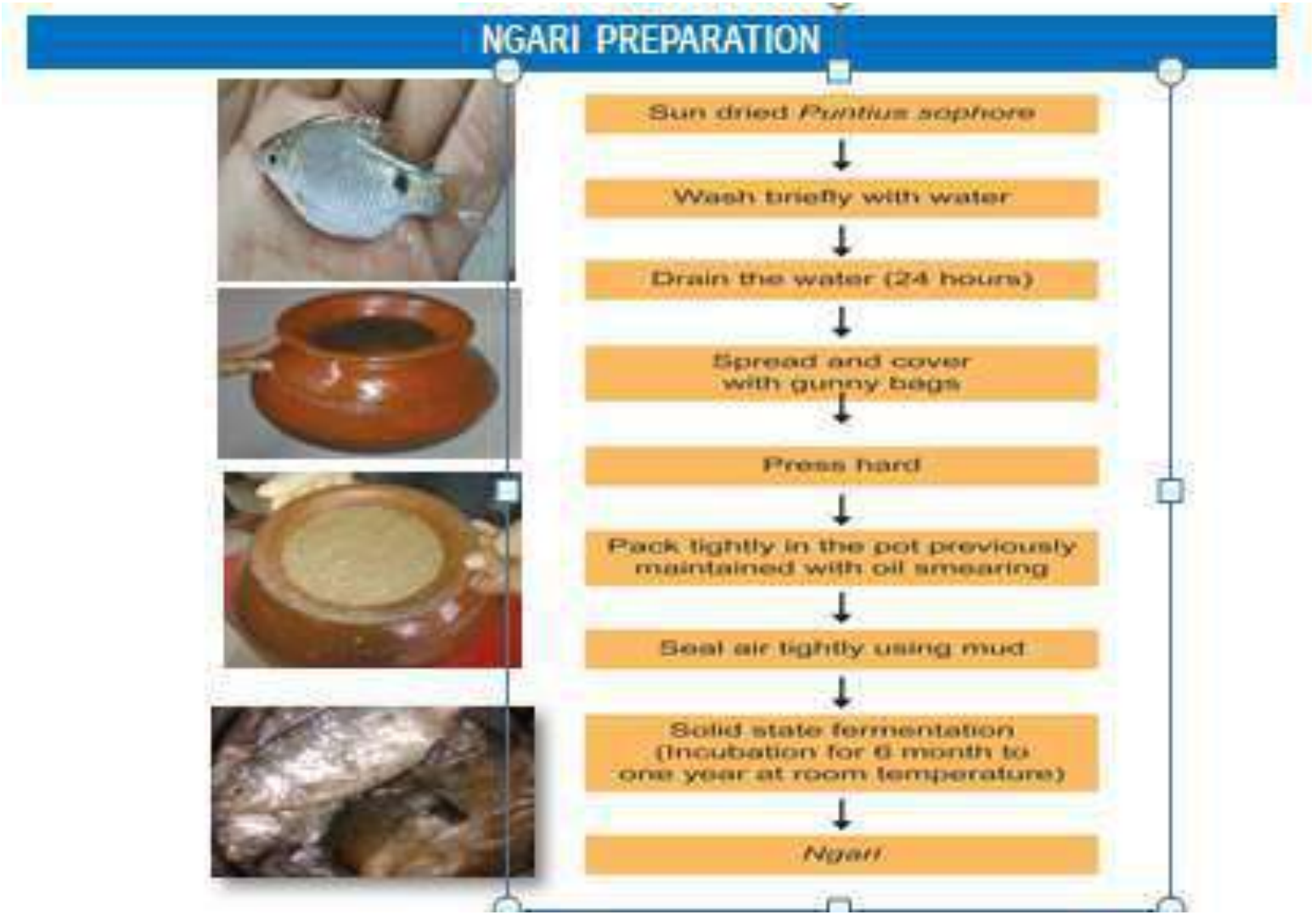
Breakdown of proteins in fermented fish

- by the action of enzymes
- sometimes microorganisms are also involved
- Fermented fish pastes and sauces are relished as a condiment (flavoured salt) along with cooked rice in many of the South East Asian countries.

Indigenous fermented fish product of india



Fermented fish preparation



Sheedal

Salt-free fermented fish products

Technology believed to be originated before 1824

It was exclusively made from *Puntius* spp.

Presently *Setipinna phasa* is also used

Sheedal is solid, bilaterally compressed and pasty with strong odour - a characteristic smell of sheedal

Quality deteriorates very fast once exposed to air outside the fermenting container

Punti-sheedal of different NE states

Phasa-sheedal of different NE states

Seedal preparation

Raw material fishes

***Puntius* spp.**
Setipinna phasa

Right time of Sheedal production

Actually dry Puntius and phasa fish are available in the market from December. Therefore, December to February is the right time for production of Sheedal. This may be extended upto April, before onset of rainy season.

Processing of matka

Before use, matkas are smeared with oil in order to close the micropores present in its wall to make it almost non-permeable to air and vapour.

Oil extracted from Puntius fish is generally preferred by fishers and commercial producers if it is available in plenty.

In case of large scale production of shidal, vegetable oil especially mustard oil is preferably used.

Oil is smeared in both inner and outer walls of the matka followed by drying in the sun.

The oil smearing and subsequent drying process is continued for 7 to 10 days in case of new matka, until they become fully saturated with oil and unable to absorb any more oil even after a fresh drying.

Matka is now ready for filling of fish. In case of re-use of matka, 2 to 5 days of oil smearing and subsequent drying is required.

Preparation of fish for Sheedal

After procurement, dry fish need further drying under sun for 3-5 days.

This is done to remove moisture from the fish to maximum possible extent and also to drive away the maggots, if any.

The dry fish are then cleaned by sorting broken pieces and adhering dusts etc. Fish with already sign of infestation is not taken for Sheedal production.

Water washing-cum-soaking

Dried and cleaned fish are taken in porous bamboo baskets

Traditionally dried fish are water soaked while washing in running water, i.e., in river at shallow depth. But due to poor quality of water in the shallow zone of river, there remains chances of contamination of dry fish with pathogens and other dirt present in the river water.

For hygienic production it is advisable to construct cement cisterns with inlet-outlet provision and use of drinking water for water washing-cum-soaking.

This step is very crucial for Sheedal production and also to some extent depends on the total period of fermentation as desired by the producer.

Usually, for fermenting fish for 3-4 months, the duration of washing is approx. 3-5 minutes.

And for fermenting fish for less than 3 months, washing is done for approx. 5-7 minutes.

However, the duration of water washing-cum-soaking depends on the producers experience and is determined by previous experience depending on the quality of dried fish, period of fermentation desired and shelf-life of the end product.

In case of washing in cistern, it is advisable to change water frequently (after washing of 1-2 lots) to prevent adding of dirt removed from one lot of fish to other lots.

Absorption of water becomes higher and quicker due to previous drying of fish.

Post-washing drying of fish

After water washing-cum-soaking, wet fish are spread over cleaned bamboo mattress (preferably) or in cemented floor under shade overnight for drying.

Evening hours is the best time for water washing-cum-soaking, because the subsequent drying of water soaked fish for 10 to 12 hours passes without any nuisance activities from flies and birds.

Filling of matka

Before filling, the oil processed matka is placed by digging a hole in the ground in such a way that one third of the belly portion of matka remains buried in the ground.

This is done to ensure fixing of matka in vertical position and also to allow the matka to withstand the pressure during filling of fish with compaction.

Clean gunny bags are spread surrounding the matka to avoid any spilled raw material getting contaminated with the soil underneath while filling.

After fixing matka in the ground, the partially dried fish are spread in a layer of about 4-5 inches in height and uniform pressure is applied with bare hand or feet (in case of large mouth matka).

Once the layer is tightly packed, subsequent layers are put in a similar manner till the layer reach near to neck.

Sometimes wooden stick is also used along with hand or feet for almost air tight packing.

About 35 to 37 kg of dried fish is required to fill one 40 kg capacity matka.

Initial sealing with c/paste

After fixing matka in the ground, the partially dried fish are spread in a layer of about 4-5 inches in height and uniform pressure is applied with bare hand or feet (in case of large mouth matka).

Once the layer is tightly packed, subsequent layers are put in a similar manner till the layer reach near to neck. Sometimes wooden stick is also used along with hand or feet for almost air tight packing. About 35 to 37 kg of dried fish is required to fill one 40 kg capacity matka.

Cover paste

A cover paste with semi-solid consistency is made by grinding left over materials after sorting and cleaning of dried fish, with addition of little water.

Initial sealing of matka

Once the matka is filled upto the neck portion, it is primarily sealed with a cover paste.

After proper sealing with cover paste, seal is covered with broad leaves.

Final sealing of matka

The matka is finally sealed by a layer of wet mud made from clay soil.

This soil is usually collected from the pond bottom. Care is taken that sealing is perfect.

This mud layer is checked on and often for about a week for any crack and is repaired immediately by wet mud again.

The final mud seal is then covered by a polythene sheet and tied, to prevent damage of the seal by rodents etc.

Fermentation shed

The filled matkas are lifted to the surface and left undisturbed under a shed for maturation/fermentation.

The fermentation shed should be such that the matkas will get minimum sunrays and rain.

In traditional practice, the ground of the fermentation shed is muddy and both roof and sides are made with bamboo fenches.

Entry of dogs, rodents etc. in the fermentation shed should be prohibited.

The usual period of maturation is 3-5 months. From third month onward 2-3 matkas of each lot is tested for checking the maturity or quality of Sheedal.

About 40-42 kg Sheedal is obtained from each matka.

The filled matkas can be sold during fermentation also after packing in gunny bags in erected position.

Ethnic fish products (Salted dried/smoked/fermented) from Assam

- Chucha
- Hidal
- Hukoti
- Lashim
- Naduba siyam
- Nah-grain
- Namsing
- Shidal


Thank you for your
kind attention

Annexure- 6

Covid-19 impacts and adaptation in aquatic food supply chains in Assam

October, 2021

COVID-19 impacts and adaptation in aquatic food supply chains in Assam

One year into the pandemic

Bianca Haas, Suresh Rajendran, Kalpajit Gogoi, Begum Rehena Parveen, Neeta Beypi, Nabamika Sonowal, Ben Belton

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About WorldFish
WorldFish is a nonprofit research and innovation institution that creates, advances and translates scientific research on aquatic food systems into scalable solutions with transformational impact on human well-being and the environment. Our research data, evidence and insights shape better practices, policies and investment decisions for sustainable development in low- and middle-income countries.

We have a global presence across 20 countries in Asia, Africa and the Pacific with 460 staff of 30 nationalities deployed where the greatest sustainable development challenges can be addressed through holistic aquatic food systems solutions.

Our research and innovation work spans climate change, food security and nutrition, sustainable fisheries and aquaculture, the blue economy and ocean governance, One Health, genetics and AgriTech, and it integrates evidence and perspectives on gender, youth and social inclusion. Our approach empowers people for change over the long term: research excellence and engagement with national and international partners are at the heart of our efforts to set new agendas, build capacities and support better decision-making on the critical issues of our times.

WorldFish is part of One CGIAR, the world's largest agricultural innovation network.

Acknowledgments
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1. Overview

In 2020, we conducted a bi-weekly phone survey, covering the period from February to November, with 108 fish supply chain actors in Assam, India, to assess impacts of COVID-19 on the availability and price of aquatic foods and production inputs (Sheih et al, 2021). In 2021, we conducted a follow-up survey with 78 participants who could be contacted and agreed to be interviewed. The sample comprised of the following: feed mills (4), feed sellers (pellet) (4), feed sellers (non-pellet) (8), fish hatcheries (2), fish farmers (20), fishers (19), fish processors (4), traders (7), and retailers (10).

Recall interviews were conducted by phone in June regarding business activities during the months of March, April, and May. The survey period during 2020 included one month at the onset of the pandemic (March) and two months during which strict lockdown measures were enforced (April and May). India's second wave of COVID-19 cases peaked in Assam during May 2021, causing serve disruptions to everyday activities as large numbers of people stayed home to avoid infection. This approach allowed for a comparative assessment the impacts experienced by businesses and adaptations they made in response, one year on from the beginning of the COVID-19 pandemic.

2. General impacts

Most of the respondents interviewed during 2021 were operational in the surveyed months (90%). We asked respondents about the value of their sales during 2019 (pre-pandemic) compared to those in 2020 (the first year of the pandemic), and how their anticipated sales for 2021 compared to sales in 2020.

Eighty-six percent of the respondents experienced a decrease in sales between 2019 and 2020. More than one-third of all respondents (35%) reported that sales declined by 10-30%, and almost one-quarter of the respondents (22%) reported that sales had declined by 30-50%. Only 6% of farms reported that their 2020 sales were higher than in 2019 (Figure 1).

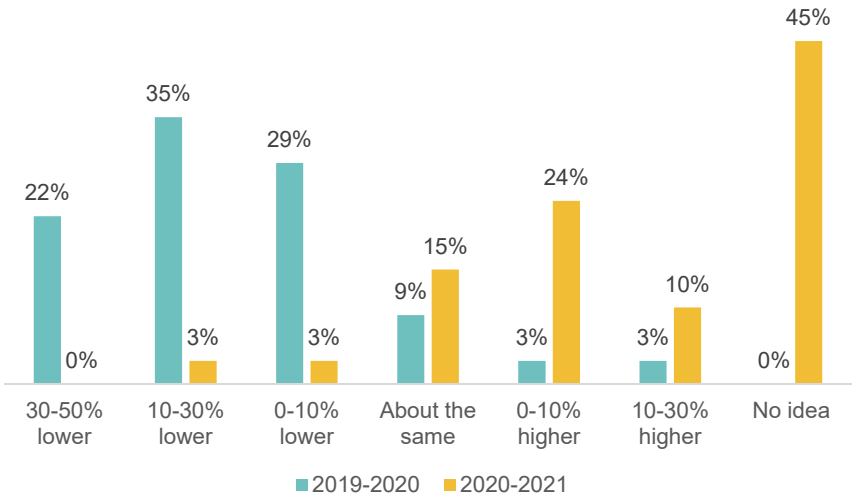

Figure 1. Change in value of sales from 2019 to 2020 and anticipated change from 2020 to 2021, reported and predicted by respondents.

Based on anticipated sales volumes, business activity in 2021 appeared to have stabilized. Only 6% of respondents anticipated that their sales for 2021 would be lower, 15% believed that their sales would remain the same, and 34% anticipated an increase in sales. However, almost half of the respondents had no idea what the outcome would be, indicating a high level of uncertainty.

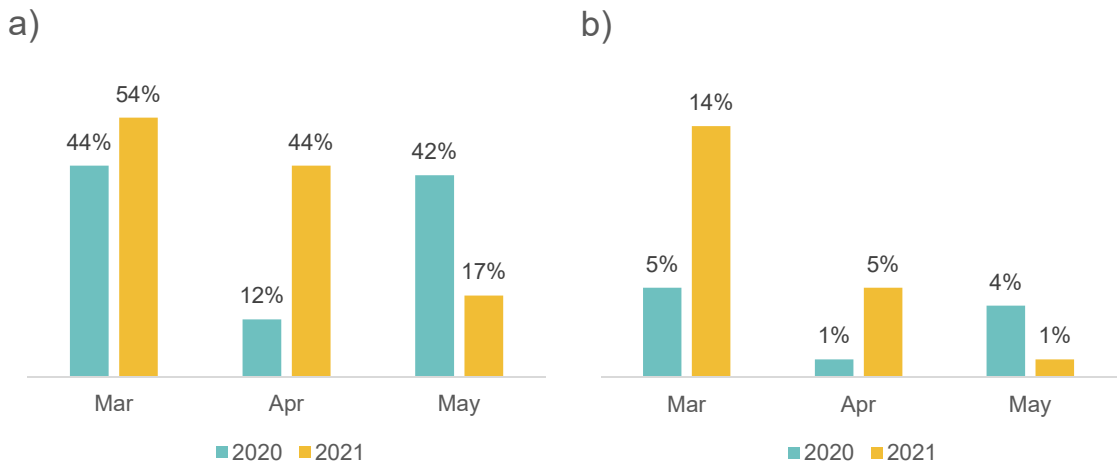

Figure 2. Percentage of respondents hiring; (a) male; (b) female daily labour.

Employment in aquaculture value chains rebounded during March and April 2021 as compared to the same period in 2020 but declined sharply in May to below 2020 levels as the second wave of COVID-19 hit India (Figure 2). In 2020, the share of respondents hiring male daily labour followed a V-shaped curve, dropping from 44% in March, to 12% in April, before bouncing back to 42% in May. In contrast, in 2021, the share of businesses employing male daily workers declined steadily from 54% in March to just 17% in May. This pattern reflects the severity of the COVID-19 outbreak in May, which likely caused many workers to stay home to avoid infection. Similar to male daily labour, the share of

respondents hiring women daily workers was higher in March and April 2021 compared to 2020, but lower in May, dropping from 14% in March 2021 to only 1% in May 2021.

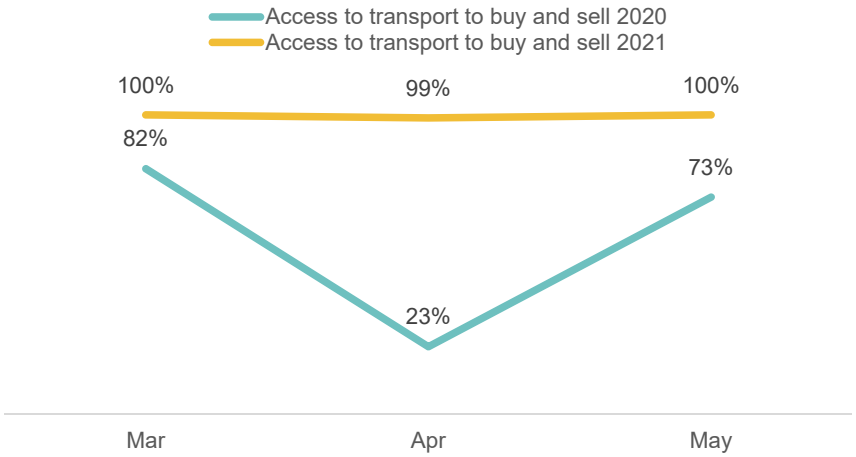

Figure 3. Share of respondents able to access whenever required to transport to buy or sell products in March-May 2020 and 2021 (%).

Respondents reported much better levels of access to transport for purchasing inputs or selling products in 2021, as compared to 2020, indicating that business transport was permitted to continue operating, even during the peak period of COVID-19 infection in May 2021. One hundred percent of respondents reported being able to access transport whenever needed in all three survey months in 2021. In contrast, in 2020 transport access followed a steep V-shaped curve, dropping from 82% in March to 23% during the April lockdown, before rebounding to 73% in May (Figure 3).

Access to inputs and buyers improved in 2021 as compared to 2020, following a similar pattern to transport (Figure 4). In 2020, the share of respondents able to access inputs whenever they attempted to do so followed a V-shaped curve, falling from 84% in March, to 8% during the nationwide lockdown in April, before recovering to 75% in May. In contrast, during the same period in 2021, an average of 98% of respondents reported being able to access inputs whenever needed. The share of respondents able to find buyers on all occasions sought was also much higher in the first two months of 2021 than in 2020, but fell back 2020 levels in May, seeming to reflect declining demand during the peak of the second wave of the COVID-19 pandemic. Specifically, in 2020, the share of respondents able to access buyers fell from 78% in March, to 13% in April, before increasing to 72% in May. In contrast, in 2021, these figures were stable at around 97% in the first two months before dropping to 73% in May.

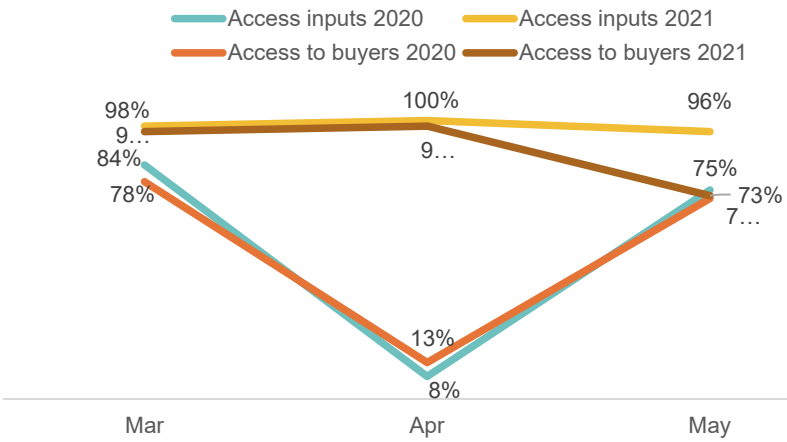

Figure 4. Share of respondents able to access inputs and buyers on all occasions attempted in March-May 2020 and 2021 (%)

The percentage of respondents reporting having a sufficient weekly income fell sharply from 51% in May 2020 to 29% in May 2021 (May was the only month for which this question was included in both survey rounds), likely reflecting the negative impact of the second wave of COVID-19 on employment. However, the share of respondents who bought less food than usual decreased somewhat from 43% in May 2020 to 31% in May 2020. The share of respondents who purchased the same quantity of food as usual increased from 57% in May 2020 to 69% in May 2021.

3. Business adaptations to COVID-19

We asked respondents about behaviours that we hypothesized they might have adopted as adaptations to challenges their businesses faced between 2019 and 2021 (Figure 5a). Among those who reported adaptations, we asked in which years they had practised these (Figure 5b). Our interpretation of these results is that behaviours that began or increased sharply from 2020 onwards are likely to be adaptations to COVID-19, whereas any that were already common in 2019 were pre-existing behaviours.

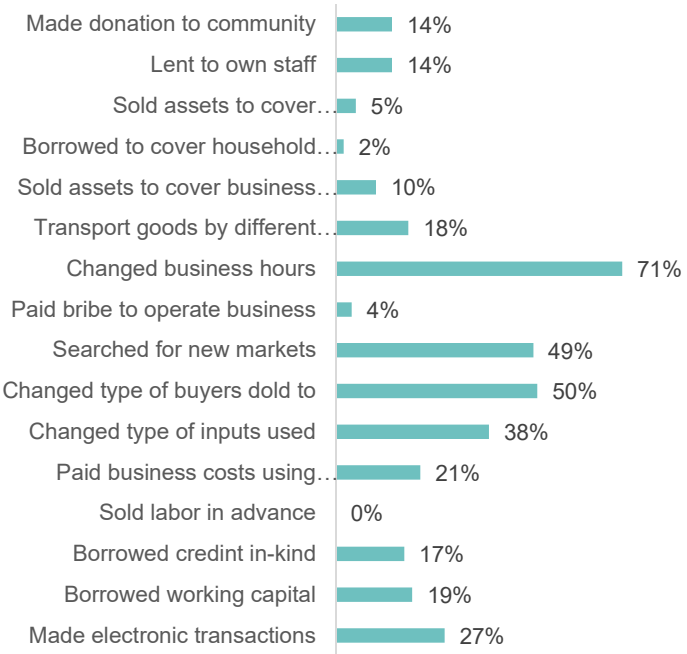

Figure 5a. Percentage of respondents reporting adaptive behaviours in any year (2019-2021)

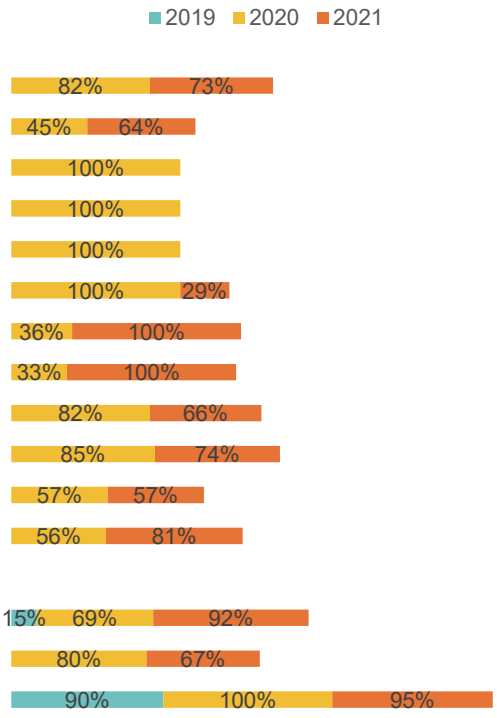

Figure 5b. Percentage of respondents reporting adaptive behaviour, by year, conditional on reporting the behavior.

Many respondents appeared to have altered their behaviour in adaptation to new challenges posed by COVID-19 (Figure 5). The greatest change was seen regarding business hours (71%), with all respondents having changed their business hours in 2021. Half of the respondents (50%) had changed the type of buyers they sold their products to, and 49% searched for new markets (Figure 5a), especially in 2020 (as reported by 82% of those who searched for new markets in 2020 and 66% in 2021 – Figure 5b). Moreover, more than one third of respondents (38%) changed the types of inputs they used, possibly in response to shortages or price rises linked to COVID-19 impacts, which was equally common in 2020 and 2021.

Most adaptive behaviors were only reported in 2020 and/or 2021, suggesting they were responses to COVID-19. For example, surveyed respondents only reported selling assets to cover households' costs, borrowing money to cover household costs, and selling assets to cover business costs in 2020. Borrowing working capital and in-kind credit also increased sharply in 2020 and 2021, relative to 2019. These behavior changes are indicative of severe levels of financial stress experienced by many businesses and households. 27% of respondents reported having made electronic transactions within the past three years but, this practice was already well established prior to the pandemic.

4. Impacts by value chain segment

The following subsections detail changes in business operation occurring between March-May 2020 and March-May 2021, for surveyed businesses in seven segments of the aquatic food supply chain in Assam[1].

4.1. Feed sellers

All but four feed sellers interviewed sold non-pellet feeds. Respondents who sold non-pelleted feed operated their business in March and May 2020, but all closed during April 2020 (the peak lockdown period). In contrast, in 2021, 88% and 75% of feed sellers operated in March and April respectively, before plummeting to 13% in May. The average number of days operated followed a similar pattern, falling steeply in 2021 from 24 days/month in March, to 2 days in May. All respondents cited COVID-linked reasons for closing their business in both years. These included temporary or permanent suspension of operations or movement restrictions.

[1]Insufficient information on feed mills was gathered for presentation here

The average sales value per ton of feed was consistently higher in March-May 2021 than in the same period during 2020. However, the total quantity of sold feed was higher in 2020 compared to 2021, on average 145 tons/month and 22 tons/month, respectively. No feed was sold in during the lockdown April 2020, but the quantity sold in May 2020 was considerably higher than in May 2021, likely due to farmers stockpiling feed after being unable to access it in April in 2020.

4.2. Fish hatcheries

All fish hatcheries operated in all three survey months in 2021, whereas in 2020 none operated in March, 50% operated in April, and 100% operated in May. The average number of operational days per month was also higher in 2021 than 2020, averaging 20 days/month, compared to 15 days in April and May. The total value of fingerlings sold in all three months in 2021 was much higher than in 2020, averaging INR 0.74 million/month and INR 163 million/month, respectively.

4.3. Fish farms

All surveyed respondents operated their fish farms in both years, except during May 2021, when only 30% were operational, likely due to the severity of the COVID-19 crisis at that time. Access to inputs improved substantially in 2021 compared to 2020. The share of surveyed farms able to procure inputs whenever needed increased from 75% in March 2021, to 100% in May 2021, up from 65% the previous year (Figure 6).

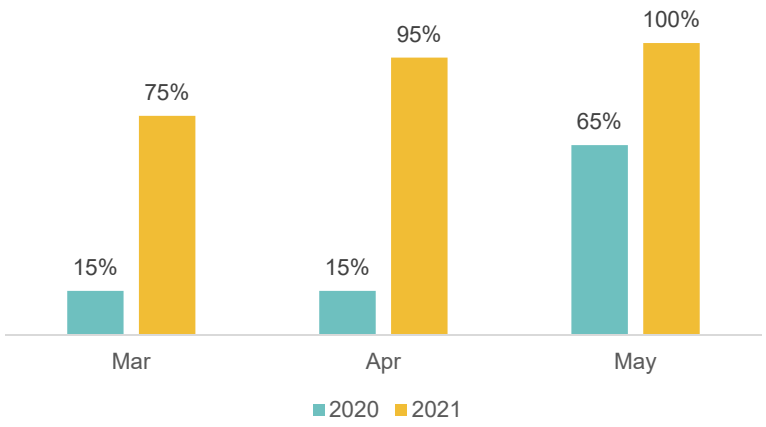

Figure 6. Share of fish farms reporting procuring inputs in March-May 2020 and 2021.

The procurement price of feed was quite stable in 2021. For instance, the price of rice bran, the main feed purchased by farms in our sample, was quite stable in 2021, at around INR 16,500/t. The quantity of feed procured by surveyed farms was slightly higher in 2021 than in 2020, except for May when the quantity procured in 2021 was much lower than during 2020, likely because most of the surveyed farms closed during this period.
The average farmgate price of fish was slightly higher in 2020 (INR 237/kg) than 2021 (INR 220/kg). Following a similar pattern to businesses in other value chain segments, the quantity of sold fish was higher in the first two months of 2021 than the same period in 2020, with no fish sold in March 2020, but the quantity of fish sold in May 2021 was much lower than in May 2020 (1t vs 17t).

4.4. Fishers

Most of the surveyed fishers own a boat (74%), but none of the boats had engines, indicating that they were very-small scale fishers. In 2021, the share of fishers operating their business halved between March and April (89% to 42%). No fisher worked in May 2021 and the period from March-May 2020. In May 2021, respondents cited seasonal closures as the main reason, whereas in 2020, businesses were suspended due to COVID-19 linked reasons such as transport restrictions. The total quantity of landed and sold fish was higher in March 2021 compared to April 2021

4.5. Fish processors

One-quarter of the surveyed fish processors operated their business in March 2021, while operations were suspended in the following two months. No fish processor operated their business in the surveyed period in 2020. In 2021, respondents cited seasonal closures as the reason for stopping their operations, whereas, in 2020, respondents cited that the current market price of fish was too high or that they had to temporarily suspend their business due to COVID-19.

4.6. Fish traders

All surveyed fish trader operated their business from March to May 2021. In contrast, in 2020, 100% of the businesses operated in March 2020, none in April, and 57% in May. Respondents cited COVID-19 linked reasons for stopping their businesses in 2020. These included temporary suspension of operations and transport restrictions. Businesses operated for an average of 21 days/month in 2021 and 14.5 days/month in 2020.

The average sales price of farmed fish was lower in 2021 than in 2020 (around INR170/kg vs INR220/kg). However, despite the lower unit price, the total quantity of fish sold by traders in 2021 was considerably higher than in 2020. The total quantity of farmed fish sold each month in 2021, ranged from 28 t to 44 t. In comparison, in 2020, 21 t was sold in March, and only 6t in May (Figure 7).

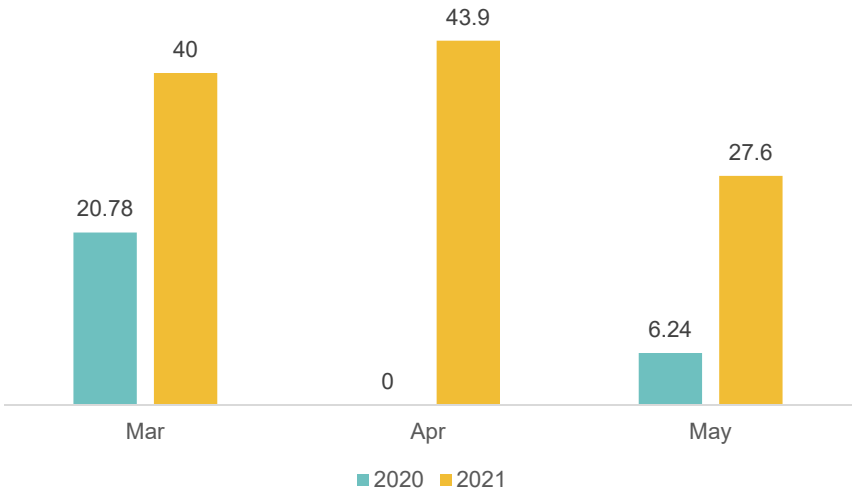

Figure 7. Total quantity of farmed fish sold by traders (t) in 2020 and 2021.

4.7. Fish retailers

Similar to fish traders, all fish retailers operated their business in all three months in 2021. In March and May 2020 80% were operational, but all suspended their business operations in April 2020 due to COVID-19. Businesses opened for an average of 27 days/month in 2021 and 17 days in March and May 2020.

The average retail price of farmed fish sold by surveyed retailers was lower in 2021 than in 2020, averaging about 15% less over the three months, while the total quantity of fish sold in 2021 was higher (Figure 8). In 2020, the quantity sold declined from 4.2t in March to 2.6t in May. Monthly sales were more stable in 2021, at between 5.3t and 5.8t. Retailers sold a small quantity of freshwater capture fish and shrimp each month in 2021, whereas sales of these products were only reported in March 2020, indicating that the diversity of aquatic foods available in the market was greater in 2021 than in 2020.

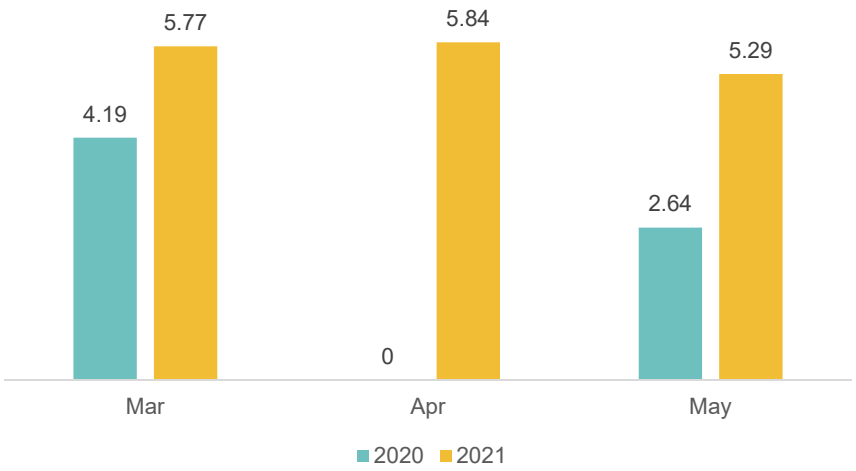

Figure 8. Total quantity of farmed fish sold by surveyed retailers (t) in 2020 and 2021.

5. Recommendations

1. During the COVID-19 lockdown and second wave, levels of employment in fisheries and aquaculture activities reduced drastically. This indicates the need for social security measures such as free food rations and cash transfers to support livelihoods
2. Government permission for movement of production inputs like seed and feed, and for fish for marketing helped overcome disruptions in supply and demand of inputs and outputs during the second wave of the COVID-19 pandemic.
3. Government support for marketing of fish through the Fisheries Federation outlets could help to reduce risk and uncertainty among farmers and fishers regarding the sale of fish
4. Most fish farms, hatcheries, seed rearing farms, feed manufacturers and suppliers, fish traders and retailers continued to operate during the study period. This moderated the impact of COVID-19 pandemic in the fish supply chain. In contrast, participants in capture fisheries were found to be more severely affected by reductions in employment and income, suggesting that that they require significant attention as part of recovery efforts.

List of figures

References

Jacqueline Shieh, Suresh Rajendran, Kalpajit Gogoi, Begum Rehena Parvin, Neeta Beypi, Nabamika Sonowal, Saadiah Ghazali, Goutam Dhar, Ben Belton, Bianca Haas. 2021. Impacts of COVID-19 on Aquatic Food Supply Chains in Assam, India. Penang, Malaysia: CGIAR Research Program on Fish Agri-Food Systems. Program Report.

WorldFish

About WorldFish

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Annexure- 7
Focus Group Discussions

Focus Group Discussion with Farmer Producer Groups of APART Fisheries Component on Better Management Practices Guidelines of WorldFish

Better Management Practices refers to a set of management practices that are developed based on the existing practices and associated risks as determined in consultation with scientists and farmers and relevant industry stakeholders. BMP development process considers the technical, environmental, social and economic issues associated with farming practices and are always location and context specific. BMPs are dynamic and evolving over period and need to be updated periodically. BMP is very much necessary to improve productivity, reduce negative environmental and social consequences of farming. In order to create awareness and adoption of Better Management Practices among the farmers of APART districts, a Farmer Producer Group level Focus Group Discussion was initiated by WorldFish in collaboration with Department of Fisheries, Govt. of Assam and College of Fisheries, Assam Agricultural University. During the discussion all members of the FGP as well as non-beneficiaries were present. Organizing Focus Group Discussion at FPD level is an effective extension strategy to disseminate the information of Better Management Practices among farming community at their place. The list of Focus Group Discussion cum BMP training conducted during the period from April, 2021 to September, 2021 along with their respective reports are given below:

Date	District	Name of the village	Name of FPG attended	Total Nos. of participants	Male	Female
5-04-2021	Nagaon	Salonabori, Batadrawa	Salonabori Meen Utpadon Got	15	12	3
6-04-2021	Nagaon	Kanchanpur, Rupohihat	Kanchanpur hatipukhuri meen palon SHG	20	18	2
7-04-2021	Nagaon	Pub Singimari, Laokhowa	Salpara Jonali Paddy FPG	18	14	4
8-04-2021	Sonitpur	Godamghat miri, Balipara	Godamghat Kachari FPG	20	12	8
9-04-2021	Sonitpur	Bhuyanpara, Sootea	Sootea FPG & Bhuyanpara FPG	25	20	5
12-04-2021	Morigaon	Gerekoni, Bechamari	APART sky FPG	20	13	7
Total				**118**	**89**	**29**

FPG Level Focus Group Discussion on Better Management Practices for Paddy cum fish Integrated Farming at Salonabori, Batadrawa, Nagaon under APART Fishery sub-Component

In order to create awareness and adoption of Better Management Practices for Paddy cum fish integrated farming, a FPG level Focus Group Discussion was conducted on 5th April, 2021 at Salonabori, Batadrawa, Nagaon by WorldFish in collaboration with College of Fisheries, Assam Agricultural University, Raha and Department of Fisheries, Govt. of Assam. A total of 15 farmers attended the Focus Group Discussion which included both beneficiary & non beneficiaries of Salonabori Meen Utpadon Got under APART. At the beginning Mr. Biswajit Borah, Project Associate, College of Fisheries, AAU, Raha welcomed all the participants and explained the program's objectives & its purpose. Mr. Prakash Kalita, TEF, Nagaon delivered lecture on general concept, principles and different systems of paddy cum fish integrated farming. Miss Ajimoon Nissa Khan, Project Associate, College of Fisheries, AAU, Raha described the fish diseases, prevention and their control measures as well as soil and water quality management in paddy cum fish integrated farming. Mr. Dibyarishi Bhattacharjya, Junior researcher, KVK, Sonitpur delivered lecture on the paddy variety selection for paddy cum fish integrated farming, seed treatment, seedling treatments and various precautionary measures for pest infestation as well as fungal infestation in paddy. He also described about the ITK, traps for controlling the pest infestation without using any chemicals in paddy field. He also explained the need for fertilizer application and its requirement in paddy. He also informed about the various machineries that can reduce the labour involvement in paddy farming. Mr. Kalpajit Gogoi, TEF, WorldFish explained the Better Management Practices for Paddy cum fish integrated farming developed by WorldFish experts exclusively for APART and described all the technical aspects of BMP for paddy cum fish integrated farming followed by the participants interaction. He informed the participants that BMP is about how better way we can do our day to day farming activities which will lead to better management of the farm and enable to reduce the loses and increase the benefits as well as sustainability & environmental safety. Additionally he also described the importance of Mola as a good source of nutrition for pregnant & lactating women and more specifically for the brain development of fetus & young children and advised regular home consumption of Mola. He also stressed the importance of stocking Mola and other small indigenous species in paddy cum fish farming system that is taken up under APART and advised to take the opportunity to adopt as much as possible. He also described the need for gender integration in fisheries and role of women in fisheries and aquaculture and advised the women participants to take a significant role in day to day activities in fish farming. In the interaction session the participants were found to be very much interactive and had good interaction with Technical Consultants regarding all technical aspects.

FPG Level Focus Group Discussion on Better Management Practices for Paddy cum fish Integrated Farming at Kanchanpur, Rupohihat, Nagaon under APART Fishery sub-Component

In order to create awareness and adoption of Better Management Practices for Paddy cum fish integrated farming, a FPG level Focus Group Discussion was conducted on 6th April, 2021 at Kanchanpur, Rupohihat, Nagaon by WorldFish in collaboration with College of Fisheries, Assam Agricultural University, Raha and Department of Fisheries, Govt. of Assam. A total of 20 farmers attended the Focus Group Discussion which included both beneficiary & non beneficiaries of Kanchanpur hatipukhuri meen palon SHG under APART. At the very beginning Mr. Biswajit Borah, Project Associate, College of Fisheries, AAU, Raha welcomed all the participants and explained the program's objectives & its purpose. Mr. Prakash Kalita, TEF, Nagaon delivered lecture on general concept, principles and different systems of paddy cum fish integrated farming. Miss Ajimoon Nissa Khan, Project Associate, College of Fisheries, AAU, Raha explained the fish diseases, prevention and their control measures as well as soil and water quality management in paddy cum fish integrated farming. Mr. Dibyarishi Bhattacharjya, Junior researcher, KVK, Sonitpur delivered lecture on the paddy variety selection for paddy cum fish integrated farming, seed treatment, seedling treatments and various precautionary measures for pest infestation as well as fungal infestation in paddy. He also described the ITK, traps for controlling the pest infestation without using any chemicals in paddy field. He also explained the importance of fertilizer application and its requirement in paddy. He also informed about the various machineries that can reduce the labour involvement in paddy farming. Mr. Kalpajit Gogoi, TEF, WorldFish explained the Better Management Practices for Paddy cum fish integrated farming developed by WorldFish experts exclusively for APART and described all the technical aspects of BMP for paddy cum fish integrated farming followed by the participants interaction. He informed the participants that BMP is about how better way we can do our day to day farming activities which will lead to better management of the farm and enable to reduce the loses and increase the benefits as well as sustainability & environmental safety. Additionally he also described the importance of Mola as a good source of nutrition for pregnant & lactating women and more especially for the brain development of fetus & young children and advised home consumption of Mola. He also stressed for stocking of Mola and other small indigenous species in paddy cum fish farming system that is taken under APART and advised to take the opportunity to adopt as much as possible. He also described the need for gender integration in fisheries and role of women in fisheries and aquaculture and advised the women participants to take a significant role in day to day activities in fish farming. In the interaction session the participants were found to be very much interactive and had good interaction with Technical Consultants regarding all technical aspects.

FPG Level Focus Group Discussion on Better Management Practices for Paddy cum fish Integrated Farming at Pub Singimari, Laokhowa, Nagaon under APART Fishery sub-Component

In order to create awareness and adoption of Better Management Practices for Paddy cum fish integrated farming, a FPG level Focus Group Discussion was conducted on 7th April, 2021 at Pub Singimari, Laokhowa, Nagaon by WorldFish in collaboration with College of Fisheries, Assam Agricultural University, Raha and Department of Fisheries, Govt. of Assam. A total of 18 farmers attended the Focus Group Discussion which included both beneficiary & non beneficiaries of Salpara Jonali Paddy FPG under APART. At the beginning Mr. Biswajit Borah, Project Associate, College of Fisheries, AAU, Raha welcomed all the participants and explained about the program's objectives & its purpose. He also described about general concept, principles and different systems of paddy cum fish integrated farming. Mr. Prakash Kalita, TEF, Nagaon delivered lecture on the fish diseases, prevention and their control measures as well as soil and water quality management in paddy cum fish integrated farming. Mr. Dibyarishi Bhattacharjya, Junior researcher, KVK, Sonitpur delivered lecture on the paddy variety selection for paddy cum fish integrated farming, seed treatment, seedling treatments and various precautionary measures for pest infestation as well as fungal infestation in paddy. He also described about the ITK, traps for controlling the pest infestation without using any chemicals in paddy field. He also explained the importance of fertilizer application and its requirement in paddy. He also informed about the various machineries that can reduce the labour involvement in paddy farming. Mr. Kalpajit Gogoi, TEF, WorldFish explained the Better Management Practices for Paddy cum fish integrated farming developed by WorldFish experts exclusively for APART and described all the technical aspects of BMP for paddy cum fish integrated farming followed by the participants interaction. He informed the participants that BMP is about how better way we can do our day to day farming activities which will lead to better management of the farm and enable to reduce the loses and increase the benefits as well as sustainability & environmental safety. Additionally he also described the importance of Mola as a good source of nutrition for pregnant & lactating women and more especially for the brain development of fetus & young children and advised regular home consumption of Mola. He also stressed on stocking Mola and other small indigenous species in paddy cum fish farming system that is taken under APART and advised to take the opportunity to adopt as much as possible. He also described the need for gender integration in fisheries and role of women in fisheries and aquaculture and advised the women participants to take a significant role in day to day activities in fish farming. In the interaction session the participants were found to be very much interactive and had good interaction with Technical Consultants regarding all technical aspects.

FPG Level Focus Group Discussion on Better Management Practices for Paddy cum fish Integrated Farming at Godamghat miri, Balipara, Sonitpur under APART Fishery sub-Component

In order to create awareness and adoption of Better Management Practices for Paddy cum fish integrated farming, a FPG level Focus Group Discussion was conducted on 8th April, 2021 at Godamghat miri, Balipara, Sonitpur by WorldFish in collaboration with College of Fisheries, Assam Agricultural University, Raha and Department of Fisheries, Govt. of Assam. A total of 20 farmers attended the Focus Group Discussion which included both beneficiary & non beneficiaries of Godamghat Kachari FPG under APART. At the very beginning Mr. Biswajit Borah, Project Associate, College of Fisheries, AAU, Raha welcomed all the participants and explained about the program's objectives & its purpose. He also described about general concept, principles and different systems of paddy cum fish integrated farming. Miss Jyotirmoyee Das, TEF, Sonitpur delivered lecture on the fish disease, prevention and their control measures as well as soil and water quality management in paddy cum fish integrated farming. Mr. Dibyarishi Bhattacharjya, Junior researcher, KVK, Sonitpur delivered lecture on the paddy variety selection for paddy cum fish integrated farming, seed treatment, seedling treatments and various precautionary measures for pest infestation as well as fungal infestation in paddy. He also described about the ITK, traps for controlling the pest infestation without using any chemicals in paddy field. He also explained the importance of fertilizer application and its requirement in paddy. He also informed about the various machineries that can reduce the labour involvement in paddy farming. Mr. Kalpajit Gogoi, TEF, WorldFish explained the Better Management Practices for Paddy cum fish integrated farming developed by WorldFish experts exclusively for APART and described all the technical aspects of BMP for paddy cum fish integrated farming followed by the participants interaction. He informed the participants that BMP is about how better we can do our day to day farming activities which will lead to better management of the farm and enable to reduce the loses and increase the benefits as well as sustainability & environmental safety. Additionally he also described the importance of Mola as a good source of nutrition for pregnant & lactating women and more especially for the brain development of fetus & young children and advised home consumption of Mola. He also emphasized stocking of Mola and other small indigenous species in paddy cum fish farming system that is taken under APART and advised to take the opportunity to adopt as much as possible. He also described the need for gender integration in fisheries and role of women in fisheries and aquaculture and advised the women participants to take a significant role in day to day activities in fish farming. In the interaction session the participants were found to be very much interactive and had good interaction with Technical Consultants regarding all technical aspects.


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FPG Level Focus Group Discussion on Better Management Practices for Paddy cum fish Integrated Farming at Bhuyanpara, Sootea, Sonitpur under APART Fishery sub-Component

In order to create awareness and adoption of Better Management Practices for Paddy cum fish integrated farming, a FPG level Focus Group Discussion was conducted on 9th April, 2021 at Bhuyanpara, Sootea, Sonitpur by WorldFish in collaboration with College of Fisheries, Assam Agricultural University, Raha and Department of Fisheries, Govt. of Assam. A total of 25 nos of farmers attended the Focus Group Discussion which included both beneficiary & non beneficiaries of Sootea FPG & Bhuyanpara FPG under APART. At the very beginning Mr. Biswajit Borah, Project Associate, College of Fisheries, AAU, Raha welcomed all the participants and explained the program's objectives & its purpose. He also described about general concept, principles and different systems of paddy cum fish integrated farming. Miss Jyotirmoyee Das, TEF, Sonitpur delivered lecture on the fish disease, prevention and their control measures as well as soil and water quality management in paddy cum fish integrated farming. Mr. Dibyarishi Bhattacharjya, Junior researcher, KVK, Sonitpur delivered lecture on the paddy variety selection for paddy cum fish integrated farming, seed treatment, seedling treatments and various precautionary measures for pest infestation as well as fungal infestation in paddy. He also described about the ITK, traps for controlling the pest infestation without using any chemicals in paddy field. He also explained on fertilizer application and its requirement in paddy. He also informed about the various machineries that can reduce the labour involvement in paddy farming. Mr. Kalpajit Gogoi, TEF, WorldFish explained the Better Management Practices for Paddy cum fish integrated farming developed by WorldFish experts exclusively for APART and described all the technical aspects of BMP for paddy cum fish integrated farming along with the participants interaction. He informed the participants that BMP is about how better we can do our day to day farming activities which will lead to better management of the farm and enable to reduce the loses and increase the benefits as well as sustainability & environmental safety. Additionally he also described the importance of Mola as a good source of nutrition for pregnant & lactating women and more especially for the brain development of fetus & young children and advised home consumption of Mola. He also informed about the advantages of stocking Mola and other small indigenous species in paddy cum fish farming system that is taken under APART and advised to take the opportunity to adopt as much as possible. He also described about the gender integration in fisheries and role of women in fisheries and aquaculture and advised the women participants to take a significant role in day to day activities in fish farming. In the interaction session the participants were found to be very much interactive and had good interaction with Technical Consultants regarding all technical aspects.


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Shot on OnePlus


Shot on OnePlus


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FPG Level Focus Group Discussion on Better Management Practices for Paddy cum fish Integrated Farming at Gerekoni, Bechamari, Morigaon under APART Fishery sub-Component

In order to create awareness and adoption of Better Management Practices for Paddy cum fish integrated farming, a FPG level Focus Group Discussion was conducted on 12th April, 2021 at Gerekoni, Bechamari, Morigaon by WorldFish in collaboration with College of Fisheries, Assam Agricultural University, Raha and Department of Fisheries, Govt. of Assam. A total of 20 farmers attended the Focus Group Discussion which included both beneficiary & non beneficiaries of APART Sky FPG under APART. At the very beginning Mr. Pranjal Pratim Gautam, Project Associate, College of Fisheries, AAU, Raha welcomed all the participants and explained about the program's objectives & its purpose. He also described principles and different systems of paddy cum fish integrated farming. Mr. Abu Suvan, TEF, Morigaon delivered lecture on the fish disease, prevention and their control measures as well as soil and water quality management in paddy cum fish integrated farming. Mrs. Kasturi Goswami, Junior researcher, IRRI, Guwahati delivered lecture on the paddy variety selection for paddy cum fish integrated farming, seed treatment, seedling treatments and various precautionary measures for pest infestation as well as fungal infestation in paddy. She also described about the ITK, traps for controlling the pest infestation without using any chemicals in paddy field. She also explained on fertilizer application and its requirement in paddy. She also informed about the various machineries that can reduce the labour involvement in paddy farming. Mr. Kalpajit Gogoi, TEF, WorldFish explained the Better Management Practices for Paddy cum fish integrated farming developed by WorldFish experts exclusively for APART and described the technical aspects of BMP for paddy cum fish integrated farming along with the participants interaction. He informed the participants that BMP is about how better way we can do our day to day farming activities which will lead to better management of the farm and enable to reduce the loses and increase the benefits as well as sustainability & environmental safety. Additionally he also described the importance of Mola as a good source of nutrition for pregnant & lactating women and more especially for the brain development of fetus & young children and advised to home consumption of Mola. He also stressed on stocking Mola and other small indigenous species in paddy cum fish farming system that is taken under APART and advised to take the opportunity to adopt the practice. He also described the need for gender integration in fisheries and role of women in fisheries and aquaculture and advised the women participants to take a significant role in day to day activities in fish farming. In the interaction session the participants were found to be very much interactive and had good interaction with Technical Consultants regarding all technical aspects.


"জলবায়ু সহিষ্ণু ঘের-মাছ পালন পদ্ধতি"

Annexure- 8

Better Management Practices for Carp Polyculture with Genetically Improved Fish strains- V1 (English version)

Assam Agribusiness and Rural Transformation Project
Fishery Sub-Component

Better Management Practices for Carp Polyculture with Genetically Improved Fish Strain - V1 (2021)

WorldFish

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Better Management Practices for Carp Polyculture with Genetically Improved Fish Strain - V1(2021)

Aquaculture is predicted to play a major and ever increasing role in meeting human needs for protein. Aquaculture systems in Assam are characterized by polyculture of Indian major carps and exotic carps and largely based on the use of unimproved species and strains. As knowledge and experience are accumulated in relation to the management, feeding and animal health issues of such production systems, the availability of genetically more productive stock becomes imperative in order to more effectively use resources and improve the production.

Genetically improved strain has high growth efficiency developed through selective breeding. As a result, demand in the market for genetically improved strain is increasing and therefore the fish farmer has a great incentive to cultivate "Jayanti Rohu" and "Amur Carp". Morphologically "Jayanti rohu" is similar to normal Rohu but the growth rate is 13 % - 17 % higher than that of ordinary Rohu, less susceptible to diseases and attractive look (slightly reddish in colour). The improved rohu proved to be feed neutral and effective under all culture practices which have enhanced the acceptance level. In the similar way, "Amur Carp" compared to the common carp is fast growing(about 27 % faster than the existing stock), late maturing (first spawning at the end of first year), accepts artificial feed and has similar food habit to that of existing stock, less susceptible for diseases, body is slender and belly is smaller than existing stock.Addition of such genetically improved fish strains in polyculture system can provide additional production and profit with effective use of resources. It is in this context, scientifically validated better management practices (BMPs) covering the full life cycle of the farming operation is essential. APART project is committed to supporting sustainable intensification of polyculture of carps with genetically improved fish strains and plans to achieve a substantial income from carp polyculture system.

Promoting the implementation of BMPs across the value chain for carp polyculture with genetically improved fish strains could benefit the state through improved productivity, more effective use of resources, reduced negative environmental and social consequences. Such BMPs and technical guidelines should cover areas of general husbandry, pond preparation, water quality, feed management, disease management, record keeping, harvest and post-harvest handling. This draft version of BMP for carp polyculture with genetically improved fish strains is complementary to the Package of Practice (PoP) developed by College of Fisheries, AAU, Assam under the APART project. BMP provided by WorldFish will be an evolving document and will be updated considering the results and

experiences of Year 1 of carp polyculture with genetically improved fish strains demonstration under the ongoing APART project.

The purpose of BMP guidelines is to increase awareness and build capacity of carp farmers, extension service providers, and other value chain actors on better management practices for carp polyculture with genetically improved fish strains in Assam.

BMP recommendations:

1. Pond Preparation

1.1. Drain pond; remove sludge from the bottom and let it dry

1.2. Keep pond dyke clean from bushes to prevent hiding of predators

1.3. Repair dyke as necessary to control water seepage

1.4. Repair inlet and outlet pipes

1.5. Place bamboo or other substrates – which help in colonizing periphyton and also help in protecting from poaching of fish

1.6. Apply lime, distributing evenly over the pond surface, at a recommended rate

1.7. Consider fencing the sides of pond using nylon net/bamboo/any other locally available materials or bio-fencing using plants like Assam Lemon, Chitranalla

Key considerations:

- Drain annually OR once in two years – depending on the need
- Liming is must if soil pH in the pond is <6.5
- Consider using cost-effective materials for fencing or provide bio-fencing

2. Water Filling and fertilization of pond

2.1. Fill pond, maintain water depth between 1.5-2.0 m. Filter water with double lined nylon nets if water from natural sources is used for filling.

2.2. Fertilize pond, using chemical fertilizers @28 kg N and 21 kg P/ha with Urea and single super phosphate OR other fertilizers readily available in local market.

2.3. Consider applying recommended doses of organic manure (livestock manure/chicken manure/compost) in

heaps in one or two pond corners enclosed with the help of split bamboo. Consider application of bio-fertilizers like Anabaena – Azolla complex

Key considerations:

- Install a water level measuring pole marked at 1m,1.5m and 2 m to check water level
- Monitor plankton growth using Secchi disc(maintain adequate greenness i.e., around 30 cm Secchi disc visibility) and adjust subsequent fertilization rate (clear water= low in natural food; too green= high plankton density)

3. Stocking

3.1. Pond is ready to stock once water turns green (rich in plankton – natural food for fish)

3.2. Acquire fish seed from Department hatcheries, Multiplication centres or Registered Private hatcheries (where available, acquire improved Jayanti Rohu, Amur carp

3.3.Replace the normal Rohu and Common Carp fish seeds withJayanti Rohu and Amur Carp fish seed.

3.4. Treat the fish seed with $KMnO_4$ @1-3 ppm or NaCl @4% before stocking

3.5. Maintain stocking density (8000 nos/ha) as recommended

3.6. Maintain stocking ratio of 4:3:3 (surface feeder: column feeder: bottom feeder)

Key considerations:

- Avoid stocking fish seeds on weight basis and follow stocking recommended species in the recommended ratio and density
- Adjust stocking density based on harvesting strategy (depending on whether fish to be harvested as 'hotel size fish' or to be grown >1 kg size; single stocking multiple harvesting)

4. Crop Calendar

4.1.Follow the crop calendar given below to plan fish production to reach the market

during the ban period in Assam i.e. April-June when fish demand and fish prices are high

4.2. Ensure stocking during July-August so that the fishes grow to marketable size by March

Key considerations:

- Fingerlings of different species should be made available for stocking in August.
- Advanced nursing on-farm reduce seed cost substantially and enable availability of required seed on-farm for stocking.
- Early season stocking enables farmers to harvest fish in April to June when fish supply in market is low and fetch better price.
- Short production cycle (March – May) for production of hotel size fish can be followed in the areas prone to flood damage.
- Follow crop calendar as recommended below (where possible).

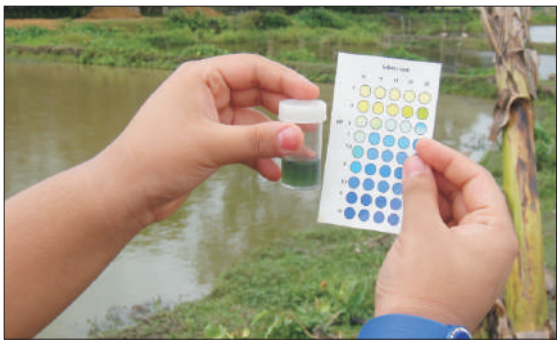
Month	Activities
July	Preparation
August	Stocking
September	Growing
October	
November	
December	
January	
February	
March	
April	Harvesting
May	
June	

5. Water quality management

5.1 Monitor the pond regularly (early morning and late in the afternoon):

5.2 Low DO stress is likely:

- If the pond is dark green with Secchi disc visibility of <15 cm (DO stress occurs either very early in the morning or when the day is cloudy)



- If pond water is dark/black coloured with foul smell (eg, H_2S)

5.3 Check pH after heavy rainfall and apply lime if pH is <6.5

Key considerations:

- Low DO stress symptom:– fish start gasping for air on pond surface OR sometimes even die if DO is too low. If such symptoms are noticed, partially exchange pond water or sprinkle water over the pond to increase DO level.
- Mechanical aerators for large farms; for small ponds pumping water and creating like fountain over the pond can be done.
- If pond water colour turns black/dark, drain some bottom water and top up with new water.

6. Feeding

6.1 Follow feeding options, depending on the feed availability and costs:

- Floating pellets

- Sinking pellets
- Farm-made feed
- Combination of commercial formulated feed and farm-made feed

6.2 Adjust feeding rate as recommended

Key considerations:

- Ideal to have 25% CP in grow out feed:
- Broadcast floating pellets from specific side of the pond along with the wind
- Place feed in feeding trays (made of locally available materials) submerged in the pond
- Put feed in perforated bags and submerge just below the water surface so that fish can browse feed and where feed loss is minimal
- Adjust feeding based on fish biomass (feeding table to be provided to the farmer)
- It is advised to cook farm made feed to make it more palatable.
- Daily feeding rate range from 5% of total fish biomass (for fry/fingerlings) and 1.0% for large size fish
- Feeding rate also needs to be adjusted based on feed quality, plankton richness in the pond, etc.
- Avoid feeding around mid-day/when temperature is very high/during the cloudy/rainy days

7. Regular Sampling

7.1 Do sampling every month to assess the growth and health of the cultured fishes:

- Monitor the length and weight of different species of fishes stocked.

- Use the information for adjusting the feeding rates.
- Check for the presence of external parasites on the body surface, fins, gills etc. and also for the presence of lesions or wounds.

8. Disease Management

8.1 There are a number of preventive measures farmers can use to reduce the risk of diseases and parasitic infection:

- Stock pond with healthy, disease-free seed.
- Disinfect all tools used in fish culture operations.

- Avoid overcrowding.
- Follow proper feeding, fertilization and water quality management practices.
- Conduct routine screening for any sign of disease/stress.
- Record all clinical signs; take pictures of clinical signs, and record of number of dead fish.

- Remove all moribund and dead fish, and bury them far away from the pond.
- Bring any unusual mortality to the attention of responsible authorities and assist them to collect sick and moribund samples for laboratory testing.
- Follow the suggestion of the responsible authority for disease management.

9. Harvesting

9.1 Follow harvesting strategy based on culture system type – generally single stocking multiple harvesting:

- Harvest fishes when they grow to 800g - 1 kg. size
- Condition fish before sending to live fish market

Key considerations:

- Harvesting strategy largely depends on purpose, market preference, growout system, etc.
- Harvest fish 1 day before sending to market and put them in nylon hapa; stop feeding at least 24 hours before sending to market

10. Marketing

10.1 Send fish to market either early in the morning or late in the afternoon

10.2 Preferably send fishes live to the market to get better price

Key consideration:

- Avoid transportation of fish when temperature is high (mid-day to early afternoon)
- While transporting live fish maintain biomass based on volume of water to avoid mortality

11. Environmental Care

11.1 Make sure that fish farming activities are not causing harm to surrounding aquatic and terrestrial environment

Key consideration:

- Avoid draining pond water and sludge directly to nearby water bodies
- Properly dispose dead fish (they should be removed immediately from the pond and buried properly)
- Properly dispose the feed bags, fertilizer bags, used bottles and containers

12. Record Keeping:

12.1Maintain records of all farm activities, stocking details, inputs, sampling details, harvest details, selling and also consumption.

12.2 Use record books provided under the project for keeping records

12.3Ensure the records are updated periodically by the Project staff or Department officials during their visit to the farm

Assam-Agribusiness and Rural Transformation Project
Directorate of Fisheries, Government of Assam
Meen Bhawan, Gopinath Nagar, Guwahati-781016
Contact for more details: APART Cell, Phone: 0361-2545104
E-mail: dirfishassam2019@gmail.com Web: https://fisheriesdirector.assam.gov.in

Annexure- 9
Better Management Practices for Polyculture of Carps with Fresh water Prawns- V1 (English & Assamese version)

Assam Agribusiness and Rural Transformation Project

Fishery Sub-Component

Better Management Practices for Polyculture of Carps with Freshwater Prawns - V1 (2021)

WorldFish

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Better Management Practices for Polyculture of Carps with Freshwater Prawns - V1(2021)

Giant freshwater prawn, *Macrobrachium rosenbergii* is commonly known as "SCAMPI". It is widely distributed in Southeast Asia and found in most river systems in India. It is highly valued due to its high price, large size, rapid growth, good taste and high export demand. These prawns inhabit rivers, canals, estuaries and coastal waters in nature. It can also be cultured in freshwater as well as slightly brackish water.

Polyculture of giant freshwater prawn along with Indian major carps is becoming popular compared to monoculture among fish farmers due to the high cost of management, low survival and differential growth of prawn under monoculture systems. The polyculture of prawn with fish is commonly practiced in the northern parts of Karnataka, Andhra Pradesh, Orissa, West Bengal and Punjab. The presence of fish in a polyculture system serves as a biological control over development of zooplankton, phytoplankton and filamentous algae, which otherwise result in ecological instability of the pond ecosystem. Since the prawn under polyculture with fish derives its nutrition by utilizing the natural pond productivity and left-over fish feed, faecal matter of fish, etc., there is no need for a separate high-cost prawn feed.

The inclusion of freshwater prawns in a polyculture system almost always has synergistic beneficial effects, which include:

- More stable dissolved oxygen levels,
- The reduction of predators,
- Coprophagy (the consumption of fish faeces by prawns), which increases the efficiency of feed,
- Greater total pond productivity (all species),
- The potential to increase the total value of the crop by the inclusion of a high-value species.

Aquaculture systems in Assam are characterized by polyculture of Indian major carps with Rohu and Catla as major species. Freshwater prawn farming is an environment friendly aquaculture farming system and Assam's agro-climatic condition is suitable for freshwater prawn production. Addition of freshwater prawn along with carps in polyculture system can provide additional profit and minimize the waste in the pond ecosystem. The freshwater prawn has a very high market value, is preferred by consumers in Assam besides having good export potential. It is in this context, scientifically validated better management practices (BMPs) covering the full life cycle of the farming operation is essential. APART project is committed to supporting sustainable intensification of polyculture of carps with

fresh water prawn and plans to achieve a substantial income from fresh water prawn with carp polyculture system.

Developing scalable aquaculture technology packages and BMP interventions are vital to realizing sustainable increase in aquaculture production and thereby narrowing the fish demand-supply gap in the future. BMP interventions should aim at sustainable intensification of aquaculture without creating adverse socio economic and environmental impacts. BMPs refer to a set of standardized management guidance that are developed, based on existing practices and associated risks, as determined in consultation with scientists and farming practitioners and relevant industry stakeholders. BMP development process should consider the technical, environmental, social and economic issues associated with farming and must be location and context specific. New innovations should be routinely incorporated into BMPs to facilitate continuous improvement in farming practices. BMPs are dynamic and evolving.

Promoting the implementation of BMPs across the value chain for freshwater prawn in carp polyculture systems could benefit the state through improved productivity, reduced negative environmental and social consequences. Such BMPs and technical guidelines should cover areas of general husbandry, pond preparation, water quality, feed management, disease management, record keeping, harvest and post-harvest handling. This first version of the freshwater prawn im carp polyculture BMP is complementary to the Package of Practice (PoP) developed by College of Fisheries, AAU, Assam under the APART project. BMP provided by WorldFish will be an evolving document and will be updated considering the results and experiences of Year 1 of polyculture of carps with freshwater prawn demonstration under the ongoing APART project.

The purpose of BMP guidelines is to increase awareness and build capacity of carp farmers, extension service providers, and other value chain actors on better management practices for fresh water prawn with carp polyculture in Assam.

BMP recommendations:

1. Pond Preparation

1.1. Drain pond; remove sludge from the bottom and let it dry

1.2. Keep pond dyke clean from bushes to prevent hiding of predators

1.3. Repair dyke as necessary to control water seepage

1.4. Repair inlet and outlet pipes

1.5. Place bamboo or other substrates – which help in colonizing periphyton and also help in protecting from poaching of fish

1.6. Apply lime, distributing evenly over the pond surface, at a recommended rate

1.7. Consider fencing the sides of pond using nylon net/bamboo/any other locally available materials or bio-fencing using plants like Assam Lemon, Chitranalla

Key considerations:

- Drain annually OR once in two years – depending on the need
- Liming is must if soil pH in the pond is <6.5
- Consider using cost-effective materials for fencing or provide bio-fencing

2. Water Filling and fertilization of pond

2.1. Fill pond, maintain water depth between 1.5-2.0 m. Filter water with double lined nylon nets if water from natural sources is used for filling.

2.2. Fertilize pond, using chemical fertilizers @ 28 kg N and 21 kg P/ha with Urea and single super phosphate OR other fertilizers readily available in local market.

2.3. Consider applying recommended doses of organic manure (livestock manure/chicken manure/compost) in heaps in one or two pond corners enclosed with the help of split bamboo. Consider application of bio-fertilizers like Anabaena – Azolla complex

Key considerations:

- Install a water level measuring pole marked at 1m,1.5m and 2 m to check water level
- Since prawns are cannibalistic in nature and also having territorial behaviour so they necessitate special hiding arrangement during moulting phase. It is to be noted that moulting is the only process of growth of shellfish.
- During moulting phase prawns are weak and are exposed with soft muscle. Thus to prevent the cannibalistic nature during moulting plastic pipe, hollow bamboo, beetalnut leaves, coconut leaves, tyres, tree branches, etc need be provided as hiding arrangement.
- Monitor plankton growth using Secchi disc(maintain adequate greenness i.e., around 30 cm Secchi disc visibility) and adjust subsequent fertilization rate (clear water = low in natural food; too green = high plankton density)

3. Stocking

3.1. Pond is ready to stock once water turns green (rich in plankton – natural food for fish)

3.2. Acquire fish seed from Department hatcheries, Multiplication centres or Registered Private hatcheries (where available, acquire improved Jayanti Rohu

3.3. Procure fish seeds of 10 cm size for stocking. If fingerlings are small (<5

cm), nurse them in nursery pond until they grow to 10 cm; feed the fingerlings with high- quality feed

3.4. Stock Fresh water prawn juveniles of size 4-6 cm and maintained stocking density (7500 nos/ha) as recommended

3.5. Treat the seeds with $KMnO_4$ @1-3 ppm or NaCl @ 4% before stocking

3.6. Maintain fish stocking density (2500 - 3500 nos/ha) as recommended

3.7. Maintain stocking ratio of 5:5 (surface feeder: column feeder)

Key considerations:

- Avoid stocking fish seeds on weight basis and follow stocking recommended species in the recommended ratio and density
- Adjust stocking density based on harvesting strategy (depending on whether fish to be harvested as 'hotel size fish' or to be grown >1 kg size; single stocking multiple harvesting)

4. Crop Calendar

4.1. Follow the crop calendar given below to plan fish production to reach the market during the ban period in Assam i.e. April-June when fish demand and fish prices are high

4.2. Ensure stocking during July-August so that the fishes grow to marketable size by March

Key considerations:

- Fingerlings of different species should be made available for stocking in August.
- Advanced nursing on-farm reduce seed cost substantially and enable availability of required seed on-farm for stocking.
- Early season stocking enables farmers to harvest fish in April to June when fish supply in market is low and fetch better price.
- Short production cycle (March – May) for production of hotel size fish can be followed in the areas prone to flood damage.
- Follow crop calendar as recommended below (where possible).

Month	Activities
July	Preparation
August	Stocking
September	Growing
October	
November	
December	
January	
February	
March	
April	Harvesting
May	
June	

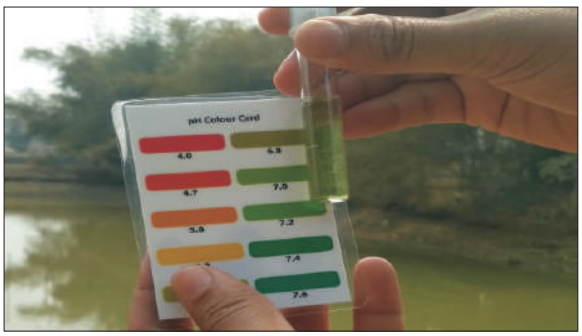
5. Water quality management

5.1 Monitor the pond regularly (early morning and late in the afternoon):

5.2 Low DO stress is likely:

- if the pond is dark green with Secchi disc visibility of <15 cm (DO stress occurs either very early in the morning or when the day is cloudy)
- if pond water is dark/black coloured with foul smell (eg, H_2S)

5.3 Check pH after heavy rainfall and apply lime if pH is <6.5



Key considerations:

- Low DO stress symptom:– fish start gasping for air on pond surface OR sometimes even die if DO is too low. If such symptoms are noticed, partially exchange pond water or sprinkle water over the pond to increase DO level.
- Mechanical aerators for large farms; for small ponds pumping water and creating like fountain over the pond can be done.
- If pond water colour turns black/dark, drain some bottom water and top up with new water.

6. Feeding

6.1 Follow feeding options, depending on the feed availability and costs:

- Sinking pellets
- Farm-made feed
- Combination of commercial formulated feed and farm-made feed

6.2 Adjust feeding rate as recommended

Key considerations:

- Ideal to have 30% CP in grow out feed. • broadcast feed to pond from the surround dykes
- place feed in feeding trays (made of locally available materials) submerged in the pond
- put feed in perforated bags and submerge just below the water surface so that fish can browse feed and where feed loss is minima
- Feed can also be given in check trays placed 2-3 m away from the dyke for better feed management
- Adjust feeding based on fish biomass (feeding table to be provided to the farmer)
- It is advised to cook farm made feed to make it more palatable.
- Daily feeding rate range from 5% of total fish biomass (for fry/fingerlings) and 1.0% for large size fish
- Feeding rate also needs to be adjusted based on feed quality, plankton richness in the pond, etc.
- Avoid feeding around mid-day/when temperature is very high/during the cloudy/rainy days

7. Regular Sampling

7.1 Do sampling every month to assess the growth and health of the cultured fishes and prawns:

- Monitor the length and weight of different species of fishes stocked.
- Monitor the length and weight of cultured prawns.

- Use the information for adjusting the feeding rates
- Check for the presence of external parasites on the body surface, fins, gills etc. and also for the presence of lesions or wounds.

8. Disease Management

8.1 There are a number of preventive measures farmers can use to reduce the risk of diseases and parasitic infection:

- Stock pond with healthy, disease-free seed.
- Disinfect all tools used in fish culture operations.

- Avoid overcrowding.
- Follow proper feeding, fertilization and water quality management practices.
- Conduct routine screening for any sign of disease/stress.
- Record all clinical signs; take pictures of clinical signs, and record of number of dead fish.
- Remove all moribund and dead fish, and bury them far away from the pond.
- Bring any unusual mortality to the attention of responsible authorities and assist them to collect sick and moribund samples for laboratory testing.
- Follow the suggestion of the responsible authority for disease management.

9. Harvesting

9.1 Follow harvesting strategy based on culture system type – generally single stocking multiple harvesting:

- Harvest fishes when they grow to 800g -1 kg. size
- Harvest prawns when they grow more than 50 g in size.
- Condition fish before sending to live fish market

Key considerations:

- Harvesting strategy largely depends on purpose, market preference, grow out system, etc.
- Harvest fish 1 day before sending to market and put them in nylon hapa; stop feeding at least 24 hours before sending to market
- Large prawns (>50 g) may be harvested using seine net of suitable mesh size after four months of culture, which should continue once every 3-4 weeks thereafter for the next 3-4 months. The prawns may be finally harvested after 8 months of culture by complete dewatering.

10. Marketing

10.1 Send fish to market either early in the morning or late in the afternoon

10.2 Preferably send fishes live to the market to get better price

Key consideration:

- Avoid transportation of fish when temperature is high (mid-day to early afternoon)
- While transporting live fish maintain biomass based on volume of water to avoid mortality

11. Environmental Care

11.1 Make sure that fish farming activities are not causing harm to surrounding aquatic and terrestrial environment

Key consideration:

- Avoid draining pond water and sludge directly to nearby water bodies
- Properly dispose dead fish (they should be removed immediately from the pond and buried properly)
- Properly dispose the feed bags, fertilizer bags, used bottles and containers

12. Record Keeping:

12.1 Maintain records of all farm activities, stocking details, inputs, sampling details, harvest details, selling and also consumption.

12.2 Use record books provided under the project for keeping records

12.3 Ensure the records are updated periodically by the Project staff or Department officials during their visit to the farm.

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অসম কৃষি বাণিজ্য আৰু গ্ৰাম্য ৰূপান্তৰকৰণ প্ৰকল্প

মীন উপ-উপাদান

কার্পৰ সৈতে মিঠা পানীৰ মিছামাছৰ মিশ্রিত পালনৰ বাবে উন্নত ব্যৱস্থাপনা অনুশীলন

সংস্কৰণ - ১(২০২১)

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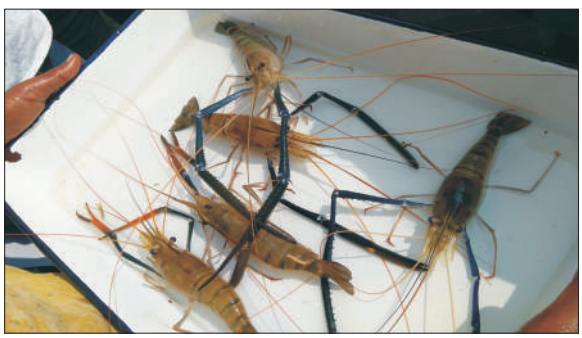
কার্পৰ সৈতে মিঠা পানীৰ মিছামাছৰ মিশ্রিত পালনৰ বাবে উন্নত ব্যৱস্থাপনা অনুশীলন

সংস্কৰণ - ১ (২০২১)

মিঠা পানীৰ মহাকায় মিছামাছ মেক্রোব্রাক্রিয়াম ৰোজেনবার্গি (*Macrobrachium rosenbergii*)ক সাধাৰণতে স্কেম্পী বুলি জনা যায়। এই মিছামাছ বিধ দক্ষিণ-পূৱ এছিয়াত ব্যাপকভাৱে বৃষ্টিত আৰু ভাৰতৰ বেছি ভাগ নদী প্রণালীতে পোৱা যায়। ইয়াৰ উচ্চ দাম, ডাঙৰ আকাৰ, দ্রুত বৃদ্ধি, উৎকৃষ্ট সোৱাদ তথা উচ্চ ৰপ্তানি চাহিদাৰ বাবে ইয়াক যথেষ্ট মূল্য দিয়া হয়। এই মিছামাছ বিধে প্রাকৃতিকভাৱে নদী, খাল, নদী আৰু সাগৰৰ সংগমস্থলী আৰু উপকূলীয় পানীত বসবাস কৰে।

মিঠাপানীৰ মিছামাছৰ একক প্রজাতি পালন পদ্ধতিত জড়িত ব্যৱস্থাপনাৰ উচ্চ ব্যয়, অধিক মৃত্যুৰ হাৰ তথা অসমান বৃদ্ধিৰ বাবে মীন পালকসকলৰ মাজত মিছামাছৰ একক প্রজাতি পালন পদ্ধতিৰ তুলনাত ভাৰতীয় প্রধান কার্পৰ সৈতে মিছামাছৰ মিশ্রিত পালন পদ্ধতিটো অধিক জনপ্রিয় হৈ পৰিছে। কার্পৰ লগত মিছামাছৰ মিশ্রিত পালন পদ্ধতি সাধাৰণতে কর্ণাটকৰ উত্তৰ অংশ, অন্ধ্র প্রদেশ, উৰিষ্যা, পশ্চিম বংগ আৰু পাঞ্জাৱত প্রচলিত। মিশ্রিত পালন পদ্ধতিত মাছৰ উপস্থিতিয়ে প্রাণী প্লৱক, উদ্ভিদ প্লৱক তথা আঁহযুক্ত শেলাই বৃদ্ধি বিকাশৰ ওপৰত জৈৱিক নিয়ন্ত্রক হিচাপে কাম কৰে, যাৰ ফলত অন্যথা পুখুৰী পৰিৱেশ তন্ত্রৰ পাৰিপার্শ্বিক অস্থিৰতা হয়। যিহেতু কার্পৰ সৈতে মিশ্রিত পালন পদ্ধতিৰ অধীনত থকা মিছামাছে পুখুৰীৰ প্রাকৃতিক উৎপাদনশীলতা, ৰৈ যোৱা মাছৰ খাদ্য আৰু মাছৰ মল ইত্যাদি ব্যৱহাৰ কৰি ইয়াৰ পুষ্টি প্রাপ্ত কৰে, তাৰোপৰি অন্য উচ্চ মূল্যৰ মিছামাছৰ খাদ্যৰ প্রয়োজন হয়।



মিশ্রিত পালন পদ্ধতিত মিঠা পানীৰ মিছামাছ অন্তর্ভূক্তকৰণে প্রায় সদায়ে সহযোগমূলক উপকাৰী প্রভাৱ থাকে, যাৰ ভিতৰত—

- দ্রৱীভূত অক্সিজেনৰ স্তৰত অধিক স্থিৰতা আনে।
- কোপ্রোফেগি (মিছামাছৰ দ্বাৰা মাছৰ মল আহৰণ কৰা) যি খাদ্যৰ দক্ষতা বৃদ্ধি কৰে আৰু পানীৰ প্রদূষণ মুক্ত কৰে।
- পুখুৰীৰ উৎপাদনশীলতা (সকলো প্রজাতিৰ বাবে বৃদ্ধি কৰে)।
- উচ্চ মূল্যৰ প্রজাতি এটা অন্তর্ভূক্ত কৰি শস্যৰ মুঠ মূল্য বৃদ্ধি কৰাৰ সম্ভাৱনা।

অসমৰ জলসংবর্ধন তথা মীন পালন পদ্ধতিবোৰৰ বিশেষত্ব হৈছে ৰৌ আৰু বাহু মাছ মুখ্য প্রজাতি হিচাপে ভাৰতীয় প্রধান কার্পৰ মিশ্রিত পালন। মিঠা পানীৰ মিছামাছৰ পালন হৈছে এক পৰিৱেশ অনুকূল মীনপালন পদ্ধতি আৰু অসমৰ কৃষি জলবায়ু মিঠা পানীৰ মিছামাছ পালন তথা উৎপাদনৰ বাবে উপযুক্ত। মিশ্রিত কার্প পালন পদ্ধতিত মিছামাছ সংযোগ কৰিলে অতিৰিক্ত লাভ প্রদান কৰাৰ লগতে পুখুৰীৰ পৰিৱেশতন্ত্রৰ আৱর্জনা হ্রাস কৰে। মিঠা পানীৰ মিছামাছৰ বজাৰ মূল্য অতি উচ্চ, ভাল ৰপ্তানিৰ সম্ভাৱনা থকাৰ উপৰিও অসমৰ গ্রাহকসকলে ইয়াক প্রাধান্য দিয়ে।

এই পৰিপ্রেক্ষিতত মিছামাছৰ মিশ্রিত পালনৰ কর্মৰাজিৰ সম্পূর্ণ জীৱন চক্র সামৰি বৈজ্ঞানিকভাৱে ৰৈধ উন্নত ব্যৱস্থাপনা অনুশীলন পদ্ধতি অপৰিহার্য। এপার্ট (APART) প্রকল্পটি র্কাপৰ সৈতে মিঠাপানীৰ মিছামাছৰ মিশ্রিত পালন পদ্ধতিৰ বহনক্ষম উৎপাদন বৃদ্ধিত সহায় কৰিবলৈ প্রতিশ্রুতিবদ্ধ আৰু কার্পৰ লগত মিছামাছৰ মিশ্রিত পালনৰ দ্বাৰা যথেষ্ট উপার্জন বৃদ্ধি কৰাৰ পৰিকল্পনা কৰা হৈছে।

জলসংবর্দ্ধনৰ উৎপাদনত বহনক্ষম বৃদ্ধিৰ উপলব্ধি তথা ভৰিষ্যতে মাছৰ চাহিদা যোগানৰ ব্যৱধান সংকুচিত

কৰাৰ বাবে পৰিমাপযোগ্য জলসংৰ্বদ্ধন প্ৰযুক্তিৰ উন্নতিকৰণ আৰু উন্নত ব্যৱস্থাপনা অনুশীলনীৰ হস্তক্ষেপ বিকশিত কৰাতো গুৰুত্বপূৰ্ণ। প্ৰতিকূল আৰ্থ-সামাজিক আৰু পাৰিপাৰ্শ্বিক প্ৰভাৱ সৃষ্টি নকৰাকৈ জলসংবৰ্দ্ধনৰ বহনক্ষমতা বৃদ্ধি কৰাটোয়ে উন্নত ব্যৱস্থাপনা অনুশীলনীৰ লক্ষ্য হোৱা উচিত। উন্নত ব্যৱস্থাপনা অনুশীলন হ'ল বিজ্ঞানী, মীন পেছাদাৰী আৰু উদ্যোগিক অংশীদাৰী সকলৰ পৰামৰ্শক্ৰমে নিৰ্ধাৰিত কৰি প্ৰস্তুত কৰা এক উন্নত মানদণ্ডৰ ব্যৱস্থাপনাৰ সহায়িকাৰ সংহতি। উন্নত ব্যৱস্থাপনা অনুশীলনীৰ উন্নয়ন প্ৰক্ৰিয়াটোৱে মীন পালনৰ সৈতে সম্পৰ্কিত কাৰিকৰী, পাৰিপাৰ্শ্বিক, সামাজিক আৰু অৰ্থনৈতিক বিষয়বোৰ বিবেচনা কৰিব লাগে আৰু অৱস্থান তথা প্ৰাসংগিক নিৰ্দিষ্ট হ'ব লাগে। মীন পালন পদ্ধতিত ক্ৰমাগত উন্নতি সাধনৰ বাবে নতুন নতুন উদ্ভাৱনবোৰ নিয়মীয়াকৈ উন্নত ব্যৱস্থাপনা অনুশীলনীত অন্তৰ্ভূক্ত কৰা উচিত। উন্নত ব্যৱস্থাপনা অনুশীলনবোৰ গতিশীল তথা ক্ৰমবিকশিত প্ৰকৃতিৰ হয়।

কাৰ্পৰ সৈতে মিঠাপানীৰ মিছামাছৰ মিশ্ৰিত পালন পদ্ধতিৰ মূল্য শৃংখলাত উন্নত ব্যৱস্থাপনা অনুশীলনৰ কাৰ্যকৰীকৰণ তথা ৰূপায়ণৰ প্ৰচাৰ কৰিলে উন্নত উৎপাদনশীলতা, নেতিবাচক পাৰিপাৰ্শ্বিক আৰু সামাজিক পৰিনতিৰ হ্ৰাসৰ জৰিয়তে ৰাজ্যখন লাভান্বিত হ'ব পাৰে। এনে ধৰণৰ উন্নত ব্যৱস্থাপনা অনুশীলন আৰু নিৰ্দেশনাবোৰে সাধাৰণ মীন পালন, পুখুৰী প্ৰস্তুত কৰণ, পানীৰ গুণাগুণ, খাদ্যৰ ব্যৱস্থাপনা, ৰোগ ব্যৱস্থাপনা, নথি-পত্ৰ ৰখা, মাছ ধৰা আৰু মাছ ধৰাৰ পিছত সঞ্চালনৰ ক্ষেত্ৰবোৰ অৰ্ন্তভূক্ত কৰা উচিত। কাৰ্প আৰু মিঠা পানীৰ মিছামাছৰ মিশ্ৰিত পালনৰ উন্নত ব্যৱস্থাপনা অনুশীলনৰ এই প্ৰথম সংস্কৰণটি এপাৰ্ট প্ৰকল্পৰ অধীনত মীন মহাবিদ্যালয়, ৰহা, অসম কৃষি বিশ্ববিদ্যালয়ৰ দ্বাৰা বিকশিত প্যাকেজ অফ প্ৰেক্টিছৰ (POP) পৰিপূৰক। বিশ্বমৎস্য(World Fish) ৰ দ্বাৰা সৰবাহিত সংস্কৰণ - ১ এটি ক্ৰমবিকশিত নথি আৰু চলিত এপাৰ্ট প্ৰকল্পৰ অন্তৰ্গত কাৰ্প আৰু মিঠা পানীৰ মিছামাছৰ মিশ্ৰিত পালন প্ৰদৰ্শনৰ প্ৰথম বৰ্ষৰ ফলাফল আৰু অভিজ্ঞতাৰ ওপৰত বিবেচনা কৰি আধুনিকীকৰণ কৰাৰ ব্যৱস্থা ৰখা হৈছে।

উন্নত ব্যৱস্থাপনাৰ অনুশীলনীৰ নিৰ্দেশনাৱলী-বোৰৰ উদ্দেশ্য হ'ল কাৰ্প আৰু মিঠাপানীত মিছামাছৰ মিশ্ৰিত পালনৰ উন্নত ব্যৱস্থাপনাৰ ওপৰত অসমৰ মীনপালক সকলক সজাগতা আৰু সক্ষমতা গঢ়ি তোলা লগতে সম্প্ৰসাৰণ পৰিসেৱা আৰু মূল্য শৃংখলৰ লগত জড়িত অংশীদাৰী সকলৰ সচেতনতা আৰু সক্ষমতা বৃদ্ধি কৰা।

উন্নত ব্যৱস্থাপনা অনুশীলনৰ পৰামৰ্শসমূহ ঃ

১। পুখুৰীৰ প্ৰস্তুতি ঃ

১.১. পুখুৰীৰ তলত থকা গেদবোৰ আঁতৰাই পুখুৰীটো শুকাবলৈ এৰি দিয়ক।

১.২. মাছ ভক্ষণাকাৰীৰ পৰা ৰক্ষা পাবৰ বাবে পুখুৰীৰ পাৰত থকা বননিবোৰ চাফা কৰি ৰাখক।

১.৩ পানী নিঃসৰণ নিয়ন্ত্ৰণৰ বাবে পুখুৰীৰ পাৰবোৰ নিয়মিতভাৱে মেৰামতি কৰক।

১.৪ আগমন আৰু নিৰ্গমণ নলী সমূহ মেৰামতি কৰক।

১.৫ পুখুৰীত বাঁহ বা অন্য কোনো সমৰ্থক সামগ্ৰী স্থাপন কৰক - এনে ব্যৱস্থাই পেৰিফাইটন্‌ৰ বৃদ্ধি তথা চোৰৰ পৰাও ৰক্ষা কৰাত সহায় কৰে।

১.৬. চূণৰ পৰিমাণ পৰামৰ্শৰ হাৰৰ মতে নিৰ্ধাৰিত কৰি পুখুৰী (পানী)ৰ পৃষ্ঠ ভাগত সমানভাৱে চটিয়াই দিয়ক।

১.৭. পুখুৰীৰ চাৰিওফালে নাইলন জাল বা স্থানীয়ভাৱে উপলব্ধ অন্যান্য সামগ্ৰীৰে বেৰ বা অসম নেমু, চিত্ৰনলাৰ দৰে গছৰ ব্যৱহাৰ কৰি জৈৱ-বেৰ দিয়াৰ বিবেচনা কৰক।

মূল বিবেচনাৰলী ঃ

- বার্ষিকভাৱে বা দুবছৰত এবাৰ প্ৰয়োজন অনুসৰি পুখুৰীৰ পানী নিস্কাষণ কৰক।
- যদি মাটিৰ pH ৰ মান ৬.৫ ৰ তলত হয় তেন্তে চুণ প্ৰয়োগ কৰাতো বাঞ্ছনীয়।
- পুখুৰীৰ চাৰিওফালৰ বেৰৰ কাৰণে ব্যয়বহুল সামগ্ৰী ব্যৱহাৰ বা জৈৱবেৰ দিয়াৰ বিবেচনা কৰক।

২. পুখুৰীত পানী ভৰোৱা আৰু সাৰ প্ৰয়োগ ঃ

২.১. পুখুৰী পানীৰে পূৰণ কৰক আৰু পানীৰ গভীৰতা ১.৫-২.০ মিটাৰ অক্ষুণ্ণ ৰাখক। যদি প্ৰাকৃতিক উৎসৰ পৰা লোৱা পানীৰে পুখুৰীত পানী ভৰোৱা হয় তেন্তে দুই সাৰিবদ্ধ নাইলন জালেদি পানীখিনি নিৰ্ম্মল কৰি ল'ব লাগে।

২.২ পুখুৰীৰ উৰ্ব্বৰতা বঢ়াবলৈ ৰাসায়নিক সাৰ যেনে ইউৰিয়া আৰু একক চুপাৰ ফচফেট প্ৰতি হেক্টৰত ক্ৰমে ২৮ কেঃজিঃ নাইট্ৰজেন (N) আৰু ২১ কেঃজিঃ ফছফৰাছ (P) প্ৰয়োগ কৰিব লাগে বা স্থানীয় বজাৰত উপলব্ধ সহজলভ্য অন্য সাৰবো ব্যৱহাৰ কৰিব পাৰে।

২.৩ ফলা বাঁহৰ সহায়ত আবদ্ধ ৰাখি পুখুৰীৰ এক বা দুই কোণত জৈৱ সাৰ (পশুসাৰ, কুকুৰাৰ সাৰ, জৈৱসাৰ) পৰামৰ্শমতে নিৰ্ধাৰিত পৰিমাণত দম কৰি প্ৰয়োগ কৰিব লাগে। এনাবিনা-এজ'লা সংমিশ্ৰণৰ দৰে জৈৱ সাৰ প্ৰয়োগৰ বিবেচনাও কৰিব পাৰে।

মূল বিবেচনাৰলী ঃ

- পুখুৰীৰ পানীৰ স্তৰ জোখমাখৰ বাবে ১মিঃ, ১.৫মিঃ আৰু ২মিঃ চিহ্নিত খুটা এটা স্থাপন কৰিব লাগে।
- চেকি ডিস্ক ব্যৱহাৰ কৰি প্লৱকৰ বৃদ্ধি পৰ্য্যবেক্ষণ কৰিব লাগে (পৰ্যাপ্ত সেউজীয়াময় বজাই ৰাখিব লাগে, প্ৰায় ৩০ ছেঃমিঃ চেকি ডিস্ক দৃশ্যমান) আৰু পৰৱৰ্তী সাৰ প্ৰয়োগৰ হাৰ নিৰ্ধাৰিত কৰিব লাগে (স্বচ্ছ পানী - কম প্ৰাকৃতিক খাদ্য আৰু অতি ঘন সেউজীয়া - উচ্চ প্লৱক ঘনত্ব)।
- যিহেতু মিছামাছ স্বগোত্ৰভক্ষণ প্ৰকৃতিৰ লগতে স্থানিক আচৰণ দেখুৱাই সেয়েহে সেইবোৰক মোট সলোৱা সময়ত লুকাই থাকিবৰ বাবে বিশেষ ব্যৱস্থাৰ প্ৰয়োজন হয়। এইটো লক্ষণীয় যে মোট সলোৱা হৈছে মিছামাছৰ বৃদ্ধিৰ একমাত্ৰ প্ৰক্ৰিয়া।
- মোট সলোৱা সময়ত মিছামাছবোৰ দুৰ্বল হয় আৰু কোমল মাংস পেশীৰে উন্মুক্ত হৈ পৰে। সেয়েহে মোট সলোৱাৰ সময়ত স্বগোত্ৰ ভক্ষণ ৰোধ কৰিবলৈ, ফোঁপোলা বাঁহ, তামোলৰ পাত, নাৰিকলৰ পাত, টায়াৰ, গছৰ ডাল আদি লুকাই থকা ব্যৱস্থা হিচাপে প্ৰদান কৰিব লাগে।

৩. মজুতকৰণ ঃ

৩.১. যেতিয়া পানীৰ ৰং সেউজীয়া হয় পুখুৰীটো মজুতকৰণৰ বাবে প্ৰস্তুত হয় (প্লৱক সমৃদ্ধ মাছৰ প্ৰাকৃতিক খাদ্য উপলব্ধ)।

৩.২ বিভাগীয় মীন প্ৰজনন কেন্দ্ৰ, মীন গৱেষণা কেন্দ্ৰ বা পঞ্জীয়নকৃত কৰা বেচৰকাৰী প্ৰজনন কেন্দ্ৰৰ পৰা মাছৰ পোনা সংগ্ৰহ কৰিব লাগে য'ত উন্নতমানৰ জয়ন্তী ৰৌ আৰু আমুৰ কার্পৰ পোনা পোৱা যায়।

৩.৩ মজুতকৰণৰ বাবে ১০ ছেঃমিঃ সদৃশ মাছৰ পোনা ক্ৰয় কৰক। যদি আঙুলি সদৃশ পোনাবোৰ সৰু হয় (<৫ ছেঃমিঃ) তেন্তে ১০ ছেঃমিঃ নোহোৱা পৰ্যন্ত নাৰ্চাৰী পুখুৰীত ৰাখিব লাগে আৰু উচ্চ গুণসম্পন্ন খাদ্যৰ যোগান ধৰিব লাগে।

৩.৪ মিঠাপানীৰ মিছামাছৰ পোনা ৪-৬ ছেঃমিঃ আকাৰৰ মজুত কৰক আৰু পৰামৰ্শ অনুসৰি মজুতৰ ঘনত্ব (৭৫০০/ হেক্টৰ) বজাই ৰাখক।

৩.৫ মজুতকৰণৰ আগত মাছৰ পোনাবোৰ $KMnO_4$ @ ১-৩ পি. পি. এম বা NaCI@8% দ্বাৰা গা ধুৱাই মেলিব লাগে।

৩.৬ পৰামৰ্শ অনুসৰি মাছৰ মজুতৰ ঘনত্ব (২৫০০-৩০০০/ হেক্টৰ) বজাই ৰাখক।

৩.৭ মজুতৰ অনুপাত ৫:৫ বজাই ৰাখক (পৃষ্ঠভোজী ঃ স্তৰভোজী)।

মূল বিৱেচনাৰলী ঃ

- ওজনৰ ভিত্তিত মাছৰ পোনা মজুতকৰণৰ পৰা বিৰত থাকক আৰু পৰামৰ্শ অনুযায়ী নির্ধাৰিত প্রজাতিসমূহ পৰামর্শগত অনুপাত আৰু ঘনত্ব বজাই ৰাখি পোনা মজুত কৰক।
- ফচল চপোৱাৰ পৰিকল্পনাৰ ওপৰত ভিত্তি কৰি মীন পোনা মজুতৰ ঘনত্ব নির্ধাৰিত কৰক (হোটেল সদৃশ মাছ চপোৱা বা তাতকৈ ডাঙৰ অর্থাৎ ১ কেঃজিঃ ওজনৰ ওপৰত ভিত্তি কৰি), একক মজুতকৰণ, একাধিক ফচল সংগ্রহ আদি ব্যৱস্থা ৰাখিব লাগে।

৪. মীন পালনৰ দিনপঞ্জী ঃ

৪.১ অসমত ঘোষিত মীন প্রকৃতিৰ উৎসত নিষেধাজ্ঞাৰ সময়ত বজাৰত উপলব্ধৰ বাবে মাছৰ উৎপাদনৰ পৰিকল্পনা কৰিবলৈ তলত দিয়া মীন পালনৰ দিনপঞ্জী অনুসৰণ কৰক অর্থাৎ এপ্রিল জুন মাহত যেতিয়া মাছৰ চাহিদা আৰু দাম বেছি থাকে সেই সময়ত মাছৰ বিক্রী নিশ্চিত কৰিব লাগে।

মূল বিবেচনাৰলী ঃ

- আগষ্ট মাহতে বিভিন্ন প্রজাতিৰ আঙুলি সদৃশ পোনা মজুতকৰণৰ বাবে উপলব্ধ কৰা উচিত।
- পামত অগ্রণী চোৱাচিতা কৰণে পোনাৰ ব্যয় যথেষ্ট হ্রাস কৰে আৰু মজুতকৰণৰ বাবে প্রয়োজনীয় পোনাও পামতে উপলব্ধ হয়।
- আগতীয়া মজুতকৰণে মীনপালকক এপ্রিলৰ পৰা জুন মাহৰ ভিতৰত মাছ চপোৱাত সক্ষম কৰাই যেতিয়া বজাৰত মাছৰ যোগান কম থাকে আৰু বেছি দাম পোৱা যায়।
- বানপানী পীড়িত অঞ্চলৰ হোটেলত ব্যৱহৃত মাছৰ উৎপাদনৰ বাবে হ্রস্বকালীন উৎপাদন চক্র (মার্চ-মে) অৱলম্বন কৰিব লাগে।
- তলত দিয়া মীন পালনৰ দিনপঞ্জীখন অৱলম্বন কৰক।

মাহ	কার্য্যৱলী
জুলাই	পুখুৰী প্রস্তুতকৰণ
আগষ্ট	মাছ মজুতকৰণ
ছেপ্তেম্বৰ	বর্দ্ধন
অক্টোবৰ	
নবেম্বৰ	
ডিচেম্বৰ	
জানুৱাৰী	
ফেব্রুৱাৰী	
মার্চ	
এপ্রিল	মাছ ধৰা
মে’	
জুন	

৫. পানীৰ গুণাগুণৰ ব্যৱস্থাপনা ঃ

৫.১ নিয়মিতভাৱে পুখুৰীটো পর্যবেক্ষণ কৰক (ৰাতিপুৱা আগ ভাগত আৰু আবেলি শেষৰ ভাগত)।

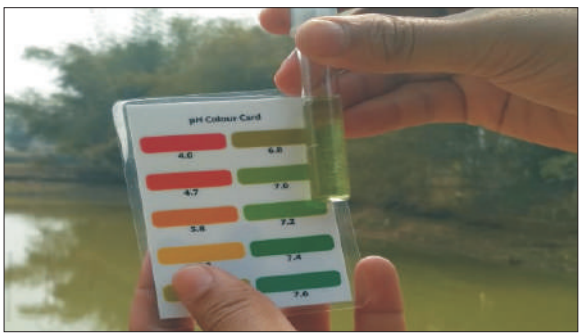
৫.২ নিম্ন দ্রৱীভূত অক্সিজেনৰ ফলত হোৱা চাপৰ লক্ষণবোৰ -

- যদি পুখুৰীৰ পানীখিনি ঘন সেউজীয়া আৰু

চেকি ডিস্কৰ দৃশ্যমান ১৫ ছেঃমিঃ হয় (দ্ৰৱীভূত অক্সিজেনৰ চাপৰ উদ্ভাৱন ৰাতিপুৱাৰ আগভাগত বা ডাঁৰৰীয়া বতৰত হয়)।

- যদি পুখুৰীৰ পানীবোৰ ছায়ছন্ন কলা ৰঙৰ আৰু দুর্গন্ধযুক্ত হয় (উদাঃ H_2S)।

৫.৩ ডাঙৰ বৰষুণৰ পাছত pH পৰীক্ষা কৰক আৰু যদি pH ৬.৫ তকৈ কম হয় তেন্তে চূণ প্ৰয়োগ কৰক।



মূল বিবেচনাৰলী ঃ

- নিম্ন দ্ৰৱীভূত অক্সিজেন চাপৰ লক্ষণ ঃ মাছবোৰে পুখুৰীৰ পৃষ্ঠত শ্বাস-প্ৰশ্বাসৰ বাবে কাপ কাপ কৰিবলৈ আৰম্ভ কৰে বা কেতিয়াবা দ্ৰৱীভূত অক্সিজেন অতি কম হোৱাৰ বাবে মৃত্যুও হয়। যদি এনেকুৱা কোনো ধৰণৰ লক্ষণ দেখা যায় তেন্তে দ্ৰৱীভূত অক্সিজেনৰ পৰিমাণ বঢ়াবৰ কাৰণে আংশিকভাৱে পানী বিনিময়ৰ ব্যৱস্থা কৰিব লাগে বা পৃষ্ঠভাগত পানী চটিয়াই দিব লাগে।
- ডাঙৰ পুখুৰীৰ বাবে যান্ত্ৰিক বায়ুযন্ত্ৰ ব্যৱহাৰ কৰক; সৰু পুখুৰীৰ বাবে পাম্পৰ সহায়ত পানী ওপৰলৈ উঠাই পুখুৰীৰ পৃষ্ঠভাগত ঝৰ্ণা সদৃশ গঢ়ি তুলিব লাগে।
- যদি পুখুৰীৰ পানীৰ ৰং কলা বা ছায়াছন্ন হয় তেন্তে পুখুৰীৰ তলৰ পৰা কিছু অংশ পানী নিষ্কাষণ কৰক আৰু ওপৰৰ অংশত নতুন পানীৰ যোগান ধৰক।

৬. খাদ্যৰ যোগান ঃ

৬.১ খাদ্যৰ উপলভ্যতা আৰু ক্ৰয় মূল্যৰ ওপৰত নিৰ্ভৰ কৰি খাদ্য যোগানৰ বিকল্প অনুসৰণ কৰক।

- উপঙা খাদ্য
- ডুবযোৱা খাদ্য
- পামত তৈয়াৰ কৰা খাদ্য
- বাণিজ্যিকভাৱে উপলব্ধ আৰু পামত তৈয়াৰ কৰা খাদ্যৰ সংমিশ্ৰণ।

৬.২ খাদ্য যোগানৰ হাৰ পৰামৰ্শ মতে নিৰ্ধাৰিত কৰক।

মূল বিবেচনাৰলী ঃ

- বৰ্দ্ধন খাদ্যত নূন্যতম ৩০% প্ৰ'টিন থকাতো আদৰ্শ স্বৰূপ।
- বতাহৰ দিশৰ সৈতে পুখুৰীৰ যিকোনো এক নিৰ্দিষ্ট পা�ৰৰ পৰা উপঙা পৰিপূৰক খাদ্যবোৰ সিচঁৰিত কৰিব লাগে।
- স্থানীয়ভাৱে উপলব্ধ সামগ্ৰীৰে তৈয়াৰি খৰাহী/ডলাত খাদ্যবোৰ ৰাখি পুখুৰীৰ পানীত ডুবাই দিব লাগে।
- খাদ্যবোৰ ছিদ্ৰযুক্ত মোনাত ভৰাই পানীৰ পৃষ্ঠভাগৰ পৰা অলপ তলত স্থাপন কৰিব লাগে যাতে মাছে খাদ্যবোৰ সহজে বিচাৰি পায় আৰু ইয়াৰ দ্বাৰা খাদ্যৰ ক্ষতিও নুন্যতম হয়।
- উন্নত খাদ্য ব্যৱস্থাপনাৰ বাবে পুখুৰীৰ পাৰৰ পৰা ২-৩ মিটাৰ দূৰত ৰখা পৰীক্ষা ডলাত খাদ্য যোগানো ধৰিব পাৰি।
- মাছৰ মুঠ ওজনৰ ওপৰত ভিত্তি কৰি খাদ্যৰ যোগান নিৰ্ধাৰণ কৰিব লাগে (খাদ্য যোগানৰ তালিকা মীন পালক গৰাকীক উপলব্ধ কৰোৱা হ'ব)।
- উপদেশমতে পামত তৈয়াৰ কৰা খাদ্য প্ৰস্তুতিৰ ব্যৱস্থা কৰিব লাগে যাতে খাদ্যবোৰ বেছিগ্ৰহণযোগ্য হয়।
- দৈনিক খাদ্য যোগানৰ হাৰ মুঠ মাছৰ ওজনৰ ৫% -আঙুলি সদৃশ পোনাৰ বাবে আৰু ১% ডাঙৰ মাছৰ বাবে।
- অৱশ্যে খাদ্যৰ গুণগত মান আৰু পুখুৰীৰ পানীত উদ্ভিদ আৰু প্ৰাণী প্লৱকৰ সমৃদ্ধিৰ ওপৰত ভিত্তি কৰি খাদ্য যোগানৰ হাৰ নিৰ্ধাৰণ কৰাতো প্ৰয়োজনীয়।
- দুপৰীয়া যেতিয়া তাপমাত্ৰা অতিশয় বেছি হয় বা ডাঁৰৰীয়া বা বৰষুণৰ দিনত খাদ্য যোগানৰ পৰা বিৰত থাকিব লাগে।

৭. নিয়মিত নমুনা সংগ্রহ ঃ

৭.১ মাছৰ বৃদ্ধি আৰু স্বাস্থ্যৰ মূল্যায়ন নির্ধাৰণ কৰিবলৈ প্ৰতিমাহে পালন কৰা মাছৰ নমুনা পৰীক্ষা কৰিব লাগে।

- মজুত কৰা বিভিন্ন প্ৰজাতি মাছৰ দৈর্ঘ্য আৰু ওজন পর্যবেক্ষণ কৰক।
- পালন কৰা মিছামাছৰ দৈর্ঘ্য আৰু ওজন নিৰীক্ষণ কৰক।

- উপৰোক্ত তথ্যবোৰ খাদ্য যোগানৰ হাৰ নির্ধাৰণ কৰিবলৈ ব্যৱহাৰ কৰক।
- মাছৰ শৰীৰৰ পৃষ্ঠ, পাখি, জলক্লোম ইত্যাদিত বাহ্যিক পৰজীৱীৰ উপস্থিতিৰ লগতে ক্ষত বা ক্ষত লক্ষণ পৰীক্ষা কৰক।

৮. ৰোগ ব্যৱস্থাপনা ঃ

৮.১ মাছৰ ৰোগ আৰু পৰজীৱী সংক্ৰমণৰ সংশয় হ্ৰাসৰ বাবে মীন পালকে বিভিন্ন ধৰণৰ ৰোগ প্ৰতিৰোধ মূলক পদক্ষেপ গ্ৰহণ কৰিব পাৰে।

- পুখুৰীত স্বাস্থ্যৱান আৰু ৰোগমুক্ত পোনা মজুত কৰক।
- মীন পালনৰ বিভিন্ন কার্য্য কলাপত ব্যৱহৃত সকলো সৰঞ্জামক বীজাণুমুক্ত কৰক।
- অধিক সংখ্যক মাছ এৰাৰ পৰা বিৰত থাকক।

- সঠিক খাদ্যৰ যোগান, সাৰৰ প্ৰয়োগ আৰু পানীৰ গুণাগুণ ব্যৱস্থাপনাৰ অনুশীলন অনুসৰণ কৰক।
- ৰোগ আৰু চাপৰ লক্ষণ নিয়মিতভাৰে পৰীক্ষা কৰক।
- যিকোনো ৰোগৰ লক্ষণ অভিলেখ ৰখাৰ লগতে লক্ষণৰ চিত্ৰ গ্ৰহণ আৰু মৃত মাছৰ সংখ্যাৰ হিচাপ ৰাখক।

- সকলো আক্ৰান্ত আৰু মৃত মাছ নিষ্কাশন কৰি মীন পামৰ পৰা যথেষ্ট দূৰত মাটিত পুতি থোৱাৰ ব্যৱস্থা কৰক।
- যিকোনো অস্বাভাৱিক মৃত্যুৰ বাবে দায়িত্বশীল কর্তৃপক্ষক অৱগত কৰক আৰু পৰীক্ষাগাৰত পৰীক্ষাৰ বাবে ৰুগীয়া মাছৰ নমুনা সংগ্ৰহ কৰাত সহায় আগবঢ়াওঁক।

৯. মাছ সংগ্রহ ঃ

৯.১. পালন পদ্ধতিৰ ওপৰত ভিত্তি কৰি মৎস্য সংগ্ৰহৰ কৌশল অৱলম্বন কৰক (সাধাৰণতে একক মজুত কৰণ আৰু একাধিক মাছ ধৰা পদ্ধতি)।

- মাছৰ বৃদ্ধি ৮০০ গ্ৰাম- ১ কেঃজিঃ হ'লে ধৰাৰ ব্যৱস্থা কৰক।
- মিছামাছৰ আকাৰ ৫০ গ্ৰামতকৈ অধিক হ'লে ধৰিব লাগে।

♦ মাছবোৰ জীৱিত অৱস্থাত বজাৰলৈ নিয়াৰ আগতে অনুকূলিত কৰক।

মূল বিবেচনাৰলী ঃ

♦ মৎস্য সংগ্রহৰ কৌশলটি মূলত বজাৰৰ চাহিদা, মাছৰ বৃদ্ধি ইত্যাদিৰ ওপৰত নির্ভৰ কৰে।

♦ বজাৰলৈ নিয়া এদিন পূর্বে মাছ সংগ্রহ কৰক আৰু নাইলন হাপাৰ ভিতৰত ৰখাৰ ব্যৱস্থা লওঁক; বজাৰলৈ পঠোৱা অতিকমেও ২৪ ঘণ্টা পূর্বে খাদ্যৰ যোগান বন্ধ কৰক।

♦ চাৰি মাহ পালনৰ পাছত ডাঙৰ আকাৰ (> ৫০ গ্রাম) মিছামাছবোৰ উপযুক্ত পাহিৰ মহাজাল ব্যৱহাৰ কৰি ধৰিব লাগে আৰু পৰৱর্তী ৩-৪ মাহৰ বাবে প্রতি ৩-৪ সপ্তাহৰ অন্তৰত এবাৰকৈ ধৰা অব্যাহত ৰাখিব লাগে। মিছামাছবোৰ অৱশেষত ৮ মাহ পালনৰ পাছত সম্পূর্ণ পানী নিষ্কাষণ কৰি ধৰিব পাৰি।

১০. বিপণন ঃ

১০.১.ৰাতিপুৱাৰ আগভাগত অথবা আবেলি শেষ ভাগত মাছ বজাৰলৈ পঠোৱাৰ ব্যৱস্থা কৰক।

১০.২.অধিক মূল্য পাবৰ বাবে যথাসম্ভৱ মাছ জীৱিত অৱস্থাত বজাৰলৈ পঠোৱাৰ ব্যৱস্থা কৰক।

মূল বিবেচনাৰলী ঃ

♦ তাপমাত্রা বেছি হ'লে মাছ বজাৰলৈ নিয়াৰ পৰা বিৰত থাকক (দিনৰ মাজভাগৰ পৰা আবেলিৰ আগভাগলৈ)।

♦ জীৱিত মাছ পৰিবহনৰ সময়ত মাছৰ মৃত্যুৰ হাৰ হ্রাস কৰিবলৈ পানীৰ পৰিমাণৰ ওপৰত ভিত্তি কৰি মুঠ মাছৰ ওজন নির্ধাৰণ কৰক।

১১. পৰিৱেশজনিত যত্ন ঃ

১১.১.মীনপালনৰ কার্য্যকলাপে মীন পামৰ চাৰিওফালে থকা জলজ আৰু স্থলজ পৰিবেশৰ যাতে কোনো ধৰণৰ ক্ষয়ক্ষতি সাধন নকৰে সেয়া নিশ্চিত কৰক।

মূল বিবেচনাৰলী ঃ

♦ পুখুৰীৰ পানী আৰু গেদ পোনপতীয়াভাৱে ওচৰৰ জলাশয়লৈ নিষ্কাশন কৰাৰ পৰা বিৰত থাকক।

♦ মৃত মাছবোৰ সঠিকভাৱে নিষ্পত্তি কৰক (অনতি পলমে মৃত মাছবোৰ নিষ্কাশন কৰক আৰু সঠিকভাৱে পুতি পেলাওঁক)।

♦ খাদ্যৰ মোনা, সাৰৰ মোনা, ব্যৱহৃত বটল আৰু পাত্রবোৰ সঠিকভাৱে নিষ্পত্তি কৰক।

১২. অভিলেশ সংগ্রহ ঃ

১২.১. মীনপামৰ সকলো কার্য্যকলাপ, মজুতকৰণৰ বিৱৰণ, নিৱেশ, নমুনা বিৱৰণ, সংগ্রহৰ বিৱৰণ, বিক্রী আৰু খোৱাৰ খতিয়ান ৰাখক।

১২.২.পাম পৰিদর্শনৰ সময়ত সকলো ধৰণৰ অভিলেখ-টোকা পর্যায়ক্রমে (উন্নীত) হৈ থকাতো প্রকল্পৰ কর্মী বা বিভাগীয় অধিকাৰীয়ে নিশ্চিত কৰিব।

অসম কৃষি বাণিজ্য আৰু গ্রাম্য ৰূপান্তৰকৰণ প্রকল্প
মীন সঞ্চালকালয়, অসম চৰকাৰ
মীন ভৱন, গোপীনাথ নগৰ, গুৱাহাটী-৭৮১০১৬

অধিক তথ্যৰ বাবে যোগাযোগ কৰক ঃ এপার্ট কোষ, দূৰভাষ ঃ ০৩৬১-২৫৪৫১০৪
ই-মেইল ঃ dirfishassam2019@gmail.com ৱেব ঃ https://fisheriesdirector.assam.gov.in

Annexure- 10
Standard Operating Procedure (SOP) for Indian Major Carp Hatcheries

Standard Operating Procedure (SOP)

For Indian Major Carp Hatcheries

ARIAS Society
GOVERNMENT OF ASSAM
Assam Rural Infrastructure and Agricultural Services Society

অসম চৰকাৰ
सत्यमेव जयते
GOVERNMENT OF ASSAM

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Standard Operating Procedure (SOP)

For Indian Major Carp Hatcheries

The aquaculture system in Assam is mainly categorized by polyculture of Indian Major Carps with Catla and Rohu as major species along with exotic carps & other minor carps. The availability of quality fish seed in adequate quantities throughout the year is the prime requisite for aquaculture development to increase production, vertical expansion and growth of the industry.

Seed supply is a major problem faced by fish farmers of Assam in terms of quality, quantity and timely availability. The state has got around 500 carp hatcheries in both Government and private sectors which produced around 95190 lakh fish seed (fry) during the year 2019–20. However, lack of adequate nursery/ rearing ponds for regional self-sufficiency, breeding practices using underweight and under size fishes unscientific brood stock replacement, improper maintenance of brood fish and mixed species breeding practices as well as lack of awareness on scientific management of fish seed rearing, poor fish seed transportation and poor marketing facilities act as major problems for quality fish seed production.

The concept of brood stock management including sourcing brood stock, nourishing brood stock, water quality and health management and use of improved strains are in the initial stages of adoption by the hatcheries. With the growing requirement for quality carp seed, there is an urgent need for developing Standard Operating Procedures (SOP) for Indian Major carp hatcheries in Assam context, where private hatcheries are the major contributors to the fish seed production and technical hand holding to improve their efficiency. Assam being the feeder state for fish seeds for the entire NE region, to cater the need of the growing fish farming sector of the region, the fish seed production sector of the state of Assam should be improved with technology for quality seed production. Purpose of this document on Standard Operating Procedures (SOP) for Indian Major Carp Hatcheries is to support the hatchery owners/operators & seed growers and to guide them for the production of quality seed.

This document on Standard Operating Procedures (SOP) and time line activity chart for different critical stages of quality seed production: i) sourcing and selection of breed, ii) better management of brood stock iii) following scientific breeding protocols iv) better hatchery practices and v) proper nursing of spawn to fry/fingerling stage is prepared based on the earlier experience and the procedures given are to be followed meticulously for better results.

1. Brood stock sourcing and raising

- Use brood stock from known source and genetic makeup produced with proper management protocol. Do not mix brood stock from different locations/ sources
- The optimal size of the brood stock pond is around 0.4-0.5 ha with a water depth of 5-6 ft.
- The brood stock ponds need to be prepared as per the SOP and brood stock managed with care for 3-4 months prior to spawning.
- Pond should be completely dewatered (drained or pumped out), sun dried and then soil ploughed for release of accumulated poisonous gases.
- In case it is difficult to completely drain the pond, at least ¾ of the water should be dewatered and then Mahua oil cake @ 250 kg/ha can be applied. This initially acts as poison to control weed and predatory fishes and later as manure and thus initial manuring could be avoided.
- The lime has to be applied @250–500 kg/ha depending on the soil pH for disinfection of pond bottom and also to act as a buffering agent to correct the pH.
- The pond should be filled with water up to 2 feet followed by manuring with cattle dung @10000 kg/ha/year (50% initially and rest in equal installments).
- If open canal water is used, place a screen in the inlet to avoid entry of SIS or other weed/predatory fishes.
- The ponds should be filled to a depth of five to seven feet (1.5-2.0 m).
- The brood stock can be released 7 days after application of manure @ 1000 kg/ha. (Two weeks in case if Manhua oil cake is already used).

2. Brood fish selection and stocking:

- Healthy fish of minimum 1.5 years age for Rohu & Mrigal and 2.5 years age for Catla with ideal size of fish at stocking should be: Rohu 1-1.5 kg, Mrigal 0.8–1.2 kg and Catla 1.5–2.0 kg.
- Record the source of the brood stock (farm reared or from grow out tanks- if out sourced, origin of the brood stock may be recorded).
- Record weight and age of all the brood fishes at the time of stocking.
- Stocking density should ne @2000kg/ha.
- Sex wise separate stocking is preferred if pond facilities are available.

3. Post-stocking Management

3.1. Feed management:

- The brood fish should be raised in brood fish ponds with special care.
- The brood fish should be fed with brood feed (32/4) @ 2% of body weight for initial 2 months
- For the months of Dec and Jan (winter months), feeding with brood feed (28/4) @ 0.5% of Body Weight is recommended
- For rest of the period till spawning brood fishes have to be fed with same feed (28/4) @ 1% of Body Weight
- Add Vitamin E with Selenium @ 5ml/kg feed daily (start from February)
- Stop feeding once in a week (fed only for 6 days in a week).
- In winter feed only 4 – 5 days in a week depending on demand.
- In case of presence/occurrence of small indigenous self-populating species (SIS), or any other unwanted fishes, they should be removed by repeated netting as they compete with feed (both zooplankton and also supplementary feed given)
- If any infestation of Argulus sp, use insecticides as cypermethrin/deltamethrin 3 times in 7 days intervals at evening time @ 100 ml/ha water spread area.
- If any infestation of Lernaea sp, use Dipterex 3 times in 7 days intervals at evening time @ 1ppm in pond water or can also give Bath treatment with 25mg/l of formalin or 2-3% NaCl for 15 min or 100ppm $KMnO_4$ pond treatment with 5mg/l of $KMnO_4$

3.2. Water Quality management:

- Lime application @ 50kg/ha/month
- Raw salt application @ 100kg/ha/month
- Exchange the water @ 20% - 30% every month
- Pull chain at the pond bottom once in two weeks for removal of poisonous gases
- Use zeolite @ 50 kg/ha/month
- Check the fish once in a month for monitoring growth and health check up
- Reschedule feeding based on the biomass as indicated

4. Breeding and Hatchery management

4.1. Hatchery preparation (prior to spawning)

4.1. 1. Water source:

1. Preferably ground water (tube well or bore well) is preferred and the water should be stored in a reservoir or pond/sump tank before pumping to overhead

tank - aging process to increase the dissolved oxygen content in the water. If earthen pond is used for storing water, pond should be sun-dried for about a week and then filled with clean water. Care should be taken to prevent entry of any fish or other unwanted predators by providing screen at entry or inlet point.

2. If water from river or other natural sources is used, it should be stored in a clean reservoir/storage tank as indicated above.
3. Overhead tank, and all pipelines and fittings and equipment should be checked, repaired, cleaned and disinfected using lime or KMnO4 before use.
4. Spawning and hatching pools should be thoroughly washed with lime water and disinfected with $KMnO_4$.

4.2. Induced spawning steps:

Day 1:

4.2.1. Brood fish selection and conditioning:

1. Fully mature Brood fish, ready to spawn should be selected by observing secondary sexual characters –
    - Females: Pectoral fin soft; swollen belly round in shape and soft to touch with reddish vent.
    - Males: Pectoral fin rough with tubercles and oozing of milt with slight pressure on abdomen
2. Net the brooders in the morning hours and condition them for spawning
3. Select fish of 2 years or more of equal weight (preferably <3kg) and equalize sex ratio by selecting equal numbers fish of almost same age and equal weight
4. The brood fishes should preferably be conditioned for 4 -6 hours before hypophysation in a separate concrete pond to empty stomach and acclimatization to the new hatchery environment
5. Brood stock should be collected and transferred to hatchery in wet condition (with water or in wet cloth) for conditioning during morning cool hours and should be handled with care to avoid stress injuries. Avoid using brood stock of unknown source

4.2.2. Spawning protocols:

1. Spawning of different species in the same spawning pool simultaneously *i.e.,* mixed species breeding should be strictly avoided to prevent possible cross breeding or hybridization as inter generic hybridization which is common in IMC
2. Evening hours (just before sunset - 5.30—6.00 pm) is the best time for administering inducing agent
3. Weight of each male and female injected should be recorded along with numbers
4. Females may be administered inducing agent first followed by males.
5. Commercially available inducing agents (Ovaprim, Ovatide, WOVA-FH) may be used. The recommended dosage for IMC g is provided below for WOVA_FH

Fish Name	Female (ml/kg body fish weight)	Male (ml/kg fish weight)
Rohu	0.40-0.50	0.25-0.30
Catla	0.50-0.60	0.30-0.40
Mrigal	0.30.0.40	0.20-0.30

6. Spawning pool should be covered with net covering to avoid possible escape of brood fish by jumping
7. Water circulation and showering in spawning pool should be at appropriate speed and continuous and maintain the water temperature around 30 ^{o}C
8. Number of breeders injected should be based on the capacity of the spawning pool and also the capacity of the hatching pools
9. Provision for power back for continuous pumping of water is essential

Day 2 - day 4:

4.2.3. Removal of spawned fish from the breeding pool and collection and transportation of eggs to hatching pools:

1) The spawning takes place in the early morning hours and water hardening of eggs completes in 4-5 hours post fertilization
2) The eggs will be ready for shifting to hatching pools on the 2nd day morning.
3) Brood fish should be removed from the breeding pool in the morning hours and disinfected by dipping in $KMnO_4$ solution.
4) Record the number and weight of females that fully released the eggs-- calculate fecundity and fertilization success.
5) Record the number and weight of females not responded and shift them to brood stock pond for preparing them for next spawning.
6) Spawned fish or spent, both male and female may be shifted for a separate pond to nurse them for later use.

4.2.4. Incubation of eggs or hatching practices:

1. The water hardened eggs should be transferred to the hatching pools 6-7 hours after fertilization.
2. Chinese type hatcheries are preferred for commercial scale egg incubation.
3. Maintain water temperature around 30-32 ^{o}C through showers and bring down water temperature by using ice blocks in overhead tank, if temperature is very high
4. Dissolved Oxygen concentration in hatchery water should be maintained at 5-7 ppm.
5. Alkalinity of water should be maintained below 130 ppm.
6. Remove the dead eggs/hatchlings periodically from the hatcheries to avoid infection to other eggs/ hatchlings

7. Water circulation rate in the hatching polls should be maintained at a proper rate throughout hatching period for better dissolved oxygen supply and better survival

DAY -5

1. Normally yolk resorption completes between 72-96 hrs. after hatching, depending on the water temperature and the spawn will be ready by 4th day evening or 5th day morning to be shifted for nursing in nursery ponds
2. Early Morning or late evening hours are the best time for collection of spawn for transportation and shifting to nursery ponds
3. Measure the quantity of spawn using measuring cups of known volume (measure randomly 3-4 cups) count and then compute to get total spawn obtained.
4. Ideally Spawn should be conditioned in a small tank with water flow for one or two hours before transportation or shifting to nursery ponds where dead spawn can be removed and counting also can be done

4.3. Spawn packing and transportation

- 50,000 spawn per polythene bag with 4 l of water and 4 l volume oxygen
- Spawn should be ideally transported in cool hours –morning or evening hours

5.0. Nursing spawn for fry production (Nursery pond management)

1. Earthen or cement ponds of 0.1 ha with a water depth of 1.00-1.20 m or 3-4 ft are ideal for spawn nursing
2. Ponds should be completely drained and sun dried (if drainable), plough the pond bottom for release of accumulated poisonous gases, oxidation of organic matter and to kill harmful bacteria,
3. Remove aquatic weeds and predators if any
4. Liming@200 – 500 kg/ha depending on the soil pH using agriculture lime Optimal water pH should be 6.5-8.5
5. Apply cow dung and/or poultry manure 7-10 days ahead of stocking at the rate of 5 – 6 tons/ha and 2 – 3 tons/ha respectively
6. Spawn stocking density @ 4million/ha
7. Feeding 6 kg/million/day for the first 5 days. For the remaining period feed 12 kg/million/day.
8. The two feed ration/day is necessary to get greater survival rate and enhanced growth rate. For first few days give powdered feed or in liquid form by spreading across the pond.
9. Number of cycles per season: 5 (making allowance of 5 days for preparation)
10. Spawn nursing duration- 15-20 days. Four to five crops could be raised in a season
11. Spawn should be stocked in nursing tank either in the early morning or late evening hours.
12. Nursing of single species is better as segregation of species at fry level will be extremely difficult.
13. If SOP is followed meticulously survival from spawn to fry could be 40-45%.

Time line chart of activities for brood stock raising and early spawning of IMC

Activity/month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug
Sourcing/collection of prospective breeders											
Pond preparation											
Stocking of breeders											
Feeding with 32/4 brood feed											
Feeding with 28/4 brood feed											
Addition of salt (cooking salt)											
Addition of Vitamin E with Selenium											
Exchange of Water (20%)											
Additional lime application											
Application Zeolite											
Disturbing the bottom by chain pulling											
Spawning											

Annexure- 11
Standard Operating Procedure (SOP) for Indian Major Carp Multiplication Centres

Standard Operating Procedure (SOP)

For Indian Major Carp Multiplication Centres

ARIAS Society
GOVERNMENT OF ASSAM
Assam Rural Infrastructure and Agricultural Services Society

অসম চৰকাৰ
सत्यमेव जयते
GOVERNMENT OF ASSAM

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Standard Operating Procedure (SOP)

For Indian Major Carp Multiplication Centers

Inadequate Seed supply in terms of quality, quantity and timely availability is a major problem faced by fish farmers of Assam. The state has over 500 carp hatcheries in both Government and private sector which produced around 95190 lakhs fish seed (fry) during the year 2019 – 20. However, due to improper brood stock replenishment and replacement, unscientific breeding practices, use of underweight and under sized fishes and lack of adequate nursery/ rearing ponds for regional self-sufficient are considered as some major constraints for quality fish seed in the state

The APART Project with technical support of WorldFish is upgrading few selected hatcheries as multiplication centres. The main purpose of these multiplication centres is to produce quality breeding material of Carp species including Genetically Improved Fish Species (GIFS) to hatcheries and supply to hatcheries to use these as brood stock to produce quality seed and supply to fish seed growers and fish growers. This requires following of best practices in genetic management of brood stock and husbandry practices in the multiplication centres.

This document on Standard Operational Procedures (SOP) for management of brood stock is prepared on the basis of principles of brood stock management and these are to be followed meticulously different critical stages of quality seed production for obtaining the desired results.

I. Genetic management of brood stock:

A) Sourcing of brood stock:

1. Broodstock must come from known sources (from the wild, from breeding nucleus, or from other farms/hatcheries)
2. Broodstock must be well mature at the age of 2 year plus, and with body weight of approximately 1.8 kg.
3. Broodstock must look healthy, well-shaped (good looking), no injuries, no deformities.

4. Broodstock should ideally be tagged with tags like Floy tags or Passive Integrated Transponder (PIT) tags for stock identification and monitoring the performance.
5. Broodstock should **NOT** be recruited from grow-out ponds.
6. Do **NOT** use under-aged or under-sized (under-weighed) broodstock.

B) Broodstock domestication and/or conditioning:

1. Broodstock ponds must be the **BEST** ponds in the hatcheries/MC in term of size with a proper depth and good water quality (high dissolved oxygen, neutral pH, no toxic gases).
2. Ideally broodstock should be reared/conditioning single species cohort (don't mix species), and single sex cohort (don't mix the two sexes)
3. Feeding broodstock at the RIGHT quantity (do NOT over-fed, and do NOT under-fed) and HIGH quality (crude protein at least 35%, fat at least 6%). Add minerals and vitamins if necessary.

C) Optimum number of broodstock required:

1. The number of breeders required in each multiplication centres depends on the targeted production of spawn/fry /fingerlings
2. At least 125 pairs (125 males and 125 females) of breeder assuming that they all are non-related should be used in a breeding season
3. Ideally 350 pairs, 350 males and 350 females, assuming that they all are non-related.

D) Managing inbreeding at an acceptable level:

- Quick calculation of inbreeding rate:
  $$\Delta \boldsymbol{F} = \frac{\mathbf{1}}{\mathbf{8} \times \boldsymbol{Number\ of\ females}} + \frac{\mathbf{1}}{\mathbf{8} \times \boldsymbol{Number\ of\ males}}$$
- Quick calculation of effective number (N_E): $\Delta F = \frac{1}{2N_E}$
- Equalize sex ratio (1:1 male: female) both in terms of number and weight of breeders
- Increase the gene pool by replenishing with fresh breeders
- Tagging of broodsotck, if possible (Power Point presentation).
- Keeping record of broodstock, including:
  - Broodstock name
  - Tag or marker of individual fish
  - Sex of fish
  - Number of fish population
  - Body weight
  - Date of Inventory

- Holding facility/location
- Information sheet on hatchery inputs and outputs-
- Remarks and other activities (*i.e.,* schedule of Clipping, feeding, fertilization and others)

- Rotation of male broodstock.
- Increase number of breeders used for spawning
- Go for individual pair meeting (one male: one female)
- Do NOT mix strains or fish from different locations.
- Introducing new fish from the wild or exchange with other centres, in case there is evidence of reduced performance of fry that likely caused by inbreeding.

E) Record keeping for breeding activity:

- Total number of fish, by sex (*i.e.* number of males and females) maintained.
- Number of male and female candidates used for spawning and weight.
- Kinds of hormones/inducing agents used.
- Doses of hormones/inducing agents used.
- Number of females spawned.
- If possible, the number/tag of each mating pair.
- Reproductive performance
  - Spawning success rate after injection for males
  - Spawning success rate after injection for females
  - Volume of milt per single male broodstock- is it required
  - Total number of eggs per single female/kg body weight
  - Fertilisation rate (%)
  - Hatching rate (%)
  - Number of hatchling (newly hatched fry) and%
  - Survival of yolk-sac fully absorbed fry(spawn) and %
  - Survival of fry (20 day old) quantity and %
  - Survival of fingerlings – quantity and %

II. Husbandry Practices:

1. Brood stock sourcing and raising:

- ❖ Use brood stock from known source and genetic makeup produced with proper management protocol. Do not mix brood stock from different locations/ sources
- ❖ The optimal size of the brood stock pond is around 0.4-0.5 ha with a water depth of 5-6 ft.
- ❖ The brood stock ponds need to be prepared as per the SOP and brood stock managed with care for 3-4 months prior to spawning.

- Pond should be completely dewatered (drained or pumped out), sun dried and then soil ploughed for release of accumulated poisonous gases.
- In case it is difficult to completely drain the pond, at least ¾ of the water should be dewatered and then Mahua oil cake @ 250 kg/ha can be applied. This initially acts as poison to control weed and predatory fishes and later as manure and thus initial manuring could be avoided.
- The lime has to be applied @250–500 kg/ha depending on the soil pH for disinfection of pond bottom and also to act as a buffering agent to correct the pH.
- The pond should be filled with water up to 2 feet followed by manuring with cattle dung @10000 kg/ha/year (50% initially and rest in equal installments).
- If open canal water is used, place a screen in the inlet to avoid entry of SIS or other weed/predatory fishes.
- The ponds should be filled to a depth of five to seven feet (1.5-2.0 m).
- The brood stock can be released 7 days after application of manure @ 1000 kg/ha. (Two weeks in case if Manhua oil cake is already used).

2. Brood fish selection and stocking:

- Healthy fish of minimum 1.5 years age for Rohu & Mrigal and 2.5 years age for Catla with ideal size of fish at stocking should be: Rohu 1-1.5 kg, Mrigal 0.8–1.2 kg and Catla 1.5–2.0 kg.
- Record the source of the brood stock (farm reared or from grow out tanks- if out sourced, origin of the brood stock may be recorded).
- Record weight and age of all the brood fishes at the time of stocking.
- Stocking density should ne @2000kg/ha.
- Sex wise separate stocking is preferred if pond facilities are available.

3. Post-stocking Management

3.1. Feed management:

- The brood fish should be raised in brood fish ponds with special care.
- The brood fish should be fed with brood feed (32/4) @ 2% of body weight for initial 2 months

- For the months of Dec and Jan (winter months), feeding with brood feed (28/4) @ 0.5% of Body Weight is recommended
- For rest of the period till spawning brood fishes have to be fed with same feed (28/4) @ 1% of Body Weight
- Add Vitamin E with Selenium @ 5ml/kg feed daily (start from February)
- Stop feeding once in a week (fed only for 6 days in a week).
- In winter feed only 4 – 5 days in a week depending on demand.
- In case of presence/occurrence of small indigenous self-populating species (SIS), or any other unwanted fishes, they should be removed by repeated netting as they compete with feed (both zooplankton and also supplementary feed given)
- If any infestation of Argulus sp, use insecticides as cypermethrin/deltamethrin 3 times in 7 days intervals at evening time @ 100 ml/ha water spread area.
- If any infestation of Lernaea sp, use Dipterex 3 times in 7 days intervals at evening time @ 1ppm in pond water or can also give Bath treatment with 25mg/l of formalin or 2-3% NaCl for 15 min or 100ppm $KMnO_4$ pond treatment with 5mg/l of $KMnO_4$

3.2. Water Quality management:

- Lime application @ 50kg/ha/month
- Raw salt application @ 100kg/ha/month
- Exchange the water @ 20% - 30% every month
- Pull chain at the pond bottom once in two weeks for removal of poisonous gases
- Use zeolite @ 50 kg/ha/month
- Check the fish once in a month for monitoring growth and health check up
- Reschedule feeding based on the biomass as indicated

4. Breeding and Hatchery management

4.1. Hatchery preparation (prior to spawning)

4.1. 1. Water source:

1. Preferably ground water (tube well or bore well) is preferred and the water should be stored in a reservoir or pond/sump tank before pumping to overhead tank - aging process to increase the dissolved oxygen content in the water. If earthen pond is used for storing water, pond should be sun-dried for about a week and then filled

with clean water. Care should be taken to prevent entry of any fish or other unwanted predators by providing screen at entry or inlet point.

2. If water from river or other natural sources is used, it should be stored in a clean reservoir/storage tank as indicated above.
3. Overhead tank, and all pipelines and fittings and equipment should be checked, repaired, cleaned and disinfected using lime or $KMnO_4$ before use.
4. Spawning and hatching pools should be thoroughly washed with lime water and disinfected with $KMnO_4$.

4.2. Induced spawning steps:

Day 1:

4.2.1. Brood fish selection and conditioning:

1. Fully mature Brood fish, ready to spawn should be selected by observing secondary sexual characters –
    - Females: Pectoral fin soft; swollen belly round in shape and soft to touch with reddish vent.
    - Males: Pectoral fin rough with tubercles and oozing of milt with slight pressure on abdomen
2. Net the brooders in the morning hours and condition them for spawning
3. Select fish of 2 years or more of equal weight (preferably <3kg) and equalize sex ratio by selecting equal numbers fish of almost same age and equal weight
4. The brood fishes should preferably be conditioned for 4 -6 hours before hypophysation in a separate concrete pond to empty stomach and acclimatization to the new hatchery environment
5. Brood stock should be collected and transferred to hatchery in wet condition (with water or in wet cloth) for conditioning during morning cool hours and should be handled with care to avoid stress injuries. Avoid using brood stock of unknown source

4.2.2. Spawning protocols:

1. Spawning of different species in the same spawning pool simultaneously *i.e.,* mixed species breeding should be strictly avoided to prevent possible cross breeding or hybridization as inter generic hybridization which is common in IMC
2. Evening hours (just before sunset - 5.30—6.00 pm) is the best time for administering inducing agent
3. Weight of each male and female injected should be recorded along with numbers
4. Females may be administered inducing agent first followed by males.

5. Commercially available inducing agents (Ovaprim, Ovatide, WOVA-FH) may be used. The recommended dosage for IMC g is provided below for WOVA_FH

Fish Name	Female (ml/kg body fish weight)	Male (ml/kg fish weight)
Rohu	0.40-0.50	0.25-0.30
Catla	0.50-0.60	0.30-0.40
Mrigal	0.30.0.40	0.20-0.30

6. Spawning pool should be covered with net covering to avoid possible escape of brood fish by jumping
7. Water circulation and showering in spawning pool should be at appropriate speed and continuous and maintain the water temperature around 30 ^{o}C
8. Number of breeders injected should be based on the capacity of the spawning pool and also the capacity of the hatching pools
9. Provision for power back for continuous pumping of water is essential

Day 2 - day 4:

4.2.3. Removal of spawned fish from the breeding pool and collection and transportation of eggs to hatching pools:

1) The spawning takes place in the early morning hours and water hardening of eggs completes in 4-5 hours post fertilization
2) The eggs will be ready for shifting to hatching pools on the 2nd day morning.
3) Brood fish should be removed from the breeding pool in the morning hours and disinfected by dipping in $KMnO_4$ solution.
4) Record the number and weight of females that fully released the eggs-- calculate fecundity and fertilization success.
5) Record the number and weight of females not responded and shift them to brood stock pond for preparing them for next spawning.
6) Spawned fish or spent, both male and female may be shifted for a separate pond to nurse them for later use.

4.2.4. Incubation of eggs or hatching practices:

1. The water hardened eggs should be transferred to the hatching pools 6-7 hours after fertilization.
2. Chinese type hatcheries are preferred for commercial scale egg incubation.
3. Maintain water temperature around 30-32 ^{o}C through showers and bring down water temperature by using ice blocks in overhead tank, if temperature is very high

4. Dissolved Oxygen concentration in hatchery water should be maintained at 5-7 ppm.
5. Alkalinity of water should be maintained below 130 ppm.
6. Remove the dead eggs/hatchlings periodically from the hatcheries to avoid infection to other eggs/ hatchlings
7. Water circulation rate in the hatching polls should be maintained at a proper rate throughout hatching period for better dissolved oxygen supply and better survival

DAY -5

1. Normally yolk resorption completes between 72-96 hrs. after hatching, depending on the water temperature and the spawn will be ready by 4th day evening or 5th day morning to be shifted for nursing in nursery ponds
2. Early Morning or late evening hours are the best time for collection of spawn for transportation and shifting to nursery ponds
3. Measure the quantity of spawn using measuring cups of known volume (measure randomly 3-4 cups) count and then compute to get total spawn obtained.
4. Ideally Spawn should be conditioned in a small tank with water flow for one or two hours before transportation or shifting to nursery ponds where dead spawn can be removed and counting also can be done

4.3. Spawn packing and transportation

- 50,000 spawn per polythene bag with 4 l of water and 4 l volume oxygen
- Spawn should be ideally transported in cool hours –morning or evening hours

5.0. Nursing spawn for fry production (Nursery pond management)

1. Earthen or cement ponds of 0.1 ha with a water depth of 1.00-1.20 m or 3-4 ft are ideal for spawn nursing
2. Ponds should be completely drained and sun dried (if drainable), plough the pond bottom for release of accumulated poisonous gases, oxidation of organic matter and to kill harmful bacteria,
3. Remove aquatic weeds and predators if any
4. Liming@200 – 500 kg/ha depending on the soil pH using agriculture lime Optimal water pH should be 6.5-8.5
5. Apply cow dung and/or poultry manure 7-10 days ahead of stocking at the rate of 5 – 6 tons/ha and 2 – 3 tons/ha respectively
6. Spawn stocking density @ 4million/ha
7. Feeding 6 kg/million/day for the first 5 days. For the remaining period feed 12 kg/million/day.

8. The two feed ration/day is necessary to get greater survival rate and enhanced growth rate. For first few days give powdered feed or in liquid form by spreading across the pond.
9. Number of cycles per season: 5 (making allowance of 5 days for preparation)
10. Spawn nursing duration- 15-20 days. Four to five crops could be raised in a season
11. Spawn should be stocked in nursing tank either in the early morning or late evening hours.
12. Nursing of single species is better as segregation of species at fry level will be extremely difficult.
13. If SOP is followed meticulously survival from spawn to fry could be 40-45%.

Quick calculation of annual target and requirements:

Each multiplication centre needs to be fixed the annual target for producing quality seed materials (Fingerlings) and back up facilities required to achieve the targeted production needs to be made available in these multiplication centres. These are calculated on back-calculation on standard rates of survival

Sl. No	Product	Requirements
1	Fingerlings	Number of fry based on survival of fry to fingerlings (70%)
2	Fry	Number of spawn required to produce fry based on the survival for spawn to fry (45-50%)
3	Spawn	Number of hatchlings required @90% survival form hatchlings to spawn
4	Fertilized eggs	Number of eggs required @fecundity 1.5 lakh/kg body weight of female
5	No. of eggs required	Number and weight of breeders(female) and males to required eggs
6	No. and weight of females and males required	Based on the success rate /response of breeders (70-80%)
7	Area required to maintain these breeders	Area at stocking density of 2000kg/ha

Time line chart of activities for brood stock raising and early spawning of IMC

Activity/month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug
Sourcing/collection of prospective breeders											
Pond preparation											
Stocking of breeders											
Feeding with 32/4 brood feed											
Feeding with 28/4 brood feed											
Addition of salt (cooking salt)											
Addition of Vitamin E with Selenium											
Exchange of Water (20%)											
Additional lime application											
Application Zeolite											
Disturbing the bottom by chain pulling											
Spawning											

Annexure- 12
Social Behaviour Communication Change Social Media Posts

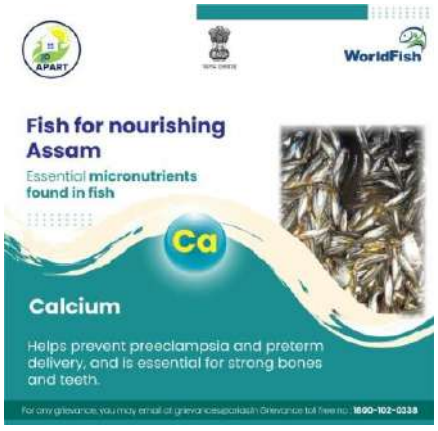
SOCIAL MEDIA PUBLICATION ON FISH IN NUTRITION


APART
WorldFish
Fish for nourishing Assam
Essential micronutrients found in fish
Fe
Iron
Essential for brain development in children and increases maternal survival rates.


APART
WorldFish
অসমক পুষ্টি প্রদান কৰাৰ বাবে মাছ
মাছত থকা ক্ষুদ্ৰ পুষ্টিকাৰক গুণাগুণবোৰ
Fe
আয়ৰণ
শিশুৰ মগজু বিকাশৰ লগতে মাতৃৰ জীয়াই থকা ক্ষমতা বৃদ্ধিৰ বাবে আৱশ্যক।


APART
WorldFish
Fish for nourishing Assam
Essential micronutrients found in fish
Zn
Zinc
Crucial for childhood survival, reduces stunting in children and fights diarrhea.


APART
WorldFish
অসমক পুষ্টি প্রদান কৰাৰ বাবে মাছ
মাছত থকা ক্ষুদ্ৰ পুষ্টিকাৰক গুণাগুণবোৰ
Zn
জিংক
শিশু অৱস্থাত অভিযোজনৰ বাবে অত্যন্ত গুৰুত্বপূৰ্ণ। ডায়েৰিয়া ৰোগ প্ৰতিৰোধৰ বাবে আৰু শিশুৰ পুষ্টিহীনতা হ্ৰাস কৰিবৰ বাবে আৱশ্যক।

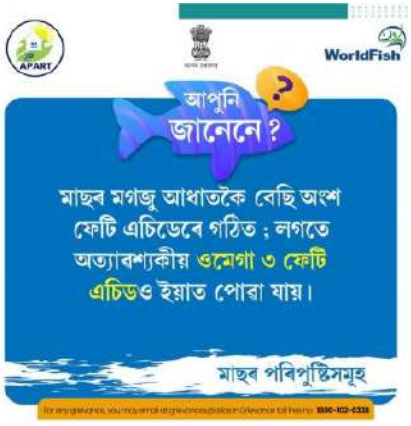

APART
WorldFish
Fish for nourishing Assam
Essential micronutrients found in fish
Ca
Calcium
Helps prevent preeclampsia and preterm delivery, and is essential for strong bones and teeth.


APART
WorldFish
অসমক পুষ্টি প্রদান কৰাৰ বাবে মাছ
মাছত থকা ক্ষুদ্ৰ পুষ্টিকাৰক গুণাগুণবোৰ
Ca
কেলছিয়াম
শিশু অৱস্থাত অভিযোজনৰ বাবে অত্যন্ত গুৰুত্বপূৰ্ণ। ডায়েৰিয়া ৰোগ প্ৰতিৰোধৰ বাবে আৰু শিশুৰ পুষ্টিহীনতা হ্ৰাস কৰিবৰ বাবে আৱশ্যক।


APART
WorldFish
Did you know?
Globally, 3 billion people depend on fish for almost 20% of their average per capita intake of animal protein.
Fish in Human Nutrition


APART
WorldFish
আপুনি জানেনে?
WHO মতে অসমৰ প্ৰায় 95% জনসাধাৰণে মাছ খাই ভাল পায়।
মাছৰ পৰিপুষ্টিসমূহ

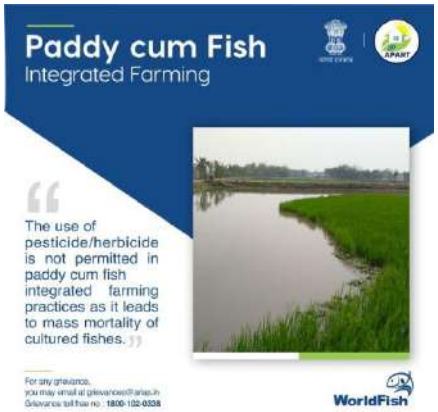

APART
WorldFish
Did you know?
More than half of the brain is made up of fatty acids including essential omega 3 fatty acids, which can be found in fish.
Fish in Human Nutrition

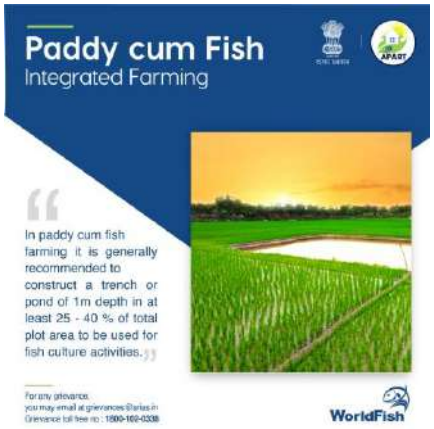

APART
WorldFish
আপুনি জানেনে?
মাছৰ মগজু আধাতকৈ বেছি অংশ ফেটি এচিডেৰে গঠিত ; লগতে অত্যাবশ্যকীয় ওমেগা ৩ ফেটি এচিডও ইয়াত পোৱা যায়।
মাছৰ পৰিপুষ্টিসমূহ

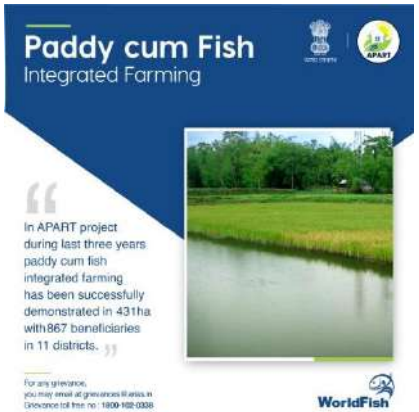

APART
WorldFish
Did you know?
Fish, particularly small fish, is rich in micronutrients like Vitamin A, Vitamin B12, Vitamin D, Iodine, Iron, Calcium, Zinc, and Essential Fatty Acids.
Fish in Human Nutrition


APART
WorldFish
আপুনি জানেনে?
সৰুমাছ, বিশেষকৈ মোৰা মাছত প্ৰচুৰ পৰিমাণে মাইক্ৰ নিউট্ৰিয়েণ্ট যেনে ভিটামিন A, আয়ৰন (Fe), কেলছিয়াম (Ca), ভিটামিন B12, ভিটামিন D, আয়ডিন, জিংক (Zn) আৰু অত্যাবশকীয় ফেটি এচিড থাকে।
মাছৰ পৰিপুষ্টিসমূহ

SOCIAL MEDIA PUBLICATION ON PADDY CUM FISH INTEGRATED FARMING








Paddy cum Fish
Integrated Farming
Paddy cum fish integrated farming is a climate-resilient technology to support the income, employment and livelihood of marginal and small scale farmers in the flood plain areas of Assam.
For any grievance, you may email at grievances@icar.gov.in
Grievance toll free no : 1800-102-0338
WorldFish


সমন্বিত ধান আৰু মীন পালন পদ্ধতি
সমন্বিত ধান আৰু মীন পালন পদ্ধতি হৈছে অসমৰ প্লাবিত সমভূমি অঞ্চলৰ সীমান্ত তথা ক্ষুদ্ৰ খেতিয়কৰ উপাৰ্জন, কৰ্ম সংস্থাপন আৰু জীৱিকাৰ বাবে এক ফলদায়ী সহিষ্ণু কৃষি প্ৰযুক্তি।
For any grievance, you may email at grievances@icar.gov.in
Grievance toll free no : 1800-102-0338
WorldFish

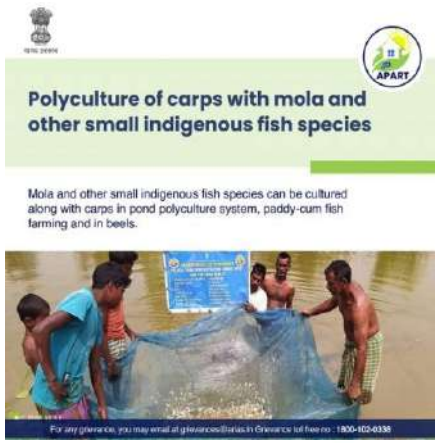

DID YOU
KNOW?
In paddy cum fish integrated farming system, the trenches or ponds not only serve as a refuge when the fishes are not foraging among paddy crops, but also serve as fish harvesting areas when the water level goes down.
WorldFish
Grievance Toll free no :
1800-102-0338
For any grievance, you may email at grievances@icar.gov.in

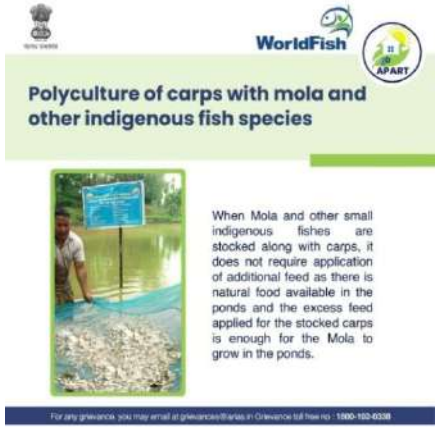

আপুনি
জানেনে?
সমন্বিত ধান আৰু মীন পালন পদ্ধতিত খাৰৈ আৰু পুখুৰীটোৱে কেৱল মাছৰ আশ্রয় স্থল হিচাপে কাম নকৰে যেতিয়া মাছে ধান শাসাৰ মাজত প্রাকৃতিক আহাৰ ভক্ষণ কৰি নাথাকে, তদ্রূপৰি পানীৰ স্তৰ হ্রাস পালে মাছ ধৰা এলেকা হিচাপেও কাম কৰে।
WorldFish
Grievance Toll free no :
1800-102-0338
For any grievance, you may email at grievances@icar.gov.in

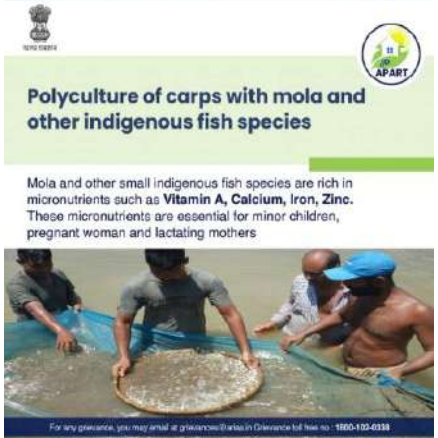

DID YOU
KNOW?
In paddy cum fish farming construction of an embankment around the paddy plot with adequate height is essential for holding water, retaining the stocked fishes and also to avoid flooding.
Grievance Toll free no :
1800-102-0338
For any grievance, you may email at grievances@icar.gov.in


আপুনি
জানেনে?
সমন্বিত ধান আৰু মীন পালনৰ ক্ষেত্ৰত পানী আৰু মজুত কৰা মাছ ধৰি ৰাখিবলৈ তথা বানপানীৰ পৰা পৰিত্রাণ পাবলৈ খেতি দৰাৰ চাৰিওফালে পৰ্যাপ্ত উচ্চতাৰ বান্ধ নিৰ্মাণ কৰাতো অত্যাবশ্যকীয়।
Grievance Toll free no :
1800-102-0338
For any grievance, you may email at grievances@icar.gov.in

SOCIAL MEDIA PUBLICATION ON POLYCULTURE OF CARPS WITH MOLA AND OTHER SMALL INDIGENOUS FISH SPECIES







Polyculture of Mola and other indigenous fish species

Mola and small indigenous fishes are very delicate to handle and therefore for harvesting the Mola and small indigenous fishes in live condition use of grading net is recommended.

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কার্পৰ সৈতে মোৱা আৰু অন্যান্য সৰু থলুৱা মাছৰ প্ৰজাতিৰ মিশ্ৰিত পালন

মোৱা আৰু সৰু থলুৱা মাছবোৰ ঘিহেতু সৰু তথা কোমল সেইবাবে মোৱা আৰু সৰু থলুৱা মাছবোৰ জীৱন্তে ধৰিবলৈ গ্ৰেডিং নেট ব্যৱহাৰ কৰিবলৈ পৰামৰ্শ দিয়া হয়।

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Polyculture of Mola and other indigenous fish species

After 2-3 months of stocking mola and small indigenous fish species, partial harvesting is recommended at regular intervals of 15-30 days to increase the production of mola and other small indigenous fishes.

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কার্পৰ সৈতে মোৱা আৰু অন্যান্য সৰু থলুৱা মাছৰ প্ৰজাতিৰ মিশ্ৰিত পালন

মোৱা আৰু সৰু থলুৱা মাছৰ প্ৰজাতি ২-৩ মাহ মজুত কৰাৰ পিছত, মোৱা আৰু অন্যান্য সৰু থলুৱা মাছৰ উৎপাদন বৃদ্ধি কৰিবলৈ নিয়মীয়াকৈ ১৫-৩০ দিনৰ ব্যবধানত আংশিক ভাবে মাছবোৰ ধৰিবলৈ পৰামৰ্শ দিয়া হয়।

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DID YOU KNOW?

Consumption of Mola and small indigenous fishes can greatly benefit pregnant women, lactating mothers and young children. It promotes optimal growth and cognitive development, particularly in the first 1000 days of life

WorldFish

আপুনি জানেনে?

মোৱা আৰু সৰু থলুৱা মাছ সেবনে গৰ্ভবতী মহিলা, স্তনপান কৰাই থকা মাতৃ আৰু সৰু শিশুসকলক যথেষ্ট উপকৃত কৰিব পাৰে। বিশেষকৈ জীৱনৰ প্ৰথম ১০০০ দিনত ই সবল বৃদ্ধি তথা বিবেক বিকাশত সহায় কৰে।

WorldFish

আপুনি জানেনে?

সৰু থলুৱা মাছবোৰৰ ভিতৰত, মোৱা (এম্বলিফাৰিংগোডন মোৱা) মাছ ভিটামিন আৰু খনিজ পদাৰ্থত অত্যন্ত সমৃদ্ধ (ইয়াৰ ১০০ গ্ৰাম খোৱা অংশত ভিটামিন- এ ২৬৮০ আৰ এ ই, আইৰণ ৫.৭ মিগ্ৰা, জিংক ৩.২ মিগ্ৰা আৰু কেলচিয়াম ৭৭৬ মিগ্ৰা) থাকে।

WorldFish

DID YOU KNOW?

Among the small indigenous fishes, Mola (Amblypharyngodon mola) is extremely rich in vitamins and minerals (100 g edible part of it contains Vitamin- A 2680 RAE, Iron 5.7 mg, Zinc 3.2 mg and Calcium 776 mg).

WorldFish

DID YOU KNOW?

The head portion of Mola and small indigenous fishes contain more micro-nutrients. Therefore, head portion of Mola and small indigenous fishes should not be removed during processing / cooking and these fishes should be eaten whole to get the full nutritional benefits.

WorldFish

আপুনি জানেনে?

মোৱা আৰু সৰু থলুৱা মাছৰ মুৰৰ অংশ অধিক সূক্ষ্ম পুষ্টিৰে গঠিত। সেয়েহে মোৱা আৰু সৰু থলুৱা মাছৰ মুৰৰ অংশ প্ৰক্ৰিয়াকৰণ বা বন্ধাৰ সময়ত আঁতৰাব নালাগে আৰু সম্পূৰ্ণ পুষ্টিগত লাভালাভ প্ৰাপ্ত কৰিবলৈ মোৱা আৰু সৰু থলুৱা মাছ সম্পূৰ্ণকৈ খাব লাগে।

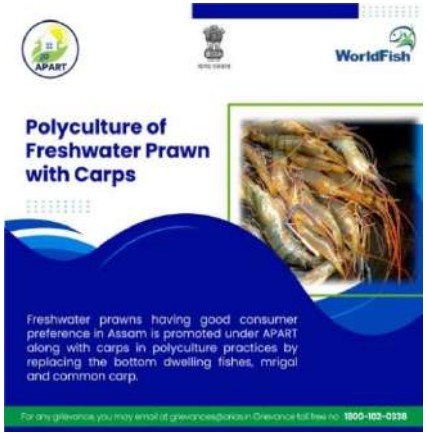
WorldFish

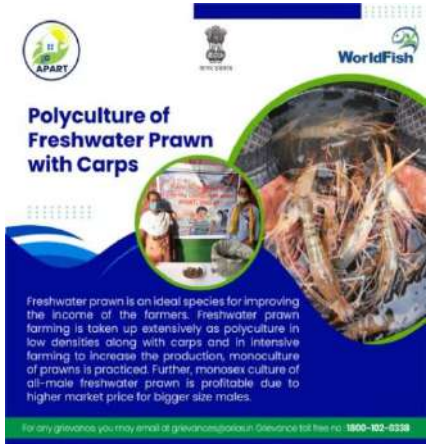
DID YOU KNOW?

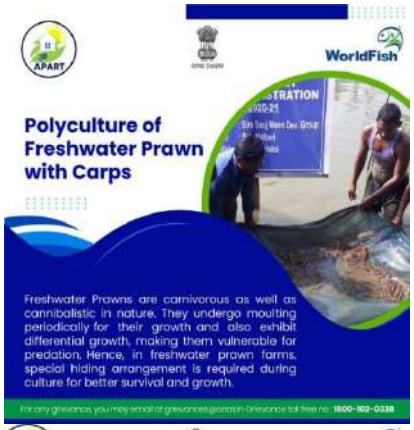
When feeding minor children (6-24 months), whole fish (mola and small indigenous fishes) should be washed, cleaned, boiled or fried, mashed to make a paste and mixed with meal like khichri.

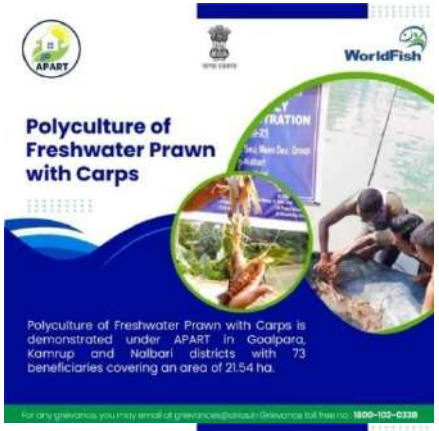
WorldFish

SOCIAL MEDIA PUBLICATION ON POLYCULTURE OF FRESHWATER PRAWN WITH CARPS



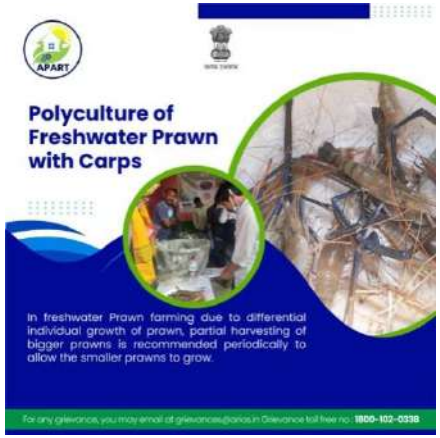


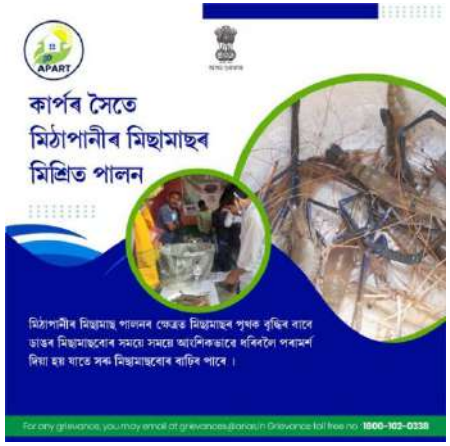





APART
WorldFish
Polyculture of Freshwater Prawn with Carps
Freshwater Prawn is a compatible species for polyculture along with Indian Major Carps with an additional yield of 400 kg of Prawns along with 3000 kg of carps/ha/yr
For any grievance, you may email at grievances@icar.gov.in Grievance toll free no. 1800-102-0338


APART
WorldFish
কার্পৰ সৈতে
মিঠাপানীৰ মিছামাছৰ
মিশ্রিত পালন
মিঠাপানীৰ মিছামাছ হৈছে ভাৰতীয় প্ৰধান কার্পৰ লগত মিশ্রিত পালনৰ বাবে এক উপযুক্ত প্ৰজাতি যাৰ অতিৰিক্ত উৎপাদন হৈছে ৪০০ কিলোগ্ৰাম মিছামাছ আৰু লগতে ৩০০০ কিলোগ্ৰাম কার্প/ হেক্টৰ/ বছৰ।
For any grievance, you may email at grievances@icar.gov.in Grievance toll free no. 1800-102-0338


APART
WorldFish
Polyculture of Freshwater Prawn with Carps
In freshwater Prawn farming due to differential individual growth of prawn, partial harvesting of bigger prawns is recommended periodically to allow the smaller prawns to grow.
For any grievance, you may email at grievances@icar.gov.in Grievance toll free no. 1800-102-0338


APART
কার্পৰ সৈতে
মিঠাপানীৰ মিছামাছৰ
মিশ্রিত পালন
মিঠাপানীৰ মিছামাছ পালনৰ ক্ষেত্ৰত মিছামাছৰ পৃথক বৃদ্ধিৰ বাবে ডাঙৰ মিছামাছবোৰ সময়ে সময়ে আংশিকভাবে দৰিবলৈ পৰামৰ্শ দিয়া হয় যাতে সৰু মিছামাছবোৰ বাঢ়িব পাৰে।
For any grievance, you may email at grievances@icar.gov.in Grievance toll free no. 1800-102-0338


APART
WorldFish
Did you know?
Freshwater prawns exhibit moulting periodically for their growth. Moulting is the process of removal of the outer hard shell called exoskeleton and hardening of the inner soft shell over a period of time.


APART
WorldFish
আপুনি জানেনে?
মিঠাপানীৰ মিছামাছবোৰে চেওঁলোকৰ বৃদ্ধি বিকাশৰ বাবে সময়ে সময়ে মোট সলাই। মোট সলোৱা হৈছে এক্সোস্কেলেটন নামৰ বাহিৰৰ কঠিন খোলাটো আঁতৰ কৰা আৰু সময়ৰ সৈতে ভিতৰৰ কোমল খোলাটো কঠিন কৰাৰ প্ৰক্ৰিয়া।


APART
WorldFish
Did you know?
In Freshwater Prawns, the males grow faster and reach a bigger size than females, since the females after reaching sexual maturity spend most of their energy for reproduction rather than growth.


APART
WorldFish
আপুনি জানেনে?
মিঠাপানীৰ মতা মিছামাছ, মাইকী মিছামাছতকৈ দ্ৰুতগতিত বৃদ্ধি হয় আৰু ডাঙৰ আকাৰত উপনীত হয় কিয়নো মাইকী মিছামাছে যৌন পৰিপক্কতা প্ৰাপ্ত কৰাৰ পাছত বেছিভাগ শক্তি বৃদ্ধি বিকাশতকৈ প্ৰজননৰ বাবে ব্যৱহাৰ কৰে।


APART
WorldFish
Did you know?
Giant Freshwater Prawn (Macrobrachium Rosenbergii) commonly called Scampi is an ideal species for freshwater aquaculture and has a good domestic and export market.


APART
WorldFish
Did you know?
মহাকায় মিঠাপানীৰ মিছামাছ (মেক্ৰোব্ৰাকিয়াম ৰোজেনবাৰ্গি) সাধাৰণতে স্কেম্পি বুলি জনা যায়, এই মিছামাছবিধ মিঠাপানীৰ জলসংবৰ্ধনৰ বাবে এক উপযুক্ত প্ৰজাতি লগতে ইয়াৰ চাহিদা তথা বপ্তানিবজাৰ যথেষ্ট ভাল।


APART
WorldFish
Did you know?
মিছামাছ হৈছে উচ্চ মানদণ্ডৰ প্ৰটিনৰ (৯ টা এমিনো এচিড) এক উৎকৃষ্ট উৎস আৰু বিদ্যমান অতি গুৰুত্বপূৰ্ণ ভিটামিন (বি- ৬, বি- ১২ আৰু নিয়াচিন) আৰু খনিজ (লো, ফেলেনিয়াম, জিংক) প্ৰদান কৰে যি এক স্বাস্থ্যকৰ আহাৰ প্ৰস্তুত কৰে।

SOCIAL MEDIA PUBLICATION ON FISH NUTRITION DURING NUTRITION WEEK CELEBRATION 2021

Articles published in Krishi Rupantar

WOMEN IN AGRICULTURE

A write up on the activities of APART, KVK, Barpeta

Women play a significant and crucial role in agricultural development and allied fields. The extent of involvement varies from region to region.

In the present scenario, women play a pivotal role in all economic and crop production activities in the agricultural sector. As per census 2011, out of the female workers, 55 per cent are agriculture labourers & 24 per cent are cultivators. In India, 85 per cent of rural women are engaged in agriculture, yet only about 13 per cent own land. The situation is worse in some other states, though women play a vital role in various agricultural activities. Economic survey 2017-18 states that with the growing rural to urban migration of man, there is a shift towards female-led activities in the agriculture sector with an increasing number of women in multiple roles as cultivators, entrepreneurs and labourers.

In the year 2018-19, under the Government of Assam (GoA) and World Bank-funded Assam Agribusiness and Rural Transformation Project (APART) and with the technical support from the International Rice Research Institute (IRRI), demonstrations on different varieties of paddy were taken up by the Krishi Vigyan Kendra (KVK),

FPG LEVEL FOCUS GROUP DISCUSSION ON BETTER MANAGEMENT PRACTICES FOR PADDY CUM FISH INTEGRATED FARMING

To create awareness among the farmers for adoption of Better Management Practices (BMP) of paddy cum fish integrated farming under APART, a series of Focus Group Discussions (FGD) at Farmer Producer Group (FPG) levels were taken up by WorldFish in collaboration with the College of Fisheries, Assam Agricultural University, Raha and Department of Fisheries, Government of Assam. A total of six (6) FGDs were conducted at Gerekoni, Bechamari in Morigaon district, Bhuyanpara, Sootea & Godamghatmiri, Balipara in Sonitpur District, Pub Singimari, Kanchanpur, & Salonabori, Batadrawa in Nagaon District. The main objectives of the FGD training were to provide technical support to the farmers on better management practices to reduce the losses and increase the benefits as well as for sustainability and environmental safety. 118 participants attended the 6 FGDs conducted, including both the beneficiaries as well as the non-beneficiaries of APART from the selected clusters.

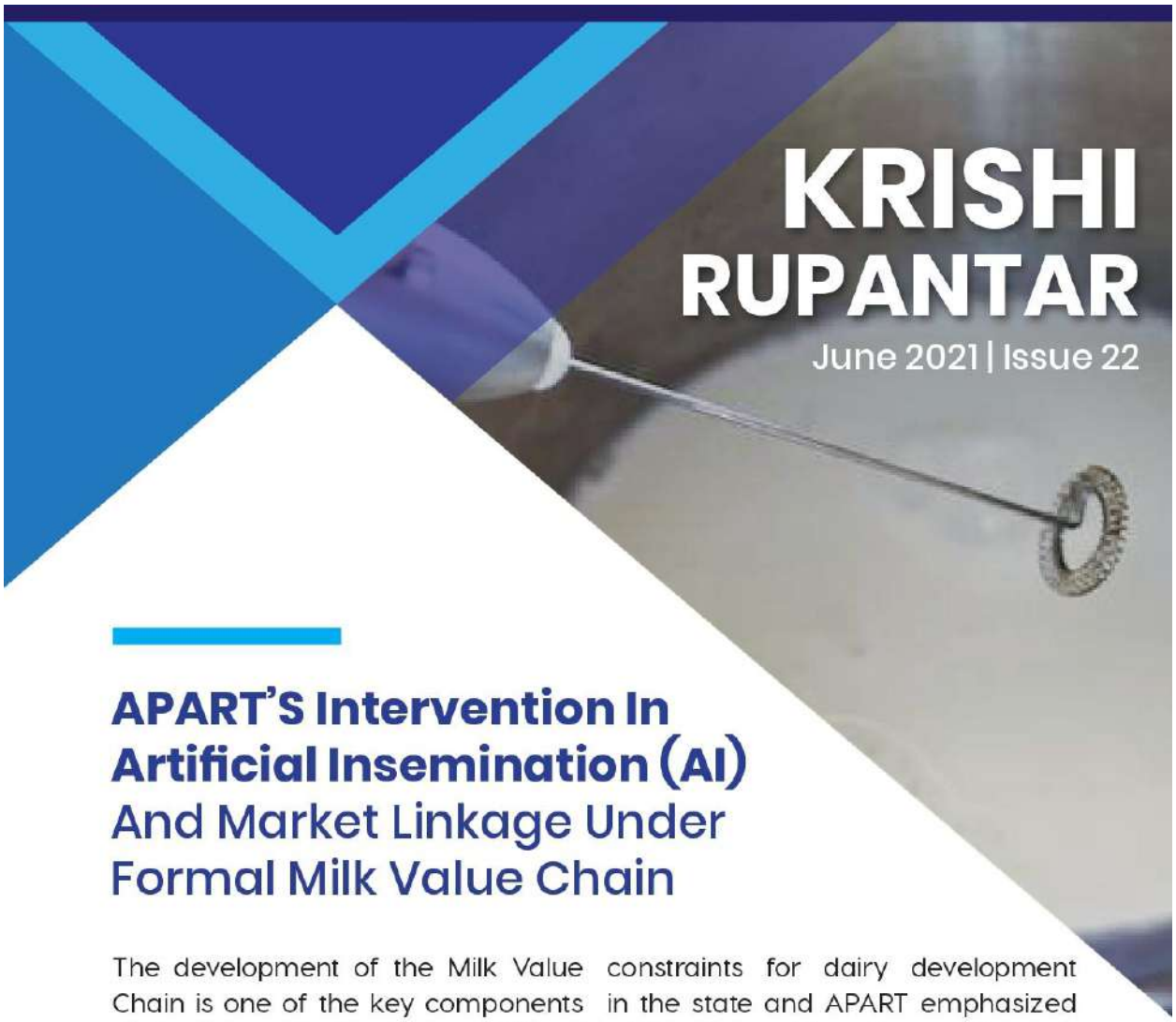
During the Focus Group Discussion, Technical Experts from WorldFish introduced the BMP guidelines for paddy cum fish integrated farming followed by delivering a lecture on the general concept, principles and different systems of paddy cum fish integrated farming, participants interaction, the importance of Mola-SIS farming along with paddy cum fish integrated farming of carps and its nutritional value, the need for gender integration in aquaculture and also the importance of the role of women in fisheries and aquaculture.

The lecture regarding the paddy variety selection for paddy cum

fish integrated farming, seed treatment, seedling treatments and various precautionary measures for pest infestation as well as fungal infestation in paddy was delivered by Mr Dibyarishi Bhattacharjya, Junior researcher, KVK, Sonitpur and Kasturi Goswami, Junior researcher, IRRI, APART. The ITK and advance methods, traps for controlling the pest infestation without using any chemicals in the paddy field was also described in the meeting. After the completion of the Focus Group Discussion, the Technical Experts also visited the beneficiaries' ponds to provide technical advice and explained to them the importance of pond record bookkeeping.

Group discussion on Better Management Practices (BMP) for paddy cum fish integrated farming

KRISHI RUPANTAR
June 2021 | Issue 22



APART'S Intervention In Artificial Insemination (AI) And Market Linkage Under Formal Milk Value Chain

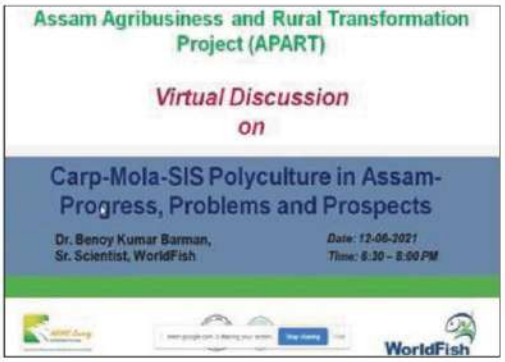
The development of the Milk Value Chain is one of the key components of the Assam Agribusiness and Rural Transformation Project (APART), a World Bank and Government of Assam financed project. The activities under the Milk Value Chain are initiated through WAMUL as the implementing agency for the formal milk sector. The value chain approach covers the productivity enhancement of dairy animals to provide the most crucial market linkage 24/7 and 365 days a year for dairy farmers.

Low productivity of animals was identified as one of the most crucial constraints for dairy development in the state and APART emphasized addressing this issue through its intervention. The Project has introduced professional Artificial Insemination (AI) service at the Farmer's doorstep to enhance the productivity in 13 Milk potential districts of the state. So far, around 5.00 lakhs inseminations and 85000 nos of improved pedigree female calves have been born through this process subsequently increasing the total production of milk in Assam. Besides, feed and fodder advisories and demonstrations are also initiated, resulting in higher yield and better

Virtual Meetings conducted by WorldFish

During June 2021 WorldFish conducted 2 virtual meetings on Carp-Mola-SIS Polyculture-Progress, Problems and Prospects in Assam, and Quality Carp Seed Production in Assam under APARTon 12th June 2021 and 19th June 2021, respectively. WorldFish Experts Dr. Benoy Kumar Barman, Senior Scientist, WorldFish, Bangladesh, Dr. Manos Kumar Saha, WorldFish, Bangladesh, and Dr. Trinh Quoc Trong, Senior Scientist, WorldFish, Malaysia served as the resource persons for the above virtual meetings. A total of 65 participants participated in the virtual meetings including WorldFish Principal Scientist and Country lead, Dr. Mohan Chadag, WorldFish Experts, Odisha WorldFish team, Bangladesh WorldFish team, DOF officials, COF faculty, ARIAS team, and APART Project staff.

In the virtual meeting conducted on 12th June 2021, the importance of the culture of Mola and SIS in Pond, Beels, and Paddy fields along with Carps, nutritional benefits of Mola-SIS, the process of collection of Mola-SIS live from ponds and large water bodies like Beels, the progress of Mola-SIS culture in different project districts under APART, the problems faced in stocking and farming ofMola-SIS and the prospects of Mola-SIS culture in Assam were discussed. Process and techniques for live transport of Mola-SIS for stocking and use of grader nets for harvesting of the Mola-SIS for marketing in live condition were also discussed in the meeting.



On 19th June 2021 during the virtual meeting on quality seed production in Assam, the actual problems in producing quality seed in sufficient quantities, the need for better nursery management practices in seed rearing, and other issues in producing quality carp seeds in Assam by private hatchery operators were discussed. Dr.Trinh Trong, WorldFish Expert explained the importance of quality carp broodstock, good breeding practices, tagging, and proper record-keeping for quality carp seed production and the Standard Operating Procedures (SOPs) and BMPsto be followed in the Up-graded Hatcheries and Multiplication Centers developed under the APART Project.

KRISHI
RUPANTAR

24th Edition, August 2021

NUTRITIONAL IMPORTANCE OF FISH CONSUMPTION – FIRST 1000 DAYS PROGRAM

World Fish - Knowledge Partner –APART

Aquatic foods have long been valued as a rich source of animal and plant protein and other essential micronutrients including vitamins & minerals and, therefore, considered a key constituent of nutritious diets. Aquatic foods include a diverse group of animals, plants and microorganisms, each with unique nutritional qualities and nutrients, such as iron, zinc, calcium, iodine, vitamins A, B12 and D, and omega-3 fatty acids. In addition, the micronutrients in aquatic animals are highly bio-available. Aquatic animals also enhance the absorption of micronutrients such as iron and zinc from plant-source foods when consumed together. Moreover, consuming aquatic foods presents an opportunity for greater sustainability, as the production of aquatic animal-source foods has a lower environmental impact than the production of most terrestrial animal-source foods.

A focus on the nutrient content of farmed aquatic food is especially important where they have a key role in food-based approaches to food security and nutrition. The awareness about the fish as a part of a healthy diet is well accepted by the majority of the population. In addition to providing essential nutrients at an affordable price, fish also contributes to the food and nutritional security of poor households in developing countries. Fish can be considered as a treasure store of nutrients. Fish and fish products are excellent sources of high-quality protein; the bioavailability of protein from fish is approximately 5-15 % higher than that from plant sources. Fish contains all the amino acids essential for human health. Fish provides essential minerals such as calcium, phosphorus, zinc, iron, selenium and iodine as well as vitamins A, B and D, thus helping to reduce the risk of both malnutrition and non-communicable diseases which may co-occur when high energy intake is combined with a lack of balanced nutrition.

Anabas testudineus : Kawoi fish

Fish, especially small fishes eaten whole, are a highly nutritious animal-source food, which contributes a wide range of micronutrients that benefit the health of women and children. New evidence shows that fish consumption is associated with children having higher IQ due to better brain development and lower rates of

stunting due to better overall health and growth meaning that fish is a highly nutritious food for pregnant and lactating women and children. Furthermore, because fish have a lower environmental footprint compared to many other animal-source foods, experts also recommend fish as a sustainable food that is healthy for both the planet and human health.

Amblypharyngodon mola : Moa fish

Fish in the first 1000 days of life

The first 1000 days of a child's life, from conception to 2 years of age, is a crucial time for growth and development. During pregnancy, women must consume adequate nutrients to sustain their pregnancy and to ensure their child develops correctly. This is also true for lactating mothers, whose breast milk must provide for the entire nutritional needs of their infants for the first 6 months of life. For some micronutrients, like vitamin A, iron and iodine, pregnant and lactating women must consume higher levels than normal. Fish can be directly introduced to infants' diets at the commencement of complementary feeding after 6 months of age. A large study of more than 11,000 pregnant women found that consumption of at least two servings of fish (340 g/week) led to higher results on multiple tests of child development compared with those who consumed less than this. A systematic review and meta-analysis found that women receiving long-chain omega-3 fatty acids in pregnancy had a 26% lower risk of early preterm delivery. Thus, consumption of fish particularly small fishes regularly by pregnant and lactating women and children is very important for cognitive and overall development. Hence, under the

Tengera Fish

APART project, WorldFish is providing technical support and is giving greater emphasis to the promotion of small fish consumption among the vulnerable groups of women and children in Assam. Making the small fishes available, accessible and affordable for the reach of target groups is the major intervention planned under the project towards nutritional security of the local communities.

WorldFish

About WorldFish

WorldFish is an international, not-for-profit research organization that works to reduce hunger and poverty by improving fisheries and aquaculture. It collaborates with numerous international, regional and national partners to deliver transformational impacts to millions of people who depend on fish for food, nutrition and income in the developing world. Headquartered in Penang, Malaysia and with regional offices across Africa, Asia and the Pacific, WorldFish is a member of CGIAR, the world's largest global partnership on agriculture research and innovation for a food secure future.

For more information, please visit www.worldfishcenter.org