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## **Proceeding of virtual inception workshop on project**

**“Taking Nutrition-Sensitive Carp-SIS Polyculture  
Technology to Scale”**

**Penang, Malaysia**

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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.

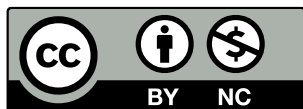
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Front cover, page 2, 8, 14 Sourabh Dubey; page 9 Kalpajit Gogoi; page 10 Rashmi Ranjan Dash

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## List of acronyms

APART	Assam Agribusiness and Rural Transformation Project
BMZ	German Federal Ministry for Economic Cooperation and Development
CGIAR	Consultative Group on International Agricultural Research
CIFA	Central Institute of Freshwater Aquaculture
CIFRI	Central Inland Fisheries Research Institute
CIFT	Central Institute of Fisheries Technology
FARD	Fisheries and Animal Resources and Development Department
FIA	Fund International Agricultural Research
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GP	Gram Panchayat
IAS	Indian Administrative Service
ICAR	Indian Council of Agricultural Research
ICDS	Integrated Child Development Scheme
IMC	Indian major carps
IST	Indian Standard Time
ITK	Indigenous Traditional Knowledge
MSSRF	M.S. Swaminathan Research Foundation
NBFGR	National Bureau of Fish Genetic Resources
NE	North-eastern
PUFA	Polyunsaturated fatty acid
SAFAL	Sustainable Aquaculture for Food and Livelihood
SIS	Small Indigenous Species
SNP	Supplementary Nutrition Program
SOP	Standard Operating Procedure
WSHG	Women's Self-Help Group

# 1. Executive summary

WorldFish is implementing a project titled “Taking Nutrition-Sensitive Carp-SIS Polyculture Technology to Scale” in Assam and Odisha states of India. This work receives financial support from the German Federal Ministry for Economic Cooperation and Development (BMZ) commissioned by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) through the Fund International Agricultural Research (FIA). On November 16, 2021, the project held a virtual inception workshop, which brought together diverse actors such as state and national governments, research and policy institutions, donor agencies, and practitioners working to alleviate poverty and improve food security through diversified aquatic food production systems. The event had one inaugural session and one technical session.

The workshop was initiated with welcoming and opening statements by Dr. Gareth Johnstone, Director General, WorldFish, Mr. Rakesh Kumar, IAS, Commissioner-cum-Secretary, Department of Fisheries, Govt. of Assam, Mr. Raghu Prasad, IFS, Commissioner-cum-Secretary, Fisheries and Animal Resources and Development Department (FARD), Govt. of Odisha, Dr. J.K. Jena, Deputy Director General (Fisheries), The Indian Council of Agricultural Research (ICAR), and Dagmar Wittine, GIZ, Germany. Dr. Shakuntala Thilsted, WorldFish, World Food Prize Laureate 2021, gave a summary of the relevance of SIS in alleviating malnutrition in developing countries, as well as the need for a nutrition-sensitive aquaculture approach. Following that, Dr. Ben Belton, Project Lead, introduced the concept of mass production of SIS seed to scale up nutrition-sensitive aquaculture with the project approach, and impact pathways.

During the technical session, Mr. Francois Rajts, an international fish breeding expert, offered a detailed description of the selection and breeding of SIS for commercialization. From WorldFish-India, Dr. Arun Padiyar and Dr. Suresh Rajendran highlighted the present state of WorldFish initiatives in Assam and Odisha, as well as SIS breeding and dissemination plans. The workshop ended with feedback from the participants, group discussions and a closing remark by Dagmar Wittine, GIZ, Germany. Dr. Chadag V. Mohan, Principal Scientist, WorldFish moderated the workshop.

A total of 86 participants participated in the inception workshop from institutions including ICAR, Department of Fisheries, Central Institute of Freshwater Aquaculture (CIFA), Central Inland Fisheries Research Institute (CIFRI), Gauhati University, Assam Agriculture University, M.S. Swaminathan Research Foundation (MSSRF), Kalong Kopili Fishery FPC besides WorldFish and GIZ personnel. These proceedings present the details of the inception workshop and lessons learned.

## 2. Background and context

Small indigenous species (SIS) of fish are a significant source of essential micronutrients and could make a crucial contribution to vanquishing malnutrition around the developing world, especially for women and children. Though small fish are an underappreciated nutritional resource, availability and access are declining rapidly in many biotopes due to reasons including resource degradation, overexploitation, pollution and climate change. Consumer preferences for locally available SIS are high in Asian countries like India and Bangladesh. Although formerly plentiful and cheap, some of the SIS are becoming increasingly scarce and expensive, and they are increasingly at risk of becoming endangered.

Over the past decade, WorldFish has promoted nutrition-sensitive carp-SIS polyculture technology in Bangladesh and India to popularize SIS for household consumption and income. However, these initiatives relied on the collection of SIS brood from natural sources and overseeing their maintenance in brood ponds for stocking. During the lesson learning process, it is realized that the lack of breeding techniques for SIS is a key barrier to scaling nutrition-sensitive aquaculture to its full potential.



Photo credit: Sourabh Dubey/WorldFish

Traditional vegetable curry with SIS mola

Against this backdrop, WorldFish is implementing a new project titled “Taking nutrition-sensitive carp-SIS polyculture technology to scale” which seeks to address this key bottleneck through applied research on mass production of SIS seed in Assam and Odisha states of India. This project is funded by the German Federal Ministry for Economic Cooperation and Development (BMZ) and commissioned by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) through the Fund International Agricultural Research (FIA). The duration of the project is March 2021 to February 2024.

## 2.1 About the workshop

On November 16, 2021, the project held a virtual inception workshop (3:30 PM - 5:35 PM IST), which aimed at facilitating sharing of knowledge and experiences on different aspects of SIS induced breeding as well as identifying challenges and gaps and exploring the opportunities of inclusive business and entrepreneurial models for commercial SIS seed production. The workshop brought together diverse actors such as state and national governments, research and policy institutions, donor agencies, experts and practitioners working towards a common goal to alleviate poverty and improve food security through diversified aquatic food production systems.

The event had one inaugural session and one technical session. The workshop was started by the welcoming and opening statements by Dr. Gareth Johnstone, Director General, WorldFish, followed by Mr. Rakesh Kumar, IAS, Commissioner-cum-Secretary, Department of Fisheries, Govt. of Assam, Mr. Raghu Prasad, IFS, Commissioner-cum-Secretary, Fisheries and Animal Resources and Development Department (FARD), Govt. of Odisha, Dr. J.K. Jena, Deputy Director General (Fisheries), The Indian Council of Agricultural Research (ICAR), and Dagmar Wittine, GIZ, Germany. In the presentation session, Dr. Shakuntala Thilsted, WorldFish, World Food Prize Laureate 2021, gave a summary of the relevance of SIS in alleviating malnutrition in developing countries, as well as the need for a nutrition-sensitive aquaculture approach. Following that, Dr. Ben Belton, Project Lead, introduced the concept of mass production of SIS seed to scale up nutrition-sensitive aquaculture with the project approach, and impact pathways, among other things.

During the technical session, Francois Rajts, an international fish breeding expert, offered a detailed description of the selection and breeding of SIS for commercialization. From WorldFish-India, Dr. Arun Padiyar and Dr. Suresh Rajendran highlighted the present state of WorldFish initiatives in Assam and Odisha, as well as SIS breeding and dissemination plans. The workshop was ended with feedback from the participants, group discussions and a closing remark by Dagmar Wittine, GIZ, Germany. Dr. Chadag V. Mohan, Principal Scientist, WorldFish moderated the workshop.

A total of 86 participants have participated in this inception workshop from different institutions such as ICAR, Department of Fisheries, Central Institute of Freshwater Aquaculture, Central Inland Fisheries Research Institute, Guwahati University, Assam Agriculture University, M.S. Swaminathan Research Foundation (MSSRF), Kalong Kopili Fishery FPC besides WorldFish and GIZ personnel.

## 3. Session 1: Project commencement

### 3.1 Welcome and opening remarks

#### **Dr. Gareth Johnstone, Director General, WorldFish**

Dr. Johnstone warmly welcomed GIZ, ICAR, Department of Fisheries and other participants. He noted that this is a game-changing project that brings in nutrition-sensitive carp and small indigenous fish polyculture that influences food security and nutrition, job opportunities and income. He emphasized the long-term collaboration and partnership with GIZ, which is contributing to sustainable fisheries and aquaculture development aligned with SDGs across geographies such as Asia and Africa. He praised ICAR's contribution to strengthening India's collaboration with WorldFish and thanked the Departments of Fisheries of Odisha and Assam for incorporating the nutrition-sensitive carp-SIS polyculture into their policy.

He precisely briefed about some of India's significant achievements including the inclusion of fish powder in the school feeding programme in Odisha and discussed the role of funding and scaling agencies such as GIZ, USAID, World Bank, and State Fisheries Departments. He highlighted that fish is considered a superfood due to its abundance of protein and highly bioavailable micronutrients. Aquaculture and fisheries are considered a biologically efficient way of animal protein production with modest emissions, act as a carbon sink and provide employment opportunities to many of the world's most vulnerable groups including women, youth and indigenous communities.

Dr. Shakuntala Thilsted, the 2021 World Food Prize Laureate, has made an exceptional contribution to defining the new global narrative on the relevance of aquatic food for a sustainable food system transition toward a healthy and resilient diet, he added. There is a great chance for south-south collaboration through this project. In Bangladesh and India, WorldFish pioneered the development and promotion of nutrition-sensitive approaches such as polyculture of carps with nutrient-dense SIS and demonstrated that prioritizing nutrition-sensitive approaches that promote pond polyculture systems, where diverse small fish are grown alongside larger carp species in household ponds, boosts economic opportunities while improving access to nutritious foods. He concluded the inception meeting discussions provide a strong platform for continued engagement in India in other states for promoting nutrition-sensitive aquatic food systems for a sustainable healthy and resilient diet.

#### **Mr. Rakesh Kumar, IAS, Commissioner-cum-Secretary, Department of Fisheries, Government of Assam**

Mr. Rakesh Kumar congratulated WorldFish for their continued engagement and partnership with Govt. of Assam through the World Bank funded APART project. He stressed WorldFish's contribution to promoting carp-SIS polyculture technology in various project demonstration districts across Assam, noting that farmers are increasingly interested in SIS polyculture because of its nutritional content and high market price. However, mass seed production of important nutrient-dense SIS is the key bottleneck to scaling the technology. He thanked GIZ and WorldFish for addressing the issues that have an influence on food security, nutrition, and employment by unlocking large-scale seed production technology of some important SIS. He also indicated his desire to work in partnership with this unique effort to improve the state's nutrition security, particularly for women and children.



**Mr. Raghu Prasad, IFS, Commissioner-cum-Secretary, Fisheries & Animal Resources Development Department, Government of Odisha**

Mr. Raghu Prasad congratulated WorldFish and GIZ for initiating this new project on “Taking nutrition-sensitive carp-SIS polyculture technology to Scale”. He narrated the interrelationships between small fish and the diet of local people in Odisha, where SIS like mola, also known as *mahurali*, is an integral component of non-vegetarian diets. He appreciated the strong partnership and collaboration of WorldFish with the Department of Fisheries for the overall improvement of fisheries and aquaculture in the state. He stated that Odisha is the 4th largest fish producing state in India with 9 lakh metric tons of fish produced during 2020-21 contributing to 2.3% of the state economy. 95% of the 45 million population in the state eat fish, so there is a huge demand for fish in the local market. Over the last 5 years, the fisheries sector has grown at a rate of about 13%, with spectacular growth in the inland aquaculture sector.

Under the Odisha Fisheries Policy of 2015 and the amended State Agriculture Policy SAMRUDDHI -2020, the government of Odisha prioritized the promotion of nutrition-sensitive fish production. Along with WorldFish in the last five years, the Department is widely promoting carp-mola polyculture and the consumption of small fish for nutritional gains in the state. In the institutional convergence model, the Department has promoted a nutrition-sensitive aquaculture approach and launched a new scheme for scientific fish farming in Gram Panchayat tanks by women’s self-help groups where carp-mola and other SIS polyculture have been adopted. He told about the pioneering achievement of the USAID-funded project on the inclusion of fish-based nutrition such as fish powder in the ICDS Anganwadi supplementary nutrition program of the state. He believes the project will bridge the gap in hatchery seed production of mola and other SIS and the Department of Fisheries is very happy to partner with this project.

**Dr. J.K. Jena, Deputy Director General (Fisheries), ICAR, Govt. of India**

Dr. Jena expressed his gratitude for the opportunity to participate in this crucial inception workshop linked with SIS. He narrated the long-standing contribution of ICAR and its institutions like CIFA for propagating aquaculture and fish breeding technology in India. He noted WorldFish's excellent collaboration with ICAR institutions such as CIFRI and CIFT, and he praised WorldFish's work in Assam and Odisha, where malnutrition is rampant. He stated that mola is one of the most essential SIS that we commonly promote. However, a large variety of SIS and minor carps with high nutritional value are frequently neglected. Establishing breeding protocols for such species would be more appropriate for easy availability and accessibility of those SIS where undernutrition is prevalent. In the last 15 years, ICAR-CIFA has been instrumental in developing breeding technology for several SIS and minor carps. Commercial large-scale production of those nutrient-rich fish will result in increased farmer’s income, a stable market price and plenty of nutritious fish for household consumption. He also emphasized the seasonal water bodies where short-term fish culture can be promoted. He wished great success to the inception workshop.

### **Dagmar Wittine, Project Manager, GIZ, Germany**

Dagmar Wittine, speaking on behalf of GIZ, greeted and complimented all participants, including government officials, scientists, and the WorldFish team. She discussed the collaboration and funding contribution between the German Federal Ministry of Economic Cooperation and Development (BMZ) and CGIAR, the World Vegetable Center in Taiwan and the International Center of Insect Physiology and Ecology in Kenya. WorldFish and GIZ have a very long history of partnership since WorldFish has always been a reliable partner and successfully implemented several projects under German funding in the last couple of years and still implements three projects in Africa and Asia to improve the smallholder fish value chain. She added that the current project was signed between GIZ and WorldFish earlier this year in 2021 and after the challenging time of COVID, we are now in the position for an official launch of the project with all key partners and actors in the planned activities. The initiative was prioritized because fish is an indispensable source of micronutrients in many poor nations, where significant populations of vulnerable people rely on it.

The project will enable farmers to develop nutrition-sensitive agriculture systems by providing a constant supply of micronutrient-rich small indigenous fish seeds. By overcoming a key technical bottleneck, increasing seed availability of popular SIS will support improvements in the nutritional status of millions of people across developing countries. In the inception workshop, the project successfully brings together various international and national stakeholders, and so it is highly valued for its interdisciplinary and collaborative approach, she added. The project contributes to the SDG goals of ending hunger and improving nutrition, in line with German priorities for achieving a world without hunger, she stated in her concluding remark.

### **Pratap Sinha, Project Manager, SAFAL, GIZ, India**

Pratap Sinha stressed strong partnership between the governments of India and Germany for over six decades in the areas of sustainable economic, ecological and social development. Nearly 70 Indo-German initiatives are currently operational in India, with eight in Assam and Odisha. He also elaborated on the Global Programme for Sustainable Fisheries and Aquaculture which is commissioned by BMZ under the special initiative ONE WORLD – No Hunger and how they aligned with SDGs. Mr. Sinha discussed the efforts of the Sustainable Aquaculture for Food and Livelihood (SAFAL) Project in Assam and Odisha which help to improve livelihood, income and better nutrition at the household level. The integration of SIS into the carp polyculture system is an ecological diversification strategy that maximizes the usage of ecological niches in existing ponds. A steady supply of SIS from WorldFish-supported hatcheries could provide a new culture target for government-supported beneficiaries and initiatives such as SAFAL, he concluded.

## 3.2 Presentation

### **“Nutrition sensitive aquaculture” – Dr. Shakuntala Thilsted, Global Lead, Nutrition and Public Health, WorldFish, World Food Prize Laureate 2021**

Dr. Thilsted began her informative talk by discussing the importance of sustainable food systems approaches and the transition to sustainable healthy diets. An aquatic food system, she explained, is a complicated network of elements, activities, and the effects of these activities. While terrestrial food production methods provide the majority of foods consumed globally, the importance of fish and seafood is being increasingly recognized. She highlighted a UN discussion paper from 2021 on the relevance of aquatic foods in maintaining a healthy diet.

Fish is considered a superfood. Fish are abundant in protein and contain highly bioavailable micronutrients (iron, iodine, calcium, zinc), vitamins (Vitamin A, B12, and D), and essential fatty acids (omega-3 fatty acids) that are difficult to replace with other foods. Small fish consumed whole is rich in bioavailable micronutrients such as zinc, iron and calcium. In addition, when small fish are combined with other foods, such as vegetables, this boosts dietary diversity and enhances the bioavailability of minerals in plant-source foods. Thus, the addition of small fish to the diets of populations that predominantly rely on plant-sourced foods is a potential strategy for improving micronutrient absorption. She also talked about the benefits of eating fish throughout the first 1000 days of life for cognitive development. She also stressed that dietary intake varies based on the species and components consumed, as well as the cleaning and processing method.

She enlightened about the nutrition-sensitive integrated pond polyculture approach which is now being practiced in homestead ponds across Bangladesh and other Asian countries, including Cambodia, Myanmar, India and Nepal. The entry point was the production of SIS, such as the micronutrient-rich mola, farmed alongside large fish species, particularly carp. Seasonal nutritious vegetables were also incorporated into the pond dykes. This integrated, nutrition-sensitive pond polyculture resulted in an increase in the intake of fish and vegetables by households, women and young children, as well as a rise in household income from the sale of fish and vegetables, with women reporting more control over the income.

Dr. Thilsted acknowledged the role of the Assam and Odisha government in integrating nutrition-sensitive approaches such as carp-SIS polyculture into their fiscal schemes and policies. Through research and technology, the GIZ-funded initiative will significantly enhance the supply of different small indigenous fish, consequently increasing the production and consumption of these superfoods. This project will be able to inform and enable the adoption and adaptation of nutrition-sensitive pond polyculture systems and technologies to boost consumption and production of different small fish for the nourishment of people and nations, she concluded.

### **“Taking nutrition-sensitive carp-SIS polyculture technology to scale” – Dr. Ben Belton, Global Lead for Social and Economic Inclusion, WorldFish**

Dr. Belton introduced the project “Taking nutrition-sensitive carp-SIS polyculture technology to scale” to the platform and very precisely presented the background of the project, approaches, species selected, and project activities and timeline. The project hypothesizes that a lack of breeding techniques for SIS is a key barrier to scaling the nutrition-sensitive aquaculture approach to its full potential.

SIS are a rich source of key micronutrients such as vitamin A and zinc, but their availability

is declining due to habitat degradation and overexploitation. Therefore, SIS are increasingly scarce and at risk of becoming endangered. WorldFish has successfully promoted nutrition-sensitive carp-SIS polyculture in Bangladesh and India by collecting wild SIS brood for distribution to project participants. However, these efforts have raised SIS consumption during active projects, but the lack of dependable seed supply is a bottleneck for sustainability. Therefore, promoting SIS culture using wild brood is unlikely to be sustainable in the long run. Market surveys in Bangladesh and India found that the SIS are increasingly expensive, and the average price of SIS is now higher than the price of Indian Major Carps in both Assam and Bangladesh, indicating high unmet demand. These observations suggest a high potential for commercialization of SIS culture in systems including village tanks, rice fields, and homestead ponds. The project is designed to overcome the key bottleneck for commercial SIS seed production by developing and disseminating standardized techniques for mass production of SIS seed by hatcheries. The project has 4 components: (1) Assess factors influencing the adoption of carp-SIS polyculture technology under previous projects. (2) Develop protocols for the mass production and transport of seeds of up to five nutrient-rich SIS; (3) Validate business models for reproduction and distribution of SIS species in partnership with private seed supply enterprises, and (4) Technical training and outreach to ensure integration into public and private investments for further scaling.



Photo credit: Sourabh Dubey/WorldFish

### 3.3 Questions and discussion session

**Dr. Jitendra Kumar Sundaray, Principal Scientist, ICAR-Central Institute of Freshwater Aquaculture**

What is the business model for the proposed SIS hatchery?

**Dr. Ben Belton:** SIS hatchery production will likely be distinct from tilapia or carp hatchery production in terms of scale, methods, hormones, and so on. Environmental stimulation is one of the key inducing agents in the case of SIS induced breeding. There may be many possible methods, but after successful breeding and applied research, the project will identify the most appropriate technical and economic model.

**Dr. P K Pradhan, Senior Scientist, ICAR-National Bureau of Fish Genetic Resources**

As SIS polyculture is going to incorporate new species in the pond ecosystem, there is a possibility of disease emergence with new pathogens. Therefore, proper preventive strategies should be adopted from the beginning stage of project implementation. As NBFGR has a national disease surveillance programme in India, the project may collaborate and explore partnerships.

**Dr. Chadag V. Mohan:** The project will collaborate and explore a partnership with NBFGR regarding disease diagnostic issues.



Photo credit: Kaipajit Gogoi/WorldFish

Pool barb *Puntius sophore* from Assam

**Dr. Birendra Kumar Bhattacharyya, Principal Scientist, ICAR-Central Inland Fisheries Research Institute**

For many SIS, such as Koi (*Anabas testudineus*), fish dressing and processing can be difficult, particularly at the city level; therefore, SIS processing or ready-to-cook conditions at the market level could increase SIS sales and consumption.

**Dr. Shakuntala Thilsted:** Small fish supply chains are changing these days. In Bangladesh, for example, the fish market is expanding with fish dressing facilities where customers can get dressed SIS ready for cooking.

**Dr. Krishna Rao, Consultant, WorldFish**

Unlike in West Bengal and Assam, the price of SIS in southern states like Karnataka is very low, and it is often not harvested from reservoirs.

**Dr. Shakuntala Thilsted:** Therefore, more context specific and culturally appropriate approach should be adopted for proper utilization of SIS to supply nutrition.



Photo credit: Rashmi Dash / WorldFish

Mola and Puntis mixed with turmeric powder ready to cook

## 4. Session 2: Technical session

### 4.1 Technical presentation

#### **“Options for selecting and breeding SIS for commercialization” –Francois Rajts, International Fish Breeding Expert**

Mr. Rajts’ presentation focused selection criteria for SIS for induced breeding, biotic and abiotic factors, and possible induced breeding options. Six SIS were chosen for induced breeding trials. Their selection criteria are listed below.

- Mola carplet (*Amblypharyngodon mola*) is predominantly a phytoplankton feeder and has high vitamin A and B 12, Iron and calcium content.
- Pool barb (*Puntius sophore*) is mainly herbivorous. Its polyunsaturated fatty acid (PUFA) content is almost three times higher than that of mola, and it also contains high levels of calcium.
- Flying barb (*Esomus danrica*) has a high iron, Iodine, selenium and vitamin B12 content.
- Dhela (*Osteobrama cotio*) is a dominant phytoplankton feeder, with high levels of calcium, selenium, and vitamin A.
- Banded gourami (*Trichogaster fasciata*) is an omnivore that can survive in hypoxic water where most fish cannot and is thus very effective for eliminating mosquito larvae. It contains high levels of iron, calcium, zinc and vitamin B12.
- Koi (*Anabas testudineus*) is an omnivore, with high levels of polyunsaturated fatty acid, and moderate selenium and high vitamin A content.

He discussed some of the stimulating factors that contribute to effective induced breeding including seasonal adaptation, water quality changes, temperature, photoperiod, light intensity, rain, flood, depth, substratum etc. Six possible induced breeding options were discussed along with their strengths and weaknesses. These are: (i) Natural breeding in a homestead pond; (ii) Breeding in pond using environmental stimulation; (iii) Breeding by environmental stimulation in hapa; (iv) Breeding by environmental stimulation in an outdoor tank; (v) Breeding by hormone application and possibly additional environmental stimulation, and (vi) Breeding by environmental stimulation or/and hormone stimulation.

#### **WorldFish activities in Assam under APART and Promoting SIS Farming Technology – Dr. Suresh Rajendran, Project Manager, WorldFish, Assam**

Dr. Rajendran centred his talk on technical collaboration between WorldFish and the Department of Fisheries, Government of Assam for the World Bank-funded APART project over a period of five years. WorldFish is responsible for providing technical assistance to achieve 10 key deliverables and some of the important activities are to promote SIS polyculture with carps in pond polyculture and promoting SIS in paddy fish farming systems and beel fisheries. WorldFish provided the necessary training to Department of Fisheries officials and APART project staff on mola brood fish harvesting, conditioning and live transportation and also conducted field training for farmers on carp-mola-SIS polyculture in targeted districts by WorldFish experts from Bangladesh. The initial results from the carp-SIS polyculture systems are promising, and the farmers obtained 500 to 800 kg/ha of mola-SIS as well, increasing their production, consumption, and income. Because of its abundant water resources and favorable climatic conditions for the

propagation of small indigenous fishes, Assam has a plethora of small indigenous fishes, with roughly 217 freshwater fish species. Many academic and research institutes in the north-eastern parts of India are involved in SIS research and promotion, including Assam Agricultural University, ICAR-CIFRI NE Regional Centre, Aquaculture and Biodiversity Centre, Guwahati University, and the Government of Assam's Department of Fisheries. In Assam, SIS has a high market demand and price, as well as a strong consumer preference.

However, limited scientific knowledge or documentation on the breeding of small fish species, lack of farmer-friendly technologies for mass production of small indigenous fishes except some of the air-breathing catfishes, lack of awareness of SIS farming technologies, continuous loss of natural habitats, use of small mesh sized gears, use of insecticides and pesticides, siltation of water bodies, invasion of exotic species and diseases are all limiting factors for promoting SIS. He concluded that with the participation of the private sector and stronger business models under the initiative, hatchery mass seed production of small indigenous fishes can be a game-changer in promoting nutrition-sensitive aquaculture in Assam.

### **“Current status of WorldFish activities in Odisha, and planned SIS breeding and dissemination activities” – Dr. Arun Padiyar, Project Manager, WorldFish, Odisha**

Dr. Padiyar emphasized the importance of strong partnership and technical collaboration with the Odisha government for the implementation of the Odisha Fisheries Policy-2015, which aims to increase fish production in a sustainable manner, improve farmer income, and job creation, women's empowerment, and nutritional security. One of the important activities under the collaboration was the promotion of carp-mola polyculture in Gram Panchayat (GP) tanks through Women's Self-Help Groups (WSHGs). To harness the potential of 64,000 GP tanks in the state for fish production, the Government has brought in a policy for long-term leasing (3-5 years) of GP tanks to WSHGs for fish farming in 2018-2019.

Simultaneously, FARD launched a gender-sensitive flagship scheme called Input Support to Women SHGs for Scientific Fish Farming in Gram Panchayat Tanks. This is an inter-departmental Convergence program involving FARD, Panchayati Raj & Drinking Water and Mission Shakti departments. The scheme promotes nutrition-sensitive pond polyculture through the farming of micronutrient-rich mola along with Indian major carps (IMC). Over the past 3 years (2018-2020), 6242 GP tanks, with a total water area of 5044 ha, were leased out to 6235 WSHGs. The WSHGs stocked advanced large-sized IMC fingerlings (50–100 g) at the rate 2700/ha and mola stocking was done at the rate of 25 kg/ha. WSHGs achieved an average fish production of 1725 kg/ha in 2018–2019, which increased to 1956 kg/ha in 2019–2020. Mola was produced in 55% of the tanks in 2018–2019 and 53% in 2019–2020. WSHGs partially harvested mola for household consumption. When compared to exclusive carp polyculture tanks, polyculture tanks with carp, mola and other small fish witnessed an 11%–34% higher yield during both the years. A total of 85% of the WSHGs made a profit in 2018–2019 and 90% in 2019–2020. He also discussed the USAID-funded Project “Scaling Nutrition-sensitive Fisheries Technologies through Partnerships in Odisha” where nutrition-sensitive carp-mola polyculture in 789 backyard ponds and 22 community ponds (GP tanks). The project also demonstrated hygienic solar drying of fish by WSHGs and marketing and supplying in Government ICDS Supplementary Nutrition Program (SNP). The important achievement under the programme is to pilot the inclusion of small fish and fish-based products in the SNP. Specifically, this piloting involved the inclusion of small fish powder in children's meals and dried small fish for pregnant and lactating women and adolescent girls. Based



on an approved Standard Operating Procedure (SOP), the pilot has been implemented in 50 Anganwadi Centers of Kaptipada block, Mayurbhanj district.

Dr. Padiyar stressed that the carp-mola polyculture relied on the collection of mola brood from natural sources and the lack of hatchery technology for SIS is a key barrier to scaling of carp-mola polyculture to its full potential. He stated that approximately 50,000 Kg of Mola seed is required under various government schemes where carp-SIS polyculture is propagated.

## 4.2 Feedback and group discussion

### **Dr. Sanjay Kumar Das, Principal Scientist, ICAR- Research Complex for NEH Region**

- In the Northeast, SIS is a key component of dried fish products. The majority of SIS are found in Assam's wetlands, and throughout December, local communities harvested the majority of SIS to utilize for dried fish.
- Setting up a small-scale SIS induced breeding unit at the village level would aid in the propagation and scaling of SIS seeds.

### **Dr. Archana Sinha, Principal Scientist, ICAR-Central Inland Fisheries Research Institute**

- SIS are very much compatible with other fishes in the pond polyculture system, and it does not affect the growth of carps. Periodic harvesting of SIS is for household consumption and sale is key to maintain proper stock.
- Documentation and integration of Indigenous Traditional Knowledge (ITKs) on small fish culture.

### **Dr. Jitendra Kumar Sundaray, Principal Scientist, ICAR-Central Institute of Freshwater Aquaculture**

- Networking of hatcheries is critical for popularizing SIS seed and creating a balance between demand and supply.
- Invasive species pose a possible threat to SIS, necessitating immediate action and increased awareness.

### **Dr. B. A. Shamasundar, Consultant, WorldFish**

- During the marketing, storage and preserving of SIS, especially dried fish, appropriate post-harvest techniques should be used to ensure that nutritional content and quality are preserved.

### **Dr. Bipul Phukan, Assistant Professor, College of Fisheries, Assam Agriculture University, Raha**

- Once abundant, the trend of SIS is declining due to several factors like pollution, use of destructive gear, pesticides etc. Therefore, community conservation

especially with farmers and fishers is of utmost needed.

### 4.3 Closing remarks

**Dr. Dagmar Wittine, Project Manager, GIZ, Germany**

The inception workshop was a big success since it brought together varied actors that are committed to nutrition-sensitive aquaculture and explored various aspects of SIS polyculture technology. She thanked all participants, including government ministries, for their contributions and support, and expressed her desire to engage with all partners and stakeholders in the future.



Photo credit: Sourabh Dubey/ WorldFish

SIS are the major catch from community fishing

## 5. Lessons learned and outcomes

The inception workshop brought together a diverse range of actors on a single platform to strengthen their voice and collaboration to address the common goal of combating malnutrition through SIS inclusive farming systems. The workshop also fostered enhanced understanding and knowledge sharing on induced breeding of SIS and explored possible partnerships. A total of 86 participants participated in the inception workshop from institutions such as ICAR, Department of Fisheries, Central Institute of Freshwater Aquaculture, Central Inland Fisheries Research Institute, Guwahati University, Assam Agriculture University, M.S. Swaminathan Research Foundation (MSSRF), Kalong Kopili Fishery FPC besides WorldFish and GIZ personnel. The salient lessons and outcomes are outlined below:

“Previously small fishes were considered as weed fishes, but now it is considered as a superfood and all aquatic food researchers must value small fish as super fish not weed fish.”

**- Dr. Chadag V. Mohan,  
Principal Scientist,  
WorldFish and Moderator**

- Aside from popular SIS such as mola, certain minor carps such as reba carp (*Cirrhinus reba*) have high nutrient value. This species should be included, and a breeding protocol for mass seed production should be established.
- SIS culture should be investigated in seasonal water bodies, such as those found in Odisha, where short-term fish culture can be promoted.
- SIS are a key component in dried fish products in the Northeast. This is a potential area where the project could intervene further.
- Establishing a small-scale SIS induced breeding unit at the village level would aid in the mass propagation and scaling of SIS seeds.
- Hatchery networking is critical for popularizing SIS seed and achieving a balance between demand and supply.
- Documentation and integration of Indigenous Traditional Knowledge (ITKs) on small fish is critical for developing better context-specific approaches to nutrition-sensitive aquaculture.
- New disease emergence and invasive species are two major potential threats to SIS that require immediate action and increased awareness.
- Market level processing and dressing of SIS to attract more consumers and proper strategies should be formulated.
- During the marketing, storage and preservation of SIS, especially dried fish, appropriate post-harvest techniques should be used to ensure that nutritional content and quality are preserved.
- Strengthen and prioritize conservation action and community-based co-management conservation models in degrading landscapes.

# Annex 1: Agenda of the inception workshop

Virtual inception workshop on new GIZ funded project – “Taking Nutrition-Sensitive Carp-SIS Polyculture Technology to Scale”  
16<sup>th</sup> November 2021, 3:30 PM – 5:35 PM IST

## Session 1 – Project commencement (3:30 PM – 4:30 PM)

SI	Welcome and Opening Remarks	Time
1	Dr. Gareth Johnstone, DG WorldFish	3:30 – 3:35 PM
2	Mr. Rakesh Kumar, IAS, Commissioner-cum-Secretary, Fisheries Department, Government of Assam	3:35 – 3:40 PM
3	Mr. Raghu Prasad, IFS, Commissioner-cum-Secretary, Fisheries & ARD Department, Government of Odisha	3:40 – 3:45 PM
4	Dr. J.K. Jena, DDG Fisheries, ICAR, New Delhi	3:45 – 3:50 PM
5	Dr. Dagmar Wittine, GIZ, Germany	3:50 – 3:55 PM

## Presentations

6	<i>Nutrition sensitive aquaculture</i> – Dr. Shakuntala Thilsted, WorldFish, World Food Prize Laureate 2021	3:55 – 4:05 PM
7	<i>Taking nutrition-sensitive carp-SIS polyculture technology to scale</i> – Dr. Ben Belton, WorldFish	4:05 – 4:15 PM
8	<i>Q&amp;A Session</i>	4:15 – 4:25 PM
9	Closing remarks by Dr. Chadag V. Mohan, Principal Scientist, WorldFish	4:25 – 4:30 PM

## Session 2 – Technical session (16:30-17:35)

Sl.	Technical Presentations	Time
1	<i>Options for selecting and breeding SIS for commercialization</i> – Francois Rajts, fish breeding expert	4:30 – 4:40 PM
2	<i>Current status of WorldFish activities in Assam and Odisha, and planned SIS breeding and dissemination activities</i> – Dr. Suresh Rajendran and Dr. Arun Padiyar, WorldFish	4:40 – 4:50 PM

## Breakout Sessions (Parallel)

3	How to support popularization of SIS aquaculture in Odisha? – facilitated by Dr. Arun Padiyar	4:50 – 5:10 PM
4	How to support popularization of SIS aquaculture in Assam? – facilitated by Dr. Suresh Rajendran	4:50 – 5:10 PM
5	Feedback and group discussion – facilitated by Dr. Chadag V. Mohan	5:10 – 5:30 PM
6	<b>Closing remarks by GIZ</b>	5:30 – 5:35 PM

## Annex 2: Participant list of the inception workshop

Virtual inception workshop on “Taking Nutrition-Sensitive Carp-SIS Polyculture Technology to Scale” 16th November 2021, 15:30-17:35 IST					
Participants' List					
SL	Name	Designation	Institution	Type of Institution	Gender
1	Dr. JK Jena	Deputy Director General (DDG) Fisheries	Indian Council of Agricultural Research (Ministry of Agriculture and Farmers Welfare), Govt. of India	Government	M
2	Dr. Bimal Prasanna Mohanty	Assistant Director General (ADG) Inland Fisheries	Indian Council of Agricultural Research (Ministry of Agriculture and Farmers Welfare), Govt. of India	Government	M
3	Mr. R Raghu Prasad, IFS	Commissioner-cum Secretary	Fisheries & Animal Resources Development Department, Govt. of Odisha	Government	M
4	Mr. Basanta Kumar Nayak	Deputy Director of Fisheries (DDF)	Fisheries & Animal Resources Development Department, Govt. of Odisha	Government	M
5	Mr. Prasanta Kumar Panigrahi	Additional Fisheries Officer (AFO)	Fisheries & Animal Resources Development Department, Govt. of Odisha	Government	M
6	Mr. Rashmi Ranjan Majhi	Additional Fisheries Officer (AFO), OIIPCRA	Fisheries & Animal Resources Development Department, Govt. of Odisha	Government	M
7	Mr. Rakesh Kumar, IAS	Commissioner-cum-Secretary	Department of Fisheries, Govt. of Assam	Government	M
8	Mr. Achinta Saikia	Fisheries Development Officer	Department of Fisheries, Govt. of Assam	Government	M
9	Mr. Manoj Das	Nodal Officer (SOPD)	Department of Fisheries, Govt. of Assam	Government	M
10	Dr. Sanjay Sarma	Fisheries Coordinator	Assam Rural Infrastructure and Agricultural Services (ARIAS) Society, Govt. of Assam	Government	M
11	Dr. Dhruvajyoti Sharma	Nodal Officer (APART)	Department of Fisheries, Govt. of Assam	Government	M
12	Mr. Pratul Barman	Fisheries Development Officer	Department of Fisheries, Govt. of Assam	Government	M
13	Mr. Ratul Sarma	Information Officer	Department of Fisheries, Govt. of Assam	Government	M
14	Dr. Jitendra Kumar Sundaray	Principal Scientist	ICAR-Central Institute of Freshwater Aquaculture	Government	M
15	Dr. Bindu R Pillai	Principal Scientist	ICAR-Central Institute of Freshwater Aquaculture	Government	F
16	Dr. Birendra Kumar Bhattacharjya	Principal Scientist	ICAR-Central Inland Fisheries Research Institute	Government	M
17	Dr. Archana Sinha	Principal Scientist	ICAR-Central Inland Fisheries Research Institute	Government	F

18	Dr. Amiya Kumar Sahoo	Senior Scientist	ICAR-Central Inland Fisheries Research Institute	Government	M
19	Dr. Sona Yengkokpam	Senior Scientist	ICAR-Central Inland Fisheries Research Institute	Government	M
20	Dr. Sanjay Kumar Das	Principal Scientist	ICAR- Research Complex for NEH Region	Government	M
21	Dr. Pronob Das	Senior Scientist	ICAR-Central Inland Fisheries Research Institute	Government	M
22	Mrs. Niti Sarmah	Scientist	ICAR-Central Inland Fisheries Research Institute	Government	M
23	Dr. Simanku Borah	Scientist	ICAR-Central Inland Fisheries Research Institute	Government	M
24	Dr. Dipesh Debnath	Scientist	ICAR-Central Inland Fisheries Research Institute	Government	M
25	Dr. P K Pradhan	Senior Scientist	ICAR-National Bureau of Fish Genetic Resources	Government	M
26	Dr. Dandadhar Sarma	Professor	Gauhati University, Guwahati	Government	M
27	Mr. Priyam Nath	PhD Research Scholar	Gauhati University, Guwahati	Government	M
28	Dr. Dipak Kumar Sarma	Professor	College of Fisheries, Assam Agriculture University, Raha	Government	M
29	Dr. Binod Kalita	Professor & Dean	College of Fisheries, Assam Agriculture University, Raha	Government	M
30	Dr. Pradip Chandra Bhuyan	Professor	College of Fisheries, Assam Agriculture University, Raha	Government	M
31	Dr. Pradip Chandra Bhuyan	Professor	College of Fisheries, Assam Agriculture University, Raha	Government	M
32	Mr. Sangipran Baishya	Assistant Professor	College of Fisheries, Assam Agriculture University, Raha	Government	M
33	Mr. Bipul Phukan	Assistant Professor	College of Fisheries, Assam Agriculture University, Raha	Government	M
34	Dagmar Wittine		GIZ	Government	F
35	Deepak Chamola		GIZ	Government	M
36	Pratap Sinha		GIZ	Government	M
37	Sandeep Nayak		GIZ	Government	M
38	Rajadyuti Mahapatra		GIZ	Government	M
39	Dr. Sven Genschick		GIZ	Government	M
40	Jens Kahle		GIZ	Government	M
41	SJ Priyanga		M.S. Swaminathan Research Foundation (MSSRF)	NGO	M
42	Mr. T. Selvarasu		M.S. Swaminathan Research Foundation (MSSRF)	NGO	M
43	Dr. S. Velvizhi		M.S. Swaminathan Research Foundation (MSSRF)	NGO	M

44	Dr. Gareth Johnstone	Director General	WorldFish	NGO	M
45	Dr. Shakuntala Thilsted	Global Lead	WorldFish	NGO	F
46	Dr. Chadag V. Mohan	Principal Scientist	WorldFish	NGO	M
47	Dr. Ben Belton	Global Lead	WorldFish	NGO	M
48	Doina Huso		WorldFish	NGO	F
49	Anis Khalid		WorldFish	NGO	M
50	Sean Lee		WorldFish	NGO	M
51	Francois Rajts	Consultant	WorldFish	NGO	M
52	Dr. Arun Padiyar	Project Manager	WorldFish	NGO	M
53	Dr. Suresh Rajendran	Project Coordinator (Assam-APART)	WorldFish	NGO	M
54	B. A. Shamasundar	Consultant	WorldFish	NGO	M
55	Dr. Y Basavaraju	Consultant	WorldFish	NGO	M
56	Dr. Krishna Rao	Consultant	WorldFish	NGO	M
57	Baishnaba Charan Ratha	Project Manager (nutrition)	WorldFish	NGO	M
58	Binimaya Mohanty	Senior Aquaculture Specialist	WorldFish	NGO	M
59	Bikram Keshari Baliarsingh	Senior Aquaculture Specialist	WorldFish	NGO	M
60	Moumita Pal	GIS analyst	WorldFish	NGO	M
61	Amar Gaikwad	Aquaculture Specialist	WorldFish	NGO	M
62	Neetha Shenoy	Aquaculture Specialist	WorldFish	NGO	F
63	Binod Kumar Sethi	Research Associate	WorldFish	NGO	M
64	Sourabh Kumar Dubey	Technical Coordinator	WorldFish	NGO	M
65	Saurava Kumar Biswal	Technical Coordinator	WorldFish	NGO	M
66	Abinash Panigrahi	Technical Coordinator	WorldFish	NGO	M
67	Aparajita priyadarsini	Technical Coordinator	WorldFish	NGO	F
68	Arddhendu Sekhar Mohanty	Technical Coordinator	WorldFish	NGO	M
69	Jugal kishor nayak	Technical Coordinator	WorldFish	NGO	M
70	Khiroda chandra Nayak	Technical Coordinator	WorldFish	NGO	M
71	Manoj Kumar Sahoo	Technical Coordinator	WorldFish	NGO	M

72	Susanta Kumar Mishra	Technical Coordinator	WorldFish	NGO	M
73	Suvendra Kumar das	Technical Coordinator	WorldFish	NGO	M
74	Aditya Narayan Dash	Technical Analyst	WorldFish	NGO	M
75	Anil Kumar Sahu	Technical Analyst	WorldFish	NGO	M
76	Arup Ranjan Lenka	Technical Analyst	WorldFish	NGO	M
77	Soumya Ranjan Mishra	Technical Analyst	WorldFish	NGO	M
78	Kalpajit Gogoi	Technical Coordinator	WorldFish	NGO	M
79	Dharitri Baruah	Technical Coordinator	WorldFish	NGO	F
80	Rashmi Ranjan Dash	Technical Coordinator	WorldFish	NGO	M
81	Mr. Biswajyoti Sarma	Progressive farmer		Farmer	M
82	Mr. Jyotish Talukdar	Chairman	Kalong Kopili Fishery FPC	NGO	M
83	Mr. Razaqul Islam	Fishery Entrepreneur		Private	M
84	Nusrat Z Hossain	Student	University of Hannover	Academia	F
85	Jyotismita Thakuria	Junior Scientist	LRS, Mandira, Assam Agricultural University	Government	F
86	Azmoon Nissa	Project Associate	College of Fisheries, Assam Agriculture University, Raha	Government	F



### **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.

For more information, please visit [www.worldfishcenter.org](http://www.worldfishcenter.org)