

WorldFish's innovation catalog



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Introduction

This document contains a collection of major innovation journeys delivered by WorldFish in collaboration with various partners in the effort of targeting some of the major development challenges in aquatic food systems. To facilitate the reader in identifying the geographies and the contribution to the various impact areas, the collection has been organized following a geographic order by region and then countries. There are colored dots next to titles in the table of contents and marking each page (right top corner) specify the contribution to the most significant impact area, as per the WorldFish 2030 Strategy.

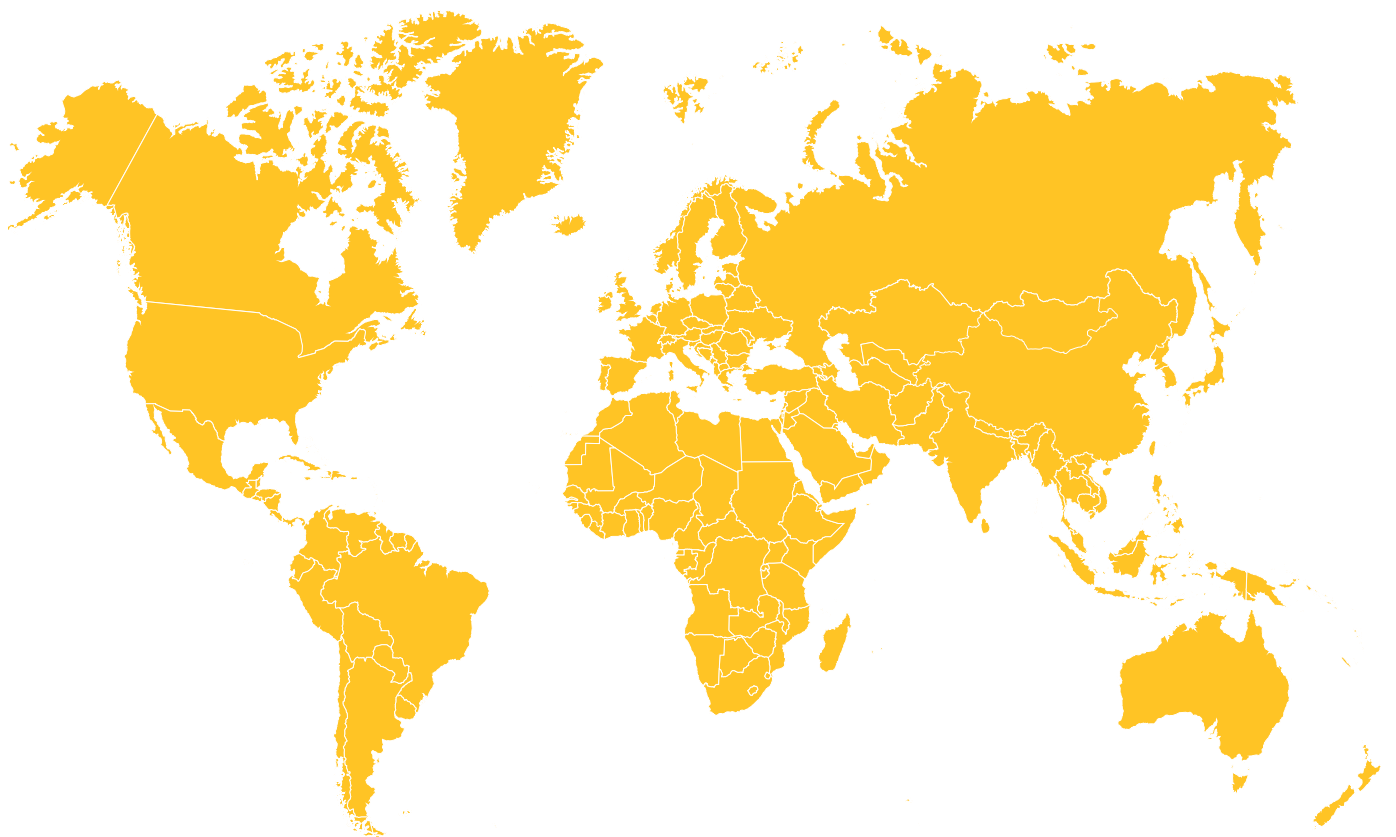
CGIAR impacts areas	WorldFish impacts areas
Nutrition, health & food security	Nutrition and public health
Poverty reduction, livelihoods & jobs	Society and the economy
Gender equality, youth & social inclusion	
Environmental health & biodiversity	Climate and the environment
Climate adaptation & mitigation	

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Global





Nutrient composition database of locally available ingredients for low-cost feed formulation in Africa and Asia

Innovation description

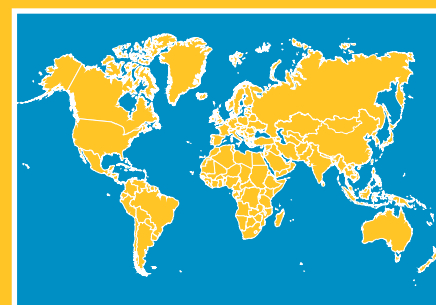
This [database](#) presents the nutrient composition of selected locally available ingredients that can be used by feed manufacturers to formulate low-cost, sustainable aquaculture feeds in Africa and Asia. The database will be expanded to include information on the digestibility of both macronutrients and micronutrients for accurate feed formulation.

Context

The global need for aquaculture continues to rise, and like all terrestrial farming activities, it is reliant on the provision and supply of nutrients. Aquaculture feeds typically account for 30%–70% of production costs, and growth in aquaculture requires associated growth in feed ingredients. In most developing countries, there is a lack of quality feed ingredients, especially fishmeal and fish oil, and dependency on imported feed ingredients and feeds, which increases production costs, especially for small-scale farmers. Escalating ingredient prices and a diminishing supply of wild caught fish used for fish-derived ingredients suggest that feeds and their value chains require transformation.

Innovation journey

To identify inexpensive, largely underused ingredients with year-round availability, WorldFish researchers surveyed literature, agricultural databases and stakeholders, including fish farmers, feed manufacturers, ingredient suppliers and other feed experts, across Bangladesh, Egypt, Malaysia, Myanmar, Nigeria and Zambia. Fifteen ingredients, including banana and cassava peels, cocoa husks, palm kernel cakes, rice and maize bran and soldier fly meal, were identified and analyzed to determine how well Genetically Improved Farmed Tilapia (GIFT) used the nutrients. The nutrient composition and digestibility of these ingredients are available through an [open-access database](#), which is currently being used by about 500 users across 10 scaling countries. This has been complemented by



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Other

Technical field

Fish health, nutrition and feeds

Stakeholders

- SingleSpark
- Skretting
- University of Selangor
- Wageningen University & Research

Contact

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training for feed millers and fish farmers across Africa and Asia on local ingredients in fish feed formulation. Efforts are ongoing to continue developing the ingredient database for improved scope and accessibility.

The future

With Skretting Egypt, researchers continue to assess novel ingredients across Africa and Asia, including algae, aquatic plants, fish processing co-products, food loss, insects and worms, that can be used to formulate sustainable and accessible fish feeds, including [nutritious pond feeds](#). Continued and scaled adoption of the database for local feed ingredients, in combination with novel feed formulations and practices, has the potential to improve farm productivity and profitability for millions, with significant implications for livelihoods and food and nutrition security. The use of an open-access Feed Ingredients Database allows a more significant number of people to access information on ingredients, including their chemical composition and nutrient digestibility. It is also an accessible and affordable tool for poor and marginalized groups, including women and youths.

The implementation and the use of the Feed Ingredients Database contribute to the achievement of the UN Sustainable Development Goals (SDGs), impacting different levels. It should be highlighted that it contributes indirectly to SDG 1 and SDG 2.



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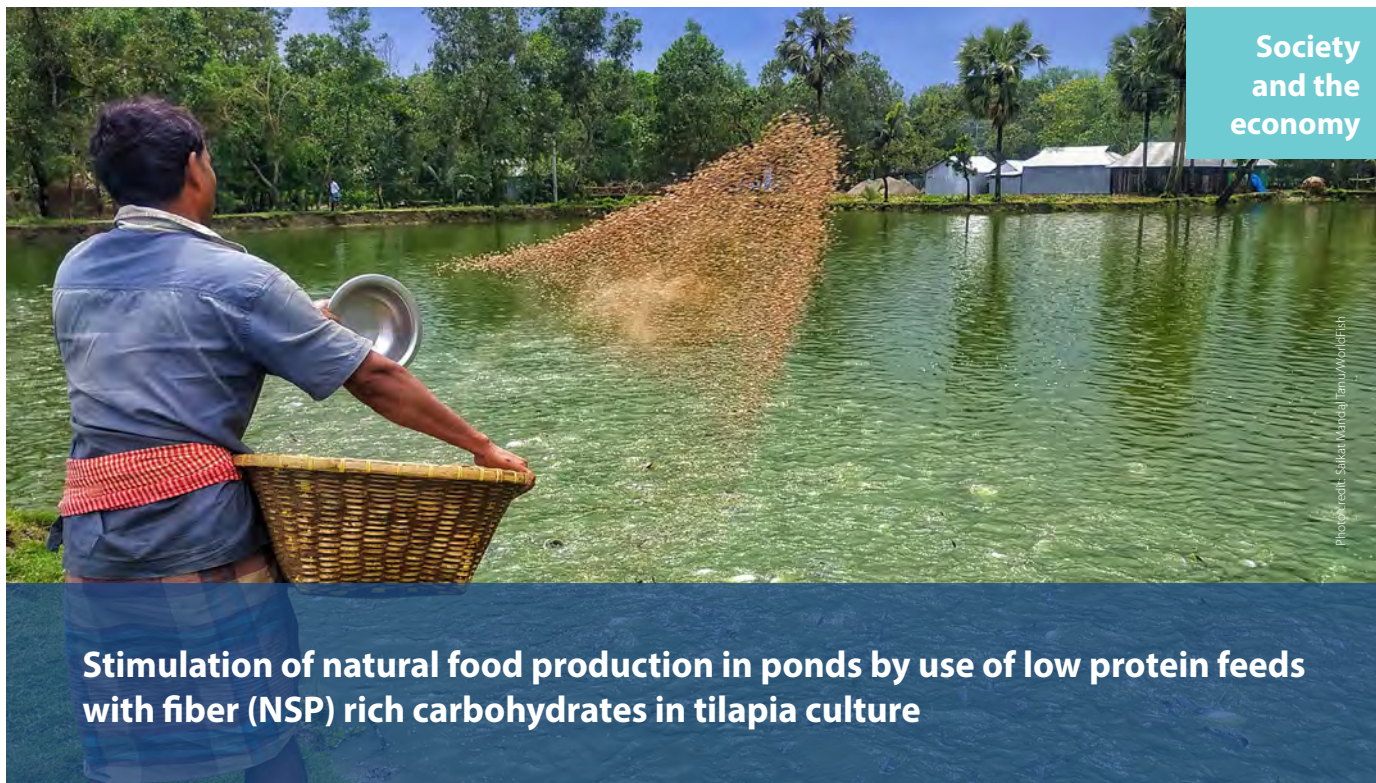
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Stimulation of natural food production in ponds by use of low protein feeds with fiber (NSP) rich carbohydrates in tilapia culture

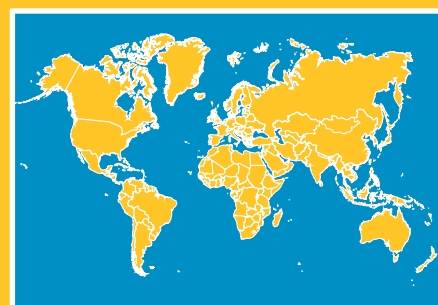
Innovation description

As the aquaculture sector has expanded, so has the potential for environmental impact. In typical pond production systems, fertilizers are designed only with cultured fish or shrimp in mind, without considering the impact on the pond ecosystem. When the recycling of animal waste becomes imbalanced, the pond environment becomes unhealthy, and the system becomes susceptible to disease. This is usually mitigated with a variety of additives, increasing production costs for farmers. Research into this problem suggests that by modifying the feed provided, the waste that is produced could be easily decomposed or used as food for animals, limiting waste accumulation and providing natural nutrients.

Context

Aquaculture has expanded and intensified rapidly as food production and demand have increased. This growing sector relies on agricultural crops and wild fish for feed, and this increasing dependence on natural resources creates concern about sustainable production. Both surface water quality and greenhouse gas emissions are areas that need to be addressed as the sector continues to grow. Feeding systems currently do not address concerns of the pond ecosystem and target only cultured animals. The concept of a nutritious pond production system aims to address the efficiency and expense concerns of the typical aquaculture production system.

Nutritious pond feeds use locally sourced ingredients to formulate feeds that nourish the farmed species as well as the other pond organisms. By increasing the amount of carbohydrates in the fish feed, the fish only partially digest the feed, leaving unused energy for bacteria to break down fish waste and release nutrients into the pond system. These low protein feeds with fiber (NSP) rich carbohydrates provide necessary nutrients for the fish while stimulating natural food production in the pond and decreasing the amount of leftover waste.



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Fish health, nutrition and feeds

Stakeholders

- Wageningen University & Research
- Khulna University
- De Heus Animal Nutrition

Contact

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Innovation journey

Research from this innovation has shown that balancing the carbon-to-nitrogen ratio in feed can contribute to naturally occurring food for cultured animals. This reduces both production costs as well as environmental impacts. Research began in 2018 with laboratory and experimental field ponds. Field trials conducted in Vietnam and Bangladesh investigated semi-intensive systems and the natural production of essential fatty acids by algae. Research also included the use of natural food sources for shrimp production and pond responses to different types of carbohydrates.

In 2021, experiments confirmed the diet effectiveness of the nutritious pond concept for tilapia in semi-intensive ponds and with shrimp in biofloc systems. This suggests that the concept is approved and can be taken into account by other organizations and in different ponds. Research into nutritious pond feeds has demonstrated an increase in farm income by 22%, which suggests great potential in contributing to livelihoods and income improvements when adopted.

The future

The nutritious ponds concept provides a more stable, healthy ecosystem for fish production to thrive. The concept has provided evidence that focusing on the pond ecosystem as a whole and feeding the pond as well as the fish can produce more animal protein with less feed. This innovation has the potential to be scaled in areas where aquaculture systems are not as intensive and input costs are a barrier to inclusion.

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New knowledge and practices for managing the risks of introductions and transfers of Genetically Improved Farmed Tilapia (GIFT) in different countries and territories

Innovation description

Introductions or transfers of Genetically Improved Farmed Tilapia (GIFT) to more countries and territories will increase in the coming years. The definition of the risks associated with these introductions and their management help to successfully prepare the transfer of GIFT. New knowledge on risk management is produced by considering the potential ecological, genetic and pathological risks of GIFT introductions and transfers, as well as established international best practices.

Context

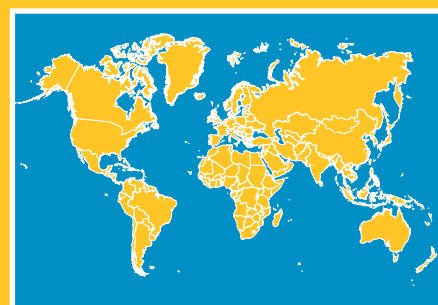
The GIFT strain of Nile tilapia is the world's first genetically improved tropical aquaculture fish species and is the result of more than 30 years of selective breeding by WorldFish and its partners. The development of GIFT was a major achievement in the history of tilapia aquaculture.

The growing role of GIFT in future global fish supplies will increase GIFT introductions or transfers to more countries and territories in the coming years. With this in view, risk management guidelines have been prepared to help transfer GIFT to any country or territory where risk analysis shows minimal risk using the highest safety standards and where cost-benefit analysis shows potential economic benefit.

Innovation journey

WorldFish has guided its dissemination of GIFT through policy and supporting code of practice and risk analysis guidelines.

In 2021, the "Guidelines for managing the risks of introductions and transfers of Genetically Improved Farmed Tilapia (GIFT)" was produced and published to successfully help prepare the transfer of GIFT. These risk management guidelines cover three stages of the introduction and transfer process: pre-border, border and post-border.



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Fish breeds and genetics

Stakeholders

- Bill & Melinda Gates Foundation

Contact

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These guidelines are based on the strategies and recommendations of three comprehensive reviews of the potential ecological, genetic and disease risks of GIFT introductions and transfers, as well as established international best practices provided by the Food and Agriculture Organization and the International Council for the Exploration of the Sea.

The future

The GIFT program is one of the most important and influential genetic improvement programs developed for fish farming. The adoption of guidelines will allow the safe transfer of GIFT, leading to improved fish productivity, family income, fish consumption and dietary diversity.



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Photo credit: Arabinda Mahapatra/WorldFish

FishNutrients: Fish nutrient data platform tools up the fight against malnutrition

Innovation description

FishNutrients is an innovative digital tool that predicts the nutrient composition of finfish species to develop fish nutrient profiles that can be used to inform national dietary guidelines and aquatic resource governance.

Context

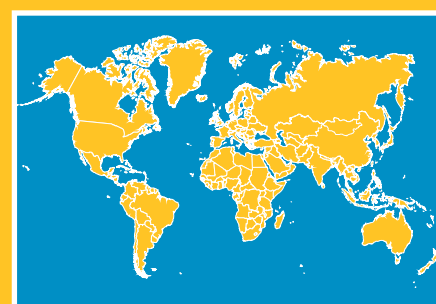
Although fish is increasingly recognized as a key element in addressing the challenge of global malnutrition, its nutritional benefits and relevance in modern diets, particularly those of vulnerable social groups in developing countries, remain largely unknown and unmet.

Not all fish are equal from a nutritional point of view. Some species, including small pelagics, are rich in many micronutrients, while others are not so rich. The nutritional composition of small indigenous species and the variety of species caught by small-scale fisheries are poorly recognized. This highlights the relevance of understanding the nutritional composition of the species we consume.

Innovation journey

The **FishBase** platform, launched in August 1996, is the world's largest most extensively accessed online database on adult finfish on the internet. It catalogues information on over 34,000 fish species and illustrates their ecology, biometrics and morphology, taxonomy and distribution. FishBase was recently named one of CGIAR's 50 Best Research Innovations for its innovative contribution to the world of open science and fisheries management.

FishNutrients was launched virtually in 2021 by an interdisciplinary team of researchers. It integrates the FishBase platform, helping to fill knowledge gaps on the nutritional composition of fish by providing easy access to open-source nutritional data for over 5000 fish species worldwide.



Contribution to impacts

Nutrition, health & food security

Type

Research and communication methodologies and tools

Technical field

Sustainable small-scale fisheries

Stakeholders

- The Minderoo Foundation
- Lancaster University
- Ocean Frontier Institute

Contact

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The new open-source tool puts fish nutrient data at the fingertips of researchers, policymakers and the general public to guide nutrition-sensitive approaches to fisheries management aimed at improving the consumption of the most nutrient-rich species.

The future

Access to data on fish species makes knowledge freely available to fishery scientists and managers, helping to find solutions for fisheries management, improve food security and better understand the nutritional potential of the global fish catch.



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Digital tool for on-farm performance assessment of aquaculture systems

Innovation description

Reliable and comparable data of aquaculture systems is currently lacking. While projects and innovations can provide many positive impacts, understand these results in their context and being able to standardize expected results and constraints are crucial to uptake and scaling. In order to assess impact from aquaculture innovations, baseline data must be provided, followed by an on-farm performance assessment. This data assesses a range of factors, including productivity, profitability, food security, dietary diversity and gendered employment.

Context

To understand how different species of fish will perform in different production systems, it is essential to collect information from a variety of geographies, economics, and social conditions. As aquaculture farming changes and intensifies, it is important to understand on-farm performance to avoid production losses and understand benchmarks on systems and management. Digital innovations allow for data collection to be harmonized across several different survey areas while collecting data in a consistent and thorough format.

Digital tools are designed with open-access and ease of use for farmer surveys. Platforms are provided that allow enumerators to collect data and perform quality control checks. The platform and survey are designed for a variety of audiences, including researchers, national partners, specialists and government field officers. The digital tools can also be adapted to the needs and concerns of the countries and communities where they are being applied. The flexibility of the tools allows for data collection to be performed under varied conditions and to collect information on a variety of aspects of the aquaculture process.



Contribution to impact

Poverty reduction, livelihoods & jobs

Type

Research and communication methodologies and tools

Technical field

Aquaculture systems

Stakeholders

- Skretting
- Development Research Initiative

Contact

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Innovation journey

This innovation provides a digital tool for on-farm performance assessment of aquaculture systems. In 2019, the digital tool was developed and made available for focal and scaling countries in the CGIAR Research Program on Fish Agri-Food Systems. It was also made available for use by other public and private sector stakeholders. The assessment tool was used in four countries: Bangladesh, Myanmar, Nigeria and Egypt. By 2020, the digital tool and [accompanying guide for digital surveying](#) was producing datasets from several countries, including Myanmar, Nigeria and Egypt, and had been used specifically to evaluate Genetically Improved Farmed Tilapia (GIFT) in Bangladesh. The data collected from this assessment can be used to inform policy, advise investment decisions and develop new innovations.

The future

The data collected from these assessments provides insight into the characteristics of farmers in particular areas and at certain stages. By collecting this data, it is possible to influence policymaking in a way that advocates for value chain actors rather than implementing policies that will not work or help in practice. This type of strategic assessment highlights socioeconomic characteristics, environmental performance, producer behavior, technical inputs, and the impact of activities on communities.

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Citation

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Design of a tilapia single nucleotide polymorphisms (SNP) chip: An SNP chip optimized for selection of GIFT and Abbassa tilapia strains

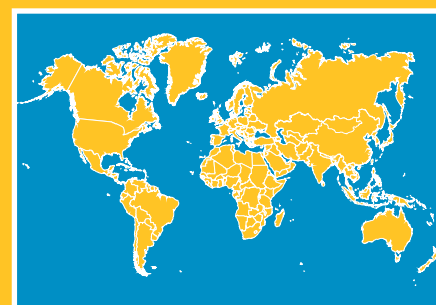
Innovation description

WorldFish has spent the past two decades developing and sharing improved tilapia strains in Southeast Asia and Africa with farmers benefitting from faster growth, higher survival rates and disease resistance. The Genetically Improved Farmed Tilapia (GIFT) and Abbassa strains of tilapia can tolerate low or variable oxygen levels, are more resistant to tilapia lake virus, and have better feed conversion ratios, which means a smaller environmental footprint of feed production and waste. To more effectively accomplish selective breeding, genomic tools like single nucleotide polymorphism (SNP) chips have been developed. These tools provide insight into the genetic architecture of different tilapia strains, providing detailed information that speeds the genomic selection process.

Context

Fish that grow faster and are more resistant to disease reduce the risk of food security that small-scale fisher families face and increase the likelihood of sufficient farm yield for profitability. However, accessibility to improved strains of farmed fish is difficult for sustainable fish farming around the world.

Tilapia is a freshwater fish species that has been successfully established in farming across Asia, Africa and South America. Tilapia are considered popular because of their fast growth rate, robustness and ability to survive well in many different farming systems. The GIFT program was created to improve the growth rate, overall survival, resistance to disease, and maturation rates. Previous genetic progress achieved had been due to traditional, pedigree-based approaches. However, genomic tools are improving breeding values for fish, particularly when looking for traits that are difficult or expensive to measure without genomic testing.



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Research and communication methodologies and tools

Technical field

Fish breeds and genetics

Stakeholders

- The University of Edinburgh, College of Medicine & Veterinary Medicine
- The Roslin Institute

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Innovation journey

Genomic tools are essential to identify fish with superior performance for breeding. An SNP chip uses small samples of fin tissue to identify genetic markers. SNP arrays have advantages over other genotyping methods because of their increased genotyping accuracy and stability. SNP arrays are genotyping tools that identify the genetic architecture of different traits. They are used by identifying markers in genes and comparing the genes of farmed tilapia strains, including GIFT strains, as well as genetically diverse populations of tilapia.

An SNP chip optimized for genomic selection of GIFT and Abbassa tilapia strains was designed for application and sent to the manufacturer in 2018. In 2020, this Nile tilapia NSP array was created and validated in several strains. This array was designed to be open access and functional across multiple strains of tilapia. It is expected that this chip will facilitate the continued research of improved tilapia strains for fish farming. The SNP chip innovation will assist with breeding decisions that are specific to users along the fish supply chain, and it is the intention of this innovation to develop more resilient fish, strengthening the livelihoods of small-scale fish farmers.



The future

With the high quality of the SNP array, there is more opportunity for detecting variants that alter gene expression or protein function. This, paired with the open-access nature of the array, opens doors for genetic research in multiple strains of tilapia. Future projects may include research of farmed population genetics, tracking farmed genomes in the wild, and further work on understanding traits of interest. As tilapia is one of the most commonly farmed fish in the world, the reach for genetic testing and improvement goes beyond the scope of current projects. Dissemination of improved strains of Nile and Abbassa tilapia has the potential to improve productivity, increase yields and improve farm efficiency for farmers at many scales.

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A framework and methodology to assess inclusion in community-based natural resource management (CBNRM)

Innovation description

A new framework with a mixed set of methods and tools for assessing inclusion (and exclusion) in community-based natural resource management (CBNRM) is defined and presented. This framework aims to pool ambiguities and assumptions by breaking down inclusion (and exclusion) into five measurable and comparable elements or stages of a CBNRM process: attending, understanding, sharing, being valued and decision-making. Although the framework is new, it integrates and builds upon important theoretical foundations.

Context

Although CBNRM is appreciated as a model of inclusive development and governance, it can also reproduce, and even accentuate, power imbalances and perpetuate the exclusion of already marginalized groups of people.

Social exclusion along the intersecting markers of social identity (such as wealth, age or life stage, ethnicity, race or caste, or migrant status) is often underestimated or completely ignored in practice and policy. The lack of a framework and methods for programs, projects and policies to understand, decompose and measure inclusion are some of the causes of this gap.

Innovation journey

A guidance note titled “Assessing inclusion in community-based natural resource management: A framework and methodology” was released in 2021. The note provides a framework that removes uncertainty about the meaning of inclusion by introducing a set of mixed methods and tools for assessing inclusion. It is inspired by The Five Degrees of Inclusion Framework, which breaks down inclusion (and exclusion) into five measurable and comparable elements or stages of a CBNRM process: participation, understanding, sharing, valorization and decision-making.



Contribution to impacts

Gender equality, youth & social inclusion

Type

Social science

Technical field

Resilient coastal fisheries

Stakeholders

- Australian Center for International Agricultural Research

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The note presents the methodology in four phases: (1) preparation, (2) field work, (3) data analysis and then (4) integrating the analyses and interpreting them to bring everything together. The methodology combines quantitative and qualitative methods and can be adapted to fit different contexts and needs.

The future

Prioritizing inclusion is a key process and outcome of CBNRM to achieve the broader goals of equity, gender equality and sustainable resource governance. Improving gender equality in and through CBNRM, policymaking and implementation of programs and projects enhances women's inclusion while contributing to more productive and equitable management of natural resources.



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Citation

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Photo credit: From Thilisee/WorldFish

Methodological innovation for “Illuminating Hidden Harvests” of small-scale fisheries

Innovation description

The Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) aim to support the development of small-scale fisheries and fishing communities through a participatory process with socially and environmentally sustainable outcomes. This involves investigating the contribution of small-scale fisheries and synthesizing fisheries, nutrition, employment and consumption information to provide policy-relevant data.

Context

In Southeast Asia, fisheries provide livelihoods and essential nutrition to millions of people and contribute to national and international economies. Small-scale fisheries are an essential component of this, with inland waters supporting the fisheries supply chain more than marine systems. Despite the cultural and economic importance of these systems of small-scale inland fisheries, quantifying their contributions is difficult. Thus, these groups are often lacking agency and are disregarded in policy.

To assess the social, environmental, economic and governance contribution of small-scale fisheries (SSF), a novel method case study approach has been developed. This approach linked traditional and non-traditional data sources and culminated in a report that pairs environmental and economic data with social indicators. This allows for examination of the links between SSF, food and nutrition security, gender equality, and sustainable livelihoods.

Innovation journey

In 2012, the Food and Agriculture Organization (FAO), World Bank and WorldFish published *Hidden Harvest: The Global Contribution of Capture Fisheries*. This project produced case studies from countries with inland and marine small-scale fisheries and suggested that globally inland



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Social science

Technical field

Sustainable small-scale fisheries

Stakeholders

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- Duke University

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fisheries have unreported rates at about 70%. In 2018, FAO, WorldFish and Duke University partnered to continue the work of this prior project. The continued project took improved national and global datasets on fisheries, employment, demographics and more to compile with new case studies that include the pre-harvest and post-harvesting processes. The [methodology was designed in 2017-2018](#) with consultation from experts. During this time, a method design publication, a protocol and training material for country case studies, and protocols for thematic studies, were produced.

The analysis and synthesis of the data collected from 52 country cases was completed in 2019, and a [preview webinar of the results](#) was attended by over 500 people in 2021. The key findings discussed in this preview webinar will be used to inform sustainable development at local, national and global scales. This project in particular can offer insight from existing survey and research data by highlighting the social differentiation in the flow of benefits from actors across the supply chain. The intention of collecting this information is to aid national governments and fisheries institutions seeking to support more sustainable livelihoods.

The future

By 2020, 54 country case studies were in the process of being contracted. These countries total 69% of the total marine catch and 81% of the global inland fish catch. Gathering data from these country case studies could provide valuable insight into estimates of global hidden harvests. As data continues to compile, global experts are consulting to produce a series of thematic studies covering key themes such as gender, food and nutrition, and climate change impacts.

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Gender-transformative approaches in fish agri-food systems

Innovation description

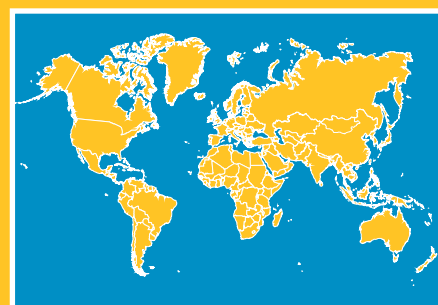
As an approach to engaging with gender within the development that goes beyond “business-as-usual” gender approaches, gender-transformative approaches (GTAs) explicitly address, rather than accommodate, underlying gender barriers that perpetuate inequalities. Emerging findings indicate that GTAs may contribute to more potent gender outcomes, such as increasing women’s participation in fishing (from 5% to 75%) and women’s contributions to intrahousehold decisions about the income generated from fish processing.

Context

Development programs and organizations in small-scale fisheries, aquaculture and their associated value chains increasingly recognize gender and social constraints that disadvantage women and other social groups. Many efforts to address this in past decades have relied on gender-accommodative approaches in which gender constraints are recognized and worked around to engage women. However, these have been critiqued as they only engage with visible gender gaps and thus may not contribute to substantive or lasting change. For this to occur, underlying structural barriers that create gender imbalances—including unequal attitudes, norms and power relations—must be addressed.

Innovation journey

Since 2012, WorldFish and partners have conceptualized, tested and scaled GTAs in fisheries, aquaculture, agriculture and broader development sectors, focusing on gender-equitable control of productive assets and resources. GTAs aim to address the underlying causes of gender imbalances by challenging the barriers that limit women’s participation in and capacities to derive benefits from, for example, fish value chains. In practice, context-appropriate and locally led GTAs engage men and women together to critically assess their gender norms and



Contribution to impacts

Gender equality, youth & social inclusion

Type

Social science

Technical field

Gender

Stakeholders

- Government of Zambia, Ministry of Fisheries and Livestock
- International Institute of Tropical Agriculture
- University of Stirling
- University of Zambia
- Zambia Center for Communication Programmes

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stereotypes, how these shape gender dynamics and relations, including inequitable divisions of labor, and how these in turn influence the opportunities and well-being of individuals, households and communities.

GTAs have been successfully piloted in [Bangladesh](#) and [Zambia](#) resulting in, for example, increased women's participation in fishing (from 5% to 75%) and women's contributions to intrahousehold decisions about the income generated from fish processing. WorldFish research on GTAs developed a foundation for the global research initiative [GENNOVATE](#) and has now been integrated into policy and practice documents of the [European Commission](#) and [Rome-based agencies](#).

The future

GTAs are crucial to supporting gender-equitable control of productive assets and resources, improving the capacity of women and other social groups to participate in decision-making, and increasing decent and meaningful livelihood opportunities. Efforts to scale and expand GTAs are ongoing, particularly in collaboration with [HER+](#) and the [CGIAR GENDER Platform](#). Progress relies on better use of evidence to inform gender-responsive, inclusive and transformative policy and programs, and on bold thinking and action to recognize and address underlying barriers.

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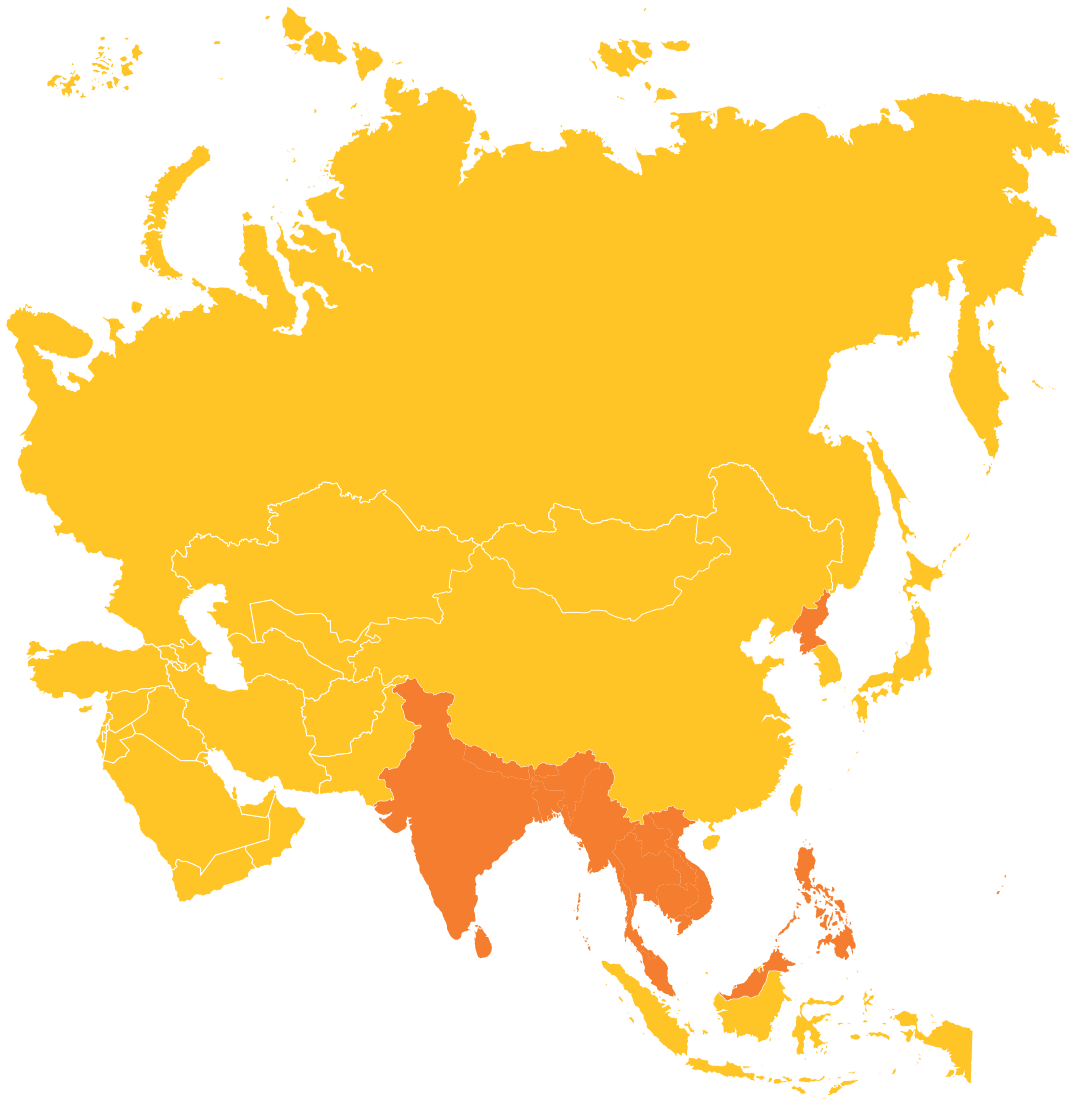
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Asia





Genetic markers (SNPs) for identifying improved tilapia strains in Asia

Innovation description

Genetic improvement of Nile tilapia (*Oreochromis niloticus*) began with selective breeding programs that targeted improved growth rate. Previous success relied on a traditional, pedigree-based approach. Recent innovation with genomic tools improves upon this process by estimating breeding values via genomic selection. **Single nucleotide polymorphisms (SNPs)** are powerful tools that assess breeding values based on accurate genotyping. SNP arrays reveal the genetic architecture of fish, allowing for more accurate and efficient genomic selection for improved commercial breeding.

Context

Aquaculture growth and production is necessary to address the growing need for food security and livelihoods in Southeast Asian countries. Nile tilapia is native to Africa but farmed across the world, emerging as one of the most important aquaculture fish. Nile tilapia aquaculture has been established in over 50 countries spanning Asia, Africa and South America. Due to its faster growth rate, shorter generational interval, adaptability and resilience, it is considered a key species for aquaculture and human consumption in underdeveloped communities and countries. Selective breeding programs for Nile tilapia have been established, including the Genetically Improved Farmed Tilapia (GIFT) strain. This strain uses selective breeding and genomic selection to improve commercially important traits for aquaculture. GIFT has consistently been shown to outperform non-GIFT tilapia strains in regard to relative growth rate, size and cost effectiveness.

The Philippines has a long history of locally developing strains of tilapia, beginning with the GIFT program in the 1980s. Because of this history of selective breeding and aquaculture, the Philippines has mature and structured programs in place. In contrast, Bangladesh is new to the tilapia sector, so its breeding and genetic improvement programs are less complex and structured. Despite the difference in research and intensity, both the Philippines and Bangladesh



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Research and communication methodologies and tools

Technical field

Fish breeds and genetics

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can benefit from improved genetic testing and mapping for GIFT strains, as both have demand for growth in the aquaculture sector. To improve the efficiency and effectiveness of genetic improvements, new technology can be implemented.

Innovation journey

SNP arrays were identified, and a low-density panel was developed, using samples from GIFT strains across Asia. In 2020, this panel was used to identify strains from sample hatcheries in Bangladesh and the Philippines. This set of particular genetic markers has been used successfully, and results have been published with the data identifying the markers made public. Evidence from these studies shows the difference between well-established genetic breeding systems versus newer programs, as the Philippines has a high prevalence of locally developed and improved strains, while Bangladesh does not. The published array and results are available for others to use, further broadening the ability of researchers to improve tilapia strains.



The future

The SNP arrays highlighted significant feed-efficiency trait inheritability, suggesting that future GIFT generations will be bred with improved genetics for this trait. The effectiveness and availability of this innovation and its resulting data has the potential to benefit both academic studies and commercial communities. This research has the opportunity to support ongoing research and breeding programs by providing expedited genetic improvement, leading to faster and improved production practices.

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South Asia

Bangladesh





Photo credit: Mohammad Mahabubur Rahman/WorldFish

Model resilient fishing village: An approach for livelihood transformation of fishery communities in Bangladesh

Innovation description

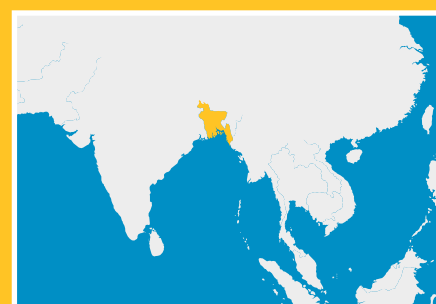
The resilient model fishing village is intended to facilitate change in ecological, social, cultural and economic well-being through inclusive community development initiatives. The approach has holistically improved livelihoods of fishing communities and the co-management system, as well as women’s empowerment and social capital.

Context

Hilsa shad (*Tenualosa ilisha*) is the most popular fish in the Bay of Bengal region, the national fish of Bangladesh, and a good source of essential micronutrients and Omega-3 fatty acids. Hilsa production dropped below 200,000 t in 2003, prompting the Government of Bangladesh to implement the Hilsa Fishery Management Action Plan that led to a 5% annual increase in hilsa production. Major influxes of Rohingya refugees from Myanmar to Bangladesh’s Cox’s Bazar have also had enormous impacts on all natural resources, including fisheries, which have severely affected river and coastal fishing communities.

Innovation journey

Enhanced Coastal Fisheries in Bangladesh II (ECOFISH II) an initiative funded by the United States Agency for International Development (USAID), builds on previous work of the original ECOFISH project on hilsa shad production in the Meghna River ecosystem. ECOFISH II is focused on reducing the impacts on natural resources and fishing communities along the Teknaf-Cox’s Bazar peninsula as well as the impact of the Naf River fishing ban on host communities in Teknaf. In 2020, WorldFish piloted the model resilient fishing village approach in three villages along the Padma-Meghna River system: Balaramsura in Bhola District, Uttar Bugola in Chandpur District, and Haloishar in Shariatpur District. This approach has now been scaled to three more fishing villages: Rastarpara-Khurusukul in Cox’s Bazar Sadar, Nidania in Ukhiya, and Bou Bazar in Char Montaz. This



Contribution to impacts

Climate adaptation & mitigation

Type

Production systems and management practices

Technical field

Resilient coastal fisheries

Stakeholders

- Bangladesh Ministry of Fisheries and Livestock, Department of Fisheries
- United States Agency for International Development

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includes expanding interventions for improving the livelihoods of fishing communities and enhancing biodiversity conservation in the artisanal fisheries of the Bay of Bengal. After one year, the government declared Haloishar “an ideal fishing village” and the Ministry of Fisheries and Livestock has begun scaling the resilient fishing village approach through its Sustainable Coastal and Marine Fisheries project, funded by the World Bank.

The future

The model resilient village approach has helped transform livelihoods, and increase livelihood opportunities, of fishing communities in Bangladesh through infrastructure improvements, aquaculture training, livelihood diversification (e.g. farming of cows, fish, goats, green mussels, poultry, seaweed, vegetables), alternative financing and the establishment of **community fish guards**. This is especially important for **increasing the resilience of coastal communities** in the face of climate change and other shocks. In 2021, more than 46,486 people increased their socioeconomic resilience thanks to alternative livelihood activities and 264,413 ha of biologically significant areas have been restored. The Ministry of Fisheries and Livestock has now taken up the program and will continue to scale the approach across Bangladesh to ensure these communities have alternative livelihood support systems for improved climate adaptation.



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Photo credit: Tom H. Hees/Woodyfish

Community fish guards (CFGs) enhanced compliance in coastal biodiversity conservation in Bangladesh

Innovation description

Enforcement agencies in Bangladesh have insufficient manpower, funds, equipment and transportation. Community fish guards (CFGs), a unique initiative to encourage community ownership of natural resources conservation, were introduced to provide the necessary support in patrolling fish sanctuaries during the juvenile and brood hilsa ban periods. CFGs are a co-management process that offers community members an opportunity to engage in local economic development and governance activities.

Context

Hilsa shad (*Tenualosa ilisha*) is the most popular fish in the Bay of Bengal region, the national fish of Bangladesh, and a good source of essential micronutrients and Omega-3 fatty acids. Hilsa production dropped below 200,000 t in 2003, prompting the Government of Bangladesh to implement the Hilsa Fishery Management Action Plan that led to a 5% annual increase in hilsa production. Major influxes of Rohingya refugees from Myanmar to Bangladesh's Cox's Bazar have also had enormous impacts on all natural resources, including fisheries, which have severely affected river and coastal fishing communities.

Innovation journey

Enhanced Coastal Fisheries in Bangladesh (ECOFISH-Bangladesh), an initiative funded by the United States Agency for International Development (USAID), was started to improve the resilience of the Meghna River ecosystem and communities reliant on coastal fisheries. The project centered on science-based adaptive co-management, incorporating strategies to diversify fishing livelihoods, to manage Bangladesh's large river ecosystems that encompass six hilsa sanctuaries. This was implemented through the establishment of hilsa conservation groups, hilsa ghat groups and community savings groups at the community level, fisheries management committees at the village



Contribution to impacts

Environmental health & biodiversity

Type

Production systems and management practices

Technical field

Resilient coastal fisheries

Stakeholders

- Bangladesh Ministry of Fisheries and Livestock, Department of Fisheries
- International Union for Conservation of Nature
- Wildlife Conservation Society
- United States Agency for International Development

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level, and CFGs. Overall, 400 CFGs have been recruited, trained and deployed along the 400 km of hilsa sanctuaries to help the Department of Fisheries, Coast Guard and River Police—especially during fishing ban periods from March to April to protect juvenile fish and October to November to protect fish ready to spawn. The Hilsa Conservation and Development Fund was established to support fishers and is used to provide lump sum incentives to CFGs. Detailed CFG guidelines have also been prepared as part of the institutionalization.

The future

The CFGs established under the ECOFISH-Bangladesh project have contributed to more productive and equitable management of hilsa fisheries. Annual hilsa production increased to 11% after 2015, with 520,000 t produced in 2018, and average hilsa size increased from 535 to 915 g between 2015 and 2019, improving the incomes of fishing households by 66%.

In 2019, WorldFish scientists contributed to facilitating the declaration of a 3188 km² marine protected area (MPA) to protect hilsa breeding and nursery grounds as well as habitats for marine fish, crustaceans, megafauna and migratory birds. This will ensure a higher production of hilsa that will benefit the livelihoods of more than 450,000 hilsa-dependent households and contribute to meeting the country's commitments to the UN Sustainable Development Goal 14 to conserve marine waters.



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Safe, hygienic, inclusive and gender-sensitive production technology developed to dry small pelagic fish in Bangladesh

Innovation description

As safe hygienic, inclusive and gender-sensitive production technology was developed in Bangladesh to support disadvantaged women in fishing communities in drying small pelagic fish. The technology is based on the preparation of bamboo Maccha (trellis) as an improved fish drying rack with a covering net (mosquito net).

Context

Dried fish is an important food in Bangladesh and is the most accessible type of fish for consumers across all income levels, which is particularly important for poor consumers. However, the dried fish sector in Bangladesh has been largely overlooked in fisheries research, which generally focuses on fishers and the benefits generated by small-scale fisheries. This has supported the narrative that small-scale fisheries have a positive impact on well-being of all actors in fish value chains, though this is *not often the case for those involved in fish drying*.

In Bangladesh, most laborers engaged in fish drying are employed by operators under unfavorable work conditions. Other factors exacerbate this, including mistreatment of vulnerable groups, like women and refugees, and geographic isolation beyond governmental reach. Disparities are further compounded by the common practice of in-kind payments or a cash piece rate, which do not always extend to men engaged in fish drying, who may be paid in cash and earn twice the daily wage of their counterparts in vulnerable groups. These labor arrangements provide distinct benefits to fishers and fish drying operators by ensuring a constant and flexible supply of low-cost labor, minimizing cash outlays, and transferring fishing risks to fish drying laborers.

Innovation journey

Inequality in the post-harvest sector has disproportionate effects on women, who make up the majority of fish processors in Bangladesh. To increase women's empowerment, income, and food and nutrition security, WorldFish and partners under the [Enhanced Coastal Fisheries in](#)



Contribution to impacts

Gender equality, youth & social inclusion

Type

Production systems and management practices

Technical field

Resilient coastal fisheries

Stakeholders

- Bangladesh Ministry of Fisheries and Livestock
- United States Agency for International Development

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Bangladesh II (ECOFISH II) project introduced an improved fish drying technology using a trellis and a mosquito net that can be used to produce safe and hygienic dried fish. In two cycles, 1014 women fishers in Cox's Bazar (Teknaf, Ukhiya, Ramu, CXB Sadar, Moheshkhali) and Bhola (Char Fasson) were trained on producing safe and hygienic dried fish from marine pelagic small fish (e.g. olua, faisla, sardine, poa). Cash support to prepare the macha and raw pelagic small fish were also provided. ECOFISH II delivered 23,546 kg of raw fish to 975 women who produced 7147 kg of dried fish—5168 kg of which was sold in local markets in the production season (October—March). The fishing households, particularly young children and women, consumed the rest of the dried fish produced. The other 39 women have yet to begin dried fish production due to a scarcity of marine pelagic small fish Char Fasson.

Of the trainees, 216 adopted and continued microbusiness activities based on the technology. An additional 2750 kg of dried fish and 250 kg of fish powder were provided among 3000 fishing households as a supplementary nutritional food aid to complement the rice support from the government during the 65-day marine fishing ban.



The future

The improved pelagic fish drying technology has significant implications for women's empowerment, income, and food and nutrition security, and is planned to reach 2500 women fishers. An economic analysis of the drying technology and its associated outcomes will be conducted to assess its contributions to women's savings, income and expenditures. In the meantime, project officials are looking for local market actors, in collaboration with fishing community leaders, to ensure the women producing safe and hygienic dried fish and fish products have long-term linkages to markets.

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Contextualized biosecurity practices and protocols for tilapia hatchery technicians in Bangladesh

Innovation description

Biosecurity practices and protocols for tilapia hatchery technicians in Bangladesh were developed based on previous experiences, including practical and empirical evidence from Bangladesh and other countries. Manuals in [Bengali](#) and [English](#) provide guidelines for capacity development activities at the hatchery level to support the sustainable intensification of tilapia production systems in Bangladesh.

Context

Tilapia lake virus (TiLV) is a highly contagious pathogen that causes high levels of mortality and poses a significant threat to small-scale tilapia farmers. It was discovered in 2014 and has since been reported in Asia, Africa and South America. Improving the detection, management and prevention of TiLV is crucial to improving the livelihoods and food and nutrition security of small-scale fish farmers and their communities.

Innovation journey

Tilapia production in Bangladesh has been rapidly increasing, with over 4 billion tilapia fry produced annually from over 400 tilapia hatcheries. With increased production and dissemination of fry, there has been an increasing incidence of disease outbreaks, including TiLV, in tilapia broodstock facilities, hatcheries, nurseries and farms. In partnership with Bangladesh's Department of Fisheries, WorldFish developed a program to improve biosecurity in the national tilapia industry.

The program included designing and implementing a training program on improving tilapia hatchery biosecurity for a group of specialists called master trainers. The manual is a result of this program and covers biosecurity measures such as hatchery layout, quality feed, water monitoring, eggs and larvae disinfection, disposal of diseased and dead fish, visitor and worker restrictions, waste disposal, staff training,



Contribution to impacts

Nutrition, health & food security

Type

Production systems and management practices

Technical field

Fish health, nutrition and feeds

Stakeholders

- Bangladesh Ministry of Fisheries and Livestock, Department of Fisheries
- United States Agency for International Development

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clean work environment, and equipment maintenance. The master trainers will use this manual for training tilapia hatchery technicians across Bangladesh on how to improve biosecurity in hatcheries.

The future

Improved hatchery biosecurity is only one part of fish health detection, management and prevention. As such, continued engagement with partners is required to (i) build human capacity for aquatic animal health management, (ii) provide accessible and relevant resources for health professionals, farmers and associated value chain actors, (iii) engage the private sector in scaling disease diagnostic and prevention strategies and tools, and (iv) operationalize national aquatic animal health management strategies across Asia and Africa. These findings, when adopted and scaled, can reach millions of fish farming households with better health management to contribute to broader goals for securing healthy and sustainable aquaculture.



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Generation 3 of improved strain of rohu carp (*Labeo rohita*) produced in Bangladesh

Innovation description

Until recently, aquatic animals had not been considered for genetic improvement, even though a majority of aquaculture stocks are genetically similar or identical to wild fishstocks. This provides an opportunity to improve aquaculture productivity through the application of selective breeding programs that can target and encourage specific traits in species of fish. Defining breed objectives, such as growth rate, resistance to diseases, and flesh quality, are all important aspects to consider when defining goals for genetic improvement. The third generation (G3) of WorldFish's genetically improved rohu seeks to address production rates by increasing the growth rate of farmed rohu.

Context

Fish accounts for 60% of all animal protein consumed in Bangladesh, and a majority of the fish consumed is sourced from domestic aquaculture. Rohu carp (*Labeo rohita*) is a species of carp found in rivers of Southeast Asia and accounts for 25% of the total production of fish from ponds. Annually, approximately 319,000 t of rohu are produced, representing USD 950 million in wholesale market value. Currently, commercial hatcheries in Bangladesh use wild broodstock to produce fry for commercial farming. These wild broodstocks are used until problems with viability and growth appear, and then new broodstock is collected. This method of farming often results in low productivity. Thus, genetic improvement programs could offer access to quality seed of significant species like rohu and drastically increase aquaculture production.

Innovation journey

In 2020, high quality G3 rohu carp were produced by the innovation lab by collecting spawn from three different rivers in Bangladesh and using a subsample as the base population. The G3 rohu were genetically improved to have a more rapid growth rate. It was



Contribution to impacts

Poverty reduction, livelihoods & jobs

CGIAR action areas

Resilient agrifood systems

Type

Genetic (variety and breeds)

Technical field

Aquaculture/Fisheries

Stakeholders

- United States Agency for International Development
- Bill & Melinda Gates Foundation

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expected that G3 would grow 30% more rapidly than river-sourced rohu or traditional commercial strains. This G3 rohu was disseminated to hatcheries to be grown into broodstock. This broodstock was expected to mature by 2022 to allow dissemination at scale as well as directly to some nurseries and farmers as a pilot scale release. In 2020 and 2021, G3 rohu was disseminated to farmers and nurseries. Dissemination at scale was forecasted to take place in 2022. Dependent upon final results from the pilot scale release, G3 will be made available for sale to nurseries and farmers. It is expected that 20 hatcheries will sell approximately 3500 kg of hatchlings to 35,000 nurseries and farmers in 2022 and 2023.



The future

Selective breeding is commonplace in agricultural programs but is relatively new in the aquaculture sector. Since 2013, WorldFish has been running programs for genetically improved rohu, catla and silver carp in Bangladesh. These programs use family-based selective breeding that allows for genetic improvement while controlling for inbreeding, which can further reduce productivity. Research and development allows for efficient rearing of individual families while investigating genotype/environment interaction to determine if improved rohu will grow consistently in different environments. This genetically improved stock grows 20%–30% faster than seed from traditional available seed. It is expected that, as genetically superior parents are selected and spawned, the rate of growth of rohu will improve by 5%–10% every 2 years.

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Boneless hilsa products (hilsa soup, hilsa noodles and hilsa minced cubes) developed for Bangladesh

Innovation description

Hilsa shad (*Tenuialosa ilisha*) is a transboundary species of the Bay of Bengal and is the national fish of Bangladesh. The species contributes to the artisanal sector of fisheries in both inland and seawater. Despite this cultural significance, poor and low-income communities have little access to the species because of its high price point. Additionally, it is considered difficult for some to eat because of its pin bones. The innovation described in this fact sheet developed with assistance through a public-private partnership (PPP), is developing boneless hilsa products for public marketing at easily accessible chain supermarkets as part of the Enhanced Coastal Fisheries in Bangladesh (ECOFISH) project.

Context

Hilsa is an anadromous fish that migrates to major rivers for breeding and nursing and spends adulthood in marine areas. In Bangladesh, hilsa is a culturally and economically important fish, with approximately 260 million Bengali people consuming it, and contributing to 12% of total fish production annually, directly employing half a million fishers and another 2.5 million value chain actors. Hilsa is a high protein and lipid fish rich in essential micronutrients and Omega-3 fatty acids, making it a worthwhile addition to diets, especially for women and young children.

Despite hilsa's significance, its skeletal system houses 138 intermuscular pin bones, which limit its consumption, particularly for younger consumers. Considering the nutritional benefits of the fish, it is worthwhile to consider products that maintain the nutritional value and preferred taste of hilsa while removing the pin bones that are a barrier to consumption.

Women in fishing communities are constrained by gender roles, limiting their role in fisheries and income-generating activities. The ECOFISH project challenges social norms by encouraging and facilitating the participation and leadership of women in project



Contribution to impacts

Nutrition, health & food security

Type

Production systems and management practices

Technical field

Aquaculture/Fisheries

Stakeholders

- Bangladesh Agricultural University
- Virgo Fish & Agro Processing Ltd.

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programs. These programs contributed to the visibility of the work that women provide and their contribution to their households, which improved women's engagement with the program and their empowerment in their communities. These programs included providing livelihood and alternative income-generation activities, as well as basic and business literacy. Income-generating activities include participating in deboning hilsa and contributing to fish drying, salting and packaging.

Innovation journey

Through the bilateral ECOFISH project, funded by the United States Agency for International Development, the Fisheries Technology Department of Bangladesh Agricultural University and private entrepreneur Virgo Fish & Agro Process (VFAP) have formulated and developed three boneless hilsa products. In 2019, hilsa soup, hilsa noodles and hilsa cubes were formulated. The production technologies were officially handed over to VFAP for marketing of the products at chain supermarkets to make available for purchase.



The future

Hilsa is the most important single-species fishery in Bangladesh. Following the rapid decline of hilsa yields in the early 2000s, the government began introducing conservation measures to mitigate the losses. Since these mitigation measures were put into place, stock recovery and higher yields have been measured. The greater availability of hilsa has multiple benefits for actors throughout the value chain as well as for consumers. With the improvement in hilsa availability, time and attention can be dedicated to improving the accessibility of hilsa for lower-income consumers and making consumer-friendly products, particularly for children, that will still provide the same levels of nutrition. This involves engaging communities as well, as women are empowered by capacity development activities on how to make nutritious diets more attainable for youths. These steps are taken to ensure that hilsa stocks are sustainably used and conserved beyond fisheries.

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Cold chain: Mitigating post-harvest fish losses through a modern transportation system and cold chain in Bangladesh

Innovation description

In Bangladesh, a new cold chain model has been developed, making the fish supply chain much safer through the use of a refrigerated van to store and transport fish over a long distance and the use of a wheeled manual van that can transport fish over a shorter distance.

Context

The small-scale fisheries sector in Bangladesh suffers severe post-harvest losses every year due to gaps at different stages of the value chain, from harvest to retail distribution. About 28% of the fish lost 60%–70% of their freshness before reaching the consumer in the local wet fish shop.

To address this problem, the Feed the Future Bangladesh Aquaculture Activity (BAA) project created a partnership to promote fish cold chain management to reduce post-harvest losses to a minimum or zero level.

Innovation journey

In 2021, BAA's partners developed packaging for the supply of dedicated fish crates, and transportation with refrigerated vans and freezers was promoted. Four new fish-selling insulated vans for home delivery are available, and the development of 3200 L storage facilities was completed.

Business networking events and marketing and sales training were implemented. Seven networking events for farms and a training course on marketing and sales took place and 215 farmers have been reached through business networking events.



Contribution to impacts

Nutrition, health & food security

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- United States Agency for International Development
- MarGEn Ltd

Contact

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The future

Improving the cold chain can reduce post-harvest losses and lead to better preservation of fish food, both for consumption and for trade.



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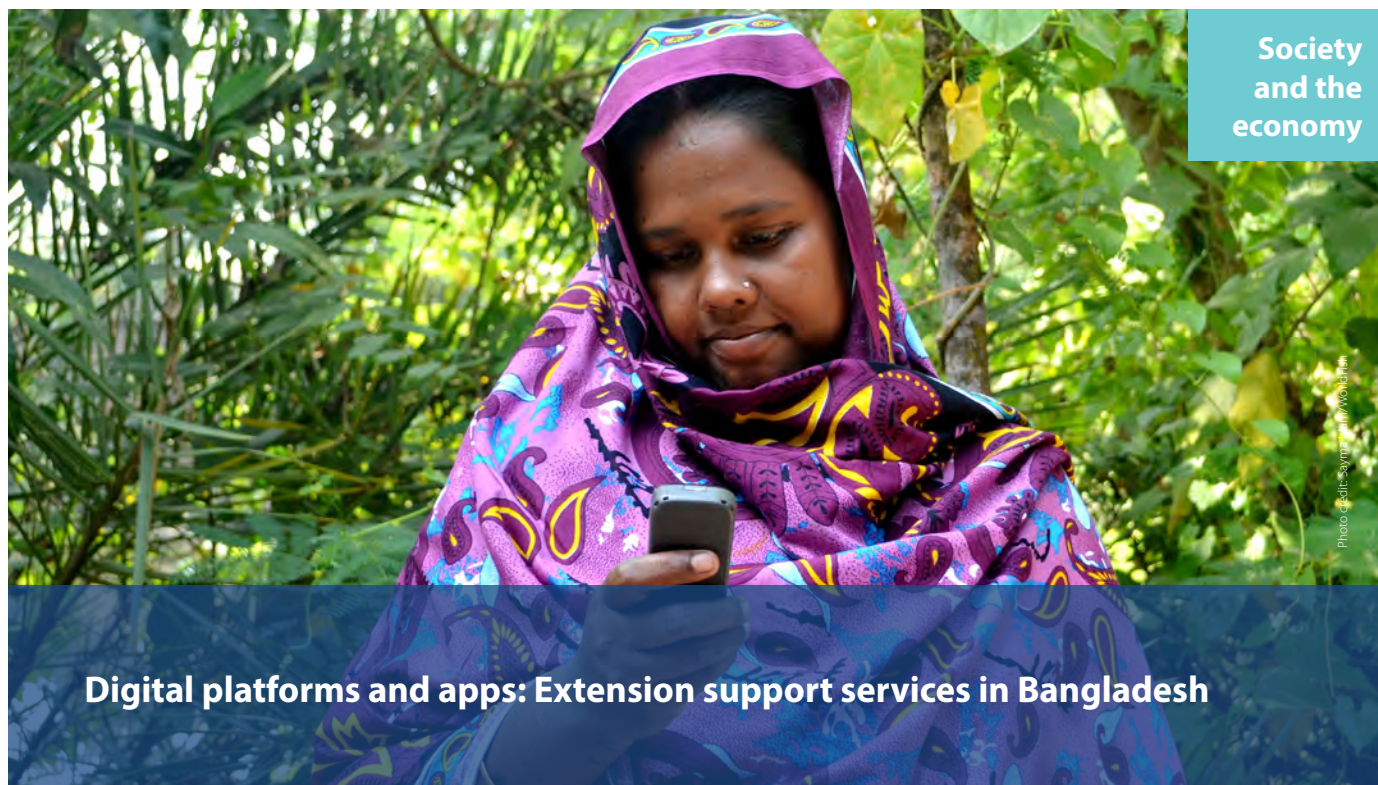
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Digital platforms and apps: Extension support services in Bangladesh

Innovation description

Digital platforms and mobile applications (apps) were introduced in Bangladesh to improve the availability of knowledge on improved fishery and aquaculture practices and access to quality inputs, information and financial services among fishers, fish farmers and the actors of the sector.

Context

Digital innovations have the potential to improve human welfare and ecological sustainability by making the fisheries and aquaculture sector more inclusive and accessible.

In Bangladesh, there are still several obstacles to the improvement of the sector that can be overcome by introducing digital innovations. For example, access to formal financial services is a significant impediment to growth for fish farmers and aquaculture enterprises. In addition, non-standard transportation systems lead to significant post-harvest losses and deteriorate the quality of fish concerning food safety. The use of an app-based digital ride-sharing mechanism for transporting fish can contribute to avoiding fish losses.

Innovation journey

Several digital innovations have recently been introduced in Bangladesh. Among them, *Rupali* is an Android-based mobile application (app) launched in 2019 that aims to improve the availability of knowledge on improved aquaculture practices and access to quality inputs among farmers. As of December 2019, the *Rupali* app has been downloaded 32,349 times with 9064 registered users.

WorldFish, in collaboration with its partners, launched in 2021 intervention entitled "*Macher Gari*," which promotes an innovative app-based transportation system for hatcheries, nurseries and farms to enable efficient and cost-effective transportation of fish while meeting all required quality and compliance standards. The app-based digital ride-sharing mechanism is for transporting fish from one place to another.



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Research and communication methodologies and tools

Technical field

Aquaculture systems

Stakeholders

- Bangladesh Ministry of Fisheries and Livestock, Department of Fisheries Bangladesh
- Fish Bangla
- United States Agency for International Development
- Advanced Chemical Industries Limited
- M-World
- Kiu Bangladesh Limited
- The Right Kind

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In 2021, WorldFish partnered with KIU-Bangladesh to explore the opportunity to connect fish farmers to formal banking services through a data-driven digital lending system (cash flow-based model).

The KIU Bookkeeping App was developed to improve farmers' and retailers' access to finance. The app has recently been translated into Bengali to comply with local company processes and loan application standards.

In Bangladesh, the innovative approach of engaging trained boat skippers as citizen scientists with smartphones to generate reliable fish catch data has been successfully piloted. The new catch monitoring system has been introduced in five sanctuaries and marine habitats involving 60 citizen scientists, who efficiently provided real-time species-wise catch data directly to the database following easy-to-use Bangla apps adapted from the Open Data Kit (ODK) module.

The future

Farmers, retailers, dealers of feed and aqua chemicals and pond mechanization equipment, hatchery owners, fish wholesalers, officials and researchers of government and nongovernmental organizations will benefit from the use of new digital platforms and mobile applications. User-friendly digital solutions make life easier for members of communities with limited resources and opportunities. The use of innovative and easy-to-access technologies creates opportunity and resilience, improving access to information, economic benefits, and safe and nutritious food.

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South Asia

India

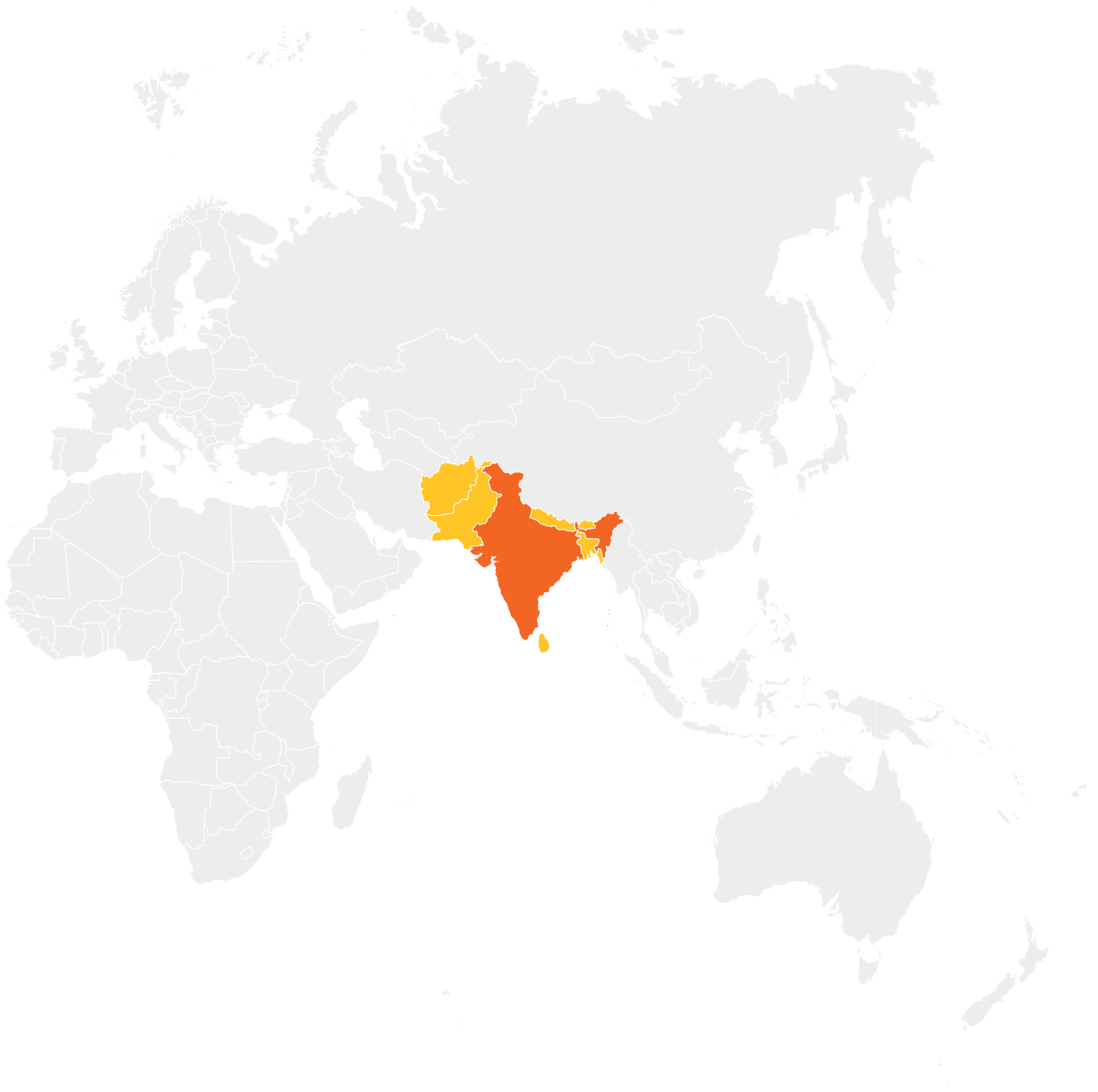




Photo credit: Devoir Odisha Studio

Better management practices for carp intensification adopted by Women Self Help Groups in India

Innovation description

Better management practices for carp polyculture systems involving a nutritious small indigenous fish species, the mola carplet (*Amblypharyngodon mola*), have been developed and used to train Women Self Help Groups (WSHGs) in Odisha State, India.

Context

Despite access to vast water resources, Odisha State has lower inland fish production but higher per capita fish consumption than other states in India. Addressing this discrepancy requires large imports of freshwater fish from neighboring states, but malnourishment is still common. With the goal of developing a sustainable aquaculture and fisheries sector in Odisha that creates employment, stimulates inward investment and reduces malnutrition among vulnerable and marginalized communities, the ambitious Odisha Fisheries Policy 2015 was introduced. In 2016, [WorldFish signed a memorandum of agreement](#) with Odisha's Fisheries and Animal Resources Development Department to support implementation of this policy. This included five programs, one of which was to promote [nutrition-sensitive carp-mola polyculture](#).

Innovation journey

The program to promote carp-mola polyculture began with the rehabilitation of underutilized Gram Panchayat tanks across Odisha's 30 districts for aquaculture, which were to be managed by WSHGs. An [important policy change](#) and innovative financing—the tanks would now be available to WSHGs on a priority basis under long-term leases of 3–5 years, with an input subsidy covering about 60% of operational expenses—encouraged participation. Over 1500 master trainers, including assistant fisheries officers, technical officers and district project coordinators, across all districts conducted 320 block level training



Contribution to impacts

Gender equality, youth & social inclusion

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- Government of Odisha
- Fisheries and Animal Resources Development Department
- Panchayati Raj and Drinking Water Department
- Women and Child Development Department and Mission Shakti

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sessions with more than 9000 members of WSHGs. Extension materials, including [better management practices](#) (BMPs) for aquaculture in Gram Panchayat tanks, were developed for these sessions and have been adopted by WSHGs.

The BMPs are contextualized to local needs and materials and include guidance on pond preparation, seed selection, transportation, stocking, feeds (including use of local ingredients), water quality, fish health, harvesting, postharvest handling, and marketing. From these efforts between 2017 and 2021, more than 60,000 women organized in 6235 WSHGs have managed 6242 tanks (5043 ha) for carp-mola polyculture, contributing to increased fish consumption of more than 200,000 people.



The future

Training and extension materials have significantly enhanced the knowledge of WSHGs on scientific and sustainable aquaculture and contributed to generating new livelihood opportunities, increasing the availability of diverse nutrient-rich foods, and improving gender-equitable control of productive assets and resources. The success of this program has supported further efforts to develop the [post-harvest capacity of WSHGs](#), including small fish and fish-based products in [supplementary nutrition programs](#), assist [tribal communities in mineral-bearing districts](#), and spur a [wider Blue Revolution](#), all with significant promise to improve livelihoods, nutrition and equity across Odisha.

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Photo credit: Arabinda Mahapatra/WorldFish

New generations of Genetically Improved Farmed Tilapia (GIFT) produced in India

Innovation description

A fully pedigreed genetic improvement program for Genetically Improved Farmed Tilapia (GIFT) has been established in India. GIFT germplasm was supplied to WorldFish’s partner in the genetic improvement program, the Rajiv Gandhi Center for Aquaculture (RGCA), in 2011, 2014 and 2016. Considering 2011 as generation zero (G0) in India, the RGCA has now produced 41 families of generation 8 (G8) in 2020 and 27 families of generation 9 (G9) in 2021. The GIFT have been re-selected to be faster-growing, hardier and more disease-resistant.

Context

India is the second-most populous country, fifth-largest economy and third-largest fish producer in the world. Approximately 69% of Indians consume fish, and demand for fish is expected to reach 22 million metric tons by 2024 to 2025. Inland aquaculture is expected to play a growing role in fish production for both domestic and export markets, with Indian major carps, minor carps, pangasius and other catfish dominating production over the past few decades. However, the government is looking to diversify farmed species for increased farm productivity, profitability, farmer resilience and consumer affordability—a task well suited for GIFT.

Innovation journey

WorldFish and partners are supporting the Government of India to disseminate GIFT, focusing on delivery of continued genetic improvements in growth rate under local conditions and appropriate distribution strategies of quality fingerlings and broodstock, to ensure gains are properly managed and maintained into the future. Phase I of the collaboration (2011–2016) saw the establishment of the RGCA’s Satellite GIFT Breeding Program in India, achieving an average genetic improvement for body weight at harvest of 8% per generation while



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Genetic (variety and breeds)

Technical field

Fish breeds and genetics

Stakeholders

- Government of India, Ministry of Commerce and Industry, Marine Products Export Development Authority, Rajiv Gandhi Centre for Aquaculture

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maintaining an acceptable accumulated rate of inbreeding and effective population size. Phase II of the collaboration (2019–2023) has already seen the development of India's GIFT dissemination plan targeting production of 2.4 million metric tons of tilapia by 2030, a policy change that allows tilapia farming by smallholders (>0.05 acre) and, using the mating list and design provided by WorldFish, production of 41 families of G8 GIFT to be used for future breeding. Between 2016 and 2020, the RGCA produced and distributed about 31 million monosex GIFT fry to 5253 licensed farmers across 18 states and 22,248 mixed-sex GIFT broodstock to 4 private and 5 public hatcheries across India. Additionally, other hatcheries distributed about 4.4 million monosex GIFT fry to 728 farmers.



The future

Successful establishment, breeding efforts and dissemination of GIFT by the RGCA's Satellite GIFT Breeding Program have helped increase aquaculture productivity, incomes, and food and nutrition security. Encouraging private sector investment and strengthening public-private partnerships, for example in state government-approved private hatcheries accessing GIFT germplasm from the RGCA, are fundamental to scaling these benefits to fish farmers and value chain actors across India.

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Photo credit: Anbinda Mahapatra/WorldFish

Introduction of Genetically Improved Farmed Tilapia (GIFT) in Odisha State, India

Innovation description

The Genetically Improved Farmed Tilapia (GIFT) strain of Nile tilapia (*Oreochromis niloticus*) was introduced for the first time in Odisha State, India. The production and management system were defined and set up for starting GIFT production at a larger scale in Odisha.

Context

Despite access to vast water resources, Odisha State has lower inland fish production but higher per capita fish consumption than other states in India. Addressing this discrepancy requires large imports of freshwater fishes from neighboring states, but malnourishment is still common. With the goal of developing a sustainable aquaculture and fisheries sector in Odisha that creates employment, stimulates inward investment and reduces malnutrition among vulnerable and marginalized communities, the ambitious Odisha Fisheries Policy 2015 was introduced. In 2016, WorldFish signed a memorandum of agreement with Odisha's Fisheries and Animal Resources Development Department to support implementation of this policy. This included five programs, one of which was to introduce GIFT.

Innovation journey

Introducing GIFT—a high yielding, hardy and low-cost fish variety—in Odisha State was accomplished in two stages. Between 2018 and 2020, farm demonstrations of GIFT were held in 40 ha of ponds belonging to 100 farmers across 17 districts. This pilot built confidence among government officials, farmers, fish traders, consumers, feed manufacturers and other value chain players on the potential of GIFT for crop diversification and as an affordable fish option. After this successful pilot, the Government of Odisha approved investment in a state-of-the-art GIFT Multiplication Center and Hatchery at the government fish seed farm in Kausalyaganga, Bhubaneswar, to produce 5 million monosex GIFT seeds



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Fish breeds and genetics

Stakeholders

- Falcon Marine Exports Limited
- Government of India, Ministry of Commerce and Industry, Marine Products Export Development Authority, Rajiv Gandhi Centre for Aquaculture
- Government of Odisha, Fisheries and Animal Resources Development Department

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annually. To promote market-driven GIFT production by farmers, the financial support scheme for GIFT farm demonstrations was gradually withdrawn, and in 2021 a total of 257 farmers began farming GIFT from seed produced at the government GIFT Multiplication Center and Hatchery. Additionally, a scheme to establish GIFT hatcheries by private hatchery operators and entrepreneurs was introduced in 2021 to scale the availability of quality GIFT seed in Odisha State.



The future

Introduction and scaling of GIFT in Odisha State has improved fish productivity, fish consumption and dietary diversity, access to necessities, and incomes. This program has supported further efforts in Odisha State to achieve [self-sufficiency in quality fish seed production by 2025](#) and [promote overall aquaculture development](#), as well as the development of favorable policies and a national strategy for GIFT dissemination across India.

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Southeast Asia and the Pacific





Photo credit: Alex Tilley/WorldFish

Coral Triangle (CT) Atlas database portal built upon open-source geospatial solutions to enable its sustainability

Innovation description

The Coral Triangle (CT) Atlas is an open-source online database that provides spatial data on the CT. This database aggregates region-wide data to provide an overview of the natural resource and socioeconomic status of the CT. This innovation will support management planning and decision-making across political boundaries, allowing for an ecosystem approach to fisheries and marine resource management. Layering spatial data also provides the building blocks for spatial decision support systems for marine conservation planning, while building a regional plan of action (RPOA) around monitoring and evaluation allows for a common set of indicators comparable across geographies.

Context

The CT is 4 million square miles of ocean and coastal waters surrounding Indonesia, Malaysia, Papua New Guinea, the Philippines, Timor Leste and Solomon Islands. This area has one of the most diverse coral reef systems in the world, with at least 485 coral species, 1019 fish species and several large marine vertebrates. Mangrove forests are distributed in the surrounding areas, providing food and wood for surrounding communities, as well as a marine habitat and nutrient cycling. These marine and coastal resources provide food, income, recreation and culture to the 360 million residents of the CT, with particular regard to the 120 million residents who live on coastlines.

The CT is central to the livelihoods of residents, yet almost no information is available on rates of extraction, development-related activities or general ecological status. Given the relative rate of economic growth from direct harvesting, sale of coral reef resources, logging, mining and expansion of tourist-related activity and urban development, a growing body of evidence suggests that the maximum sustainable rate of extraction has been reached or exceeded. Despite the estimated sustainable production capacity estimated at 11,150—13,800 t the annual catch level is estimated at 18,000 t.



Contribution to impacts

Environmental health & biodiversity

Type

Research and communication methodologies and tools

Technical field

Sustainable small-scale fisheries

Stakeholders

- International Union for Conservation of Nature
- The Nature Conservancy
- Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security

Contact

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The Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF) provides guidance for the sustainable management of coral reefs and related ecosystems in these waters. In 2007, this program was launched as a multilateral partnership of the governments surrounding the Coral Triangle to address the overexploitation of the coral reef fisheries. The actions taken by this program address conservation, natural resources, and food security.

Innovation journey

In 2009, leaders of the six CT countries met for a summit to sign the declaration launching the Coral Triangle Initiative and endorse the RPOA. This involved creating and developing the CT Atlas. The CT Atlas is an online GIS database that provides spatial data on fisheries, biodiversity, natural resources and socioeconomics. By synthesizing available regional data into a single place, the database provides the most complete and current data available and reduces duplicate data collection, allowing for a focus on filling in the gaps.

The CTI-CFF innovation manages an independent CT Atlas database to provide government bodies, nongovernmental organizations (NGOs) and researchers with spatial data. The portal has been developed and improved with the integration of the CTI-CFF monitoring and evaluation framework that provides updates to the system for continuous improvement and development. In 2019, the CT Atlas 2.0 was given its own domain to replace the WorldFish global ReefBase database and began independent donor management. Training for the CTI-CFF team on continued updates to the portal ran throughout the life of the project.

The future

Monitoring and evaluation is built into the CTI-CFF RPOA, creating a long-term plan for measuring progress toward achieving indicators. The RPOA has five goals: (1) priority seascapes designated and effectively managed, (2) an ecosystem approach to the management of fisheries and other marine resources fully applied, (3) marine protected areas established and effectively managed, (4) climate change adaptation measures achieved, and (5) threatened species status improved. These goals are paired with specific targets and indicators for measuring progress, and datasets with the progress of these goals are provided on the database to provide open-source insight into the impacts that have been made.

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Photo credit: Holly Holmes/WorldFish

Gender-inclusive sustainable livelihood diagnostic tool

Innovation description

Development projects seek to make livelihoods for fishers stronger and better, but practically doing this requires more insight. Poorly integrated initiatives that do not consider the context or community lead to inefficient efforts that do not make the changes or improvements intended. Alternatively, participatory processes enhance existing strengths, livelihoods and practices to improve the way people live their lives. This method requires community action and involvement to create opportunities and pursue ideas while receiving support to make the necessary changes and investigate the pitfalls and challenges to these ideas.

Context

In Southeast Asia and Melanesia, a significant number of people rely on coastal ecosystems for their nutrition and livelihoods. As populations increase and communities develop, there is increased pressure on fisheries and marine resources to both feed populations and sustain livelihoods. Declining numbers of key fish species are already a concern due to fishing pressures, and malnutrition is persistent. In order to tackle these challenges, prioritizing key populations like women and youths is key.

Interventions that are externally designed often miss the context and capacity available in community settings, limiting the ability for success. Using a participatory approach can better incorporate the needs, ideas and challenges that communities face, thus creating a higher chance for success. It is difficult, however, to quickly consider the risks, benefits and obstacles of turning an idea into a program. This innovation uses a set of guidelines and processes to answer questions that arise during the participatory process. This tool offers guidance and structure to those leading a participatory process in five different areas: natural resources, equipment, skills, markets and finances.



Contribution to impacts

Gender equality, youth & social inclusion

Type

Research and communication methodologies and tools

Technical field

Sustainable small-scale fisheries

Stakeholders

- The Pacific Community
- University of Wollongong
- Locally Managed Marine Area Network
- James Cook University

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Innovation journey

The intention of this innovation is to build from the ideas and solutions from community members, rather than trying to integrate top-down initiatives. This has been done through participatory processes and has been applied in several communities. Beginning in 2016, projects in Timor-Leste, Solomon Islands and Zambia have focused on prioritizing women community members through their ideas. Participatory processes have provided women's groups in Timor-Leste with support to create a small business enterprise in preserving sardines. In Solomon Islands, women in the Rokotanikeni Women's Association have used participatory processes to share responsibilities and set financial targets for solar-powered freezers for perishable foods. In 2019, [participatory action research in Zambia](#) led to improved opportunities for women in post-harvest fish processing activities, and created social change in the attitudes of men by highlighting gender norms and power relations. Learning and testing from WorldFish programs in Timor-Leste and Solomon Islands created the guideline document "[A new idea for coastal fisheries: Asking the right questions to enhance coastal livelihoods](#)," published in 2019. This document and the accompanying learning and testing programs seek to enhance fish-based livelihoods by prioritizing simplicity and building off existing strengths in communities.



The future

Across Southeast Asia and the Pacific Islands, it is crucial to enhance fish-based livelihoods and continue strengthening coastal fisheries management. This innovation seeks to deliver research and development that will help communities to be better prepared for the future. Ongoing research and innovation in this area involve food and nutrition security, sustainable fisheries management, and building the capacity and resilience of coastal communities. By creating a tool that allows for community collaboration and idea sharing, innovations are more likely to have community backing and support, thus creating a lasting impact.

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Photo credit: Olivier Joffre/WorldFish

Re-creation of generation 17 of Genetically Improved Farmed Tilapia (GIFT) in Vietnam

Innovation description

Established in 1988, WorldFish's Genetically Improved Farmed Tilapia (GIFT) project has researched a way to breed a faster growing strain of Nile tilapia (*Oreochromis niloticus*). Researchers established a systematic breeding method that would benefit both small-scale and commercial aquaculture. In the GIFT process, selective breeding has chosen broodstock that will improve the performance of the next generation of tilapia. GIFT proved to improve the growth rate of tilapia and made them more resilient. These traits allow fish to reach a size appropriate for harvesting faster and be more resistant to disease. GIFT has been developed to be fast growing and adaptable to a wide range of environments, making it lucrative for fishers globally.

Context

Millions of people throughout Vietnam rely on aquatic resources for nutrition and employment. The fisheries sector is the third-largest sector in the country and is increasing for both capture and culture fisheries. However, due to overfishing in both marine and inland fishing areas, fishing activities are declining, and the competition for resources is high. In this context, the introduction of a faster growing, more resilient strain of farmed fish is a worthwhile concept.

GIFT and GIFT-derived strains account for 17% of tilapia production in Vietnam. As generations of GIFT are bred, genetic improvements continue, leading to better performance, improved feed efficiency, tolerance to low dissolved oxygen conditions, and faster growth rates. They are also more resilient to tilapia lake virus (TiLV), a virus that causes skin damages, erosion, discoloration, abdominal swelling and eventually death. This is particularly concerning for farmers, as up to 90% of tilapia with TiLV die once infected. Genetic variation in TiLV resistance is independent from genetic variation of growth, suggesting that any breeding of GIFT that produces fish resistant to TiLV will not affect the growth of the fish.



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Genetics (variety and breeds)

Technical field

Fish breeds and genetics

Stakeholders

- The Pacific Community
- University of Wollongong
- Locally Managed Marine Area Network
- James Cook University

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Innovation journey

The goal of this innovation was to recreate Generation 17 (G17) of the developed GIFT in Vietnam. This was to ensure good genetic variation and provide updated and concise information regarding TiLV. In 2020, 83 G17 families were produced, and 74 families were tagged with 70 fish each. In the grow-out process, 2500 fish were harvested belonging to 73 of the families. Of this, 112 fish from 58 families were tested for TiLV and all were negative, suggesting viability of the recreated G17 population.



The future

Fish is a good source of micronutrients and protein, making it a worthwhile addition to diets, particularly for children. With wild fishstocks declining from increasing consumption and unsustainable practices, selective breeding for aquaculture was investigated as a solution. Tilapia serves as an ideal candidate for genetic improvement because of its ability to thrive in diverse farming systems and variable water quality. GIFT strains improve in their genetic qualities with each generation bred, leading to increased production, lower prices for consumers and increased consumption. WorldFish continues to research the possibilities for improvement of GIFT strains. This includes research regarding tolerance to salinity, disease and cold temperatures. The continued research and improvement of GIFT strains have helped improve food and nutrition security in countries across the globe.

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Southeast Asia and the Pacific

Cambodia





Integrating nutrition and gender into community fish refuge-rice field fisheries system management: A practitioner's guide for interventions in Cambodia

Innovation description

In Cambodia, new knowledge and a guide have been developed to bridge the gap between paddy fisheries production and community-level benefits, in particular, maternal and child health and nutrition as well as the co-leadership of men and women. The guide describes the phases and process of integrating nutrition and gender activities in the management of rice paddy fisheries and the community fish refuge (CFR), and the obstacles to the implementation.

Context

Food and nutrition insecurity continues to be a significant challenge in Cambodia. Many rural families engage in paddy fishing for subsistence and to supplement their livelihoods. Paddy fishing, carried out mainly during the flood season, represents a source of income, food and nutrition.

The creation and management of CFRs represent an effective way to enhance fish productivity and biodiversity. The CFRs are natural or human-made ponds that retain water throughout the year and provide a refuge for hatchery fish during the dry season. Sustainable management of CFRs, through habitat enhancement and protection from fishing, can increase fish populations in rice fields, thereby improving access to fish for local families and the consumption of high-nutrition foods in geographically malnourished areas.

Recognizing the value of these CFRs, the Royal Government of Cambodia has been promoting their establishment and management since 2005.

Innovation journey

To promote the contribution and interests of women in rice field fisheries, a guide was published in 2021: "Integrating nutrition and gender into community fish refuge-rice field fisheries system management: A practitioner's guide."



Contribution to impacts

Gender equality, youth & social inclusion

Type

Production systems and management practices

Technical field

Fish in multifunctional landscapes

Stakeholders

- Akphivath Neary Khmer Organization
- Trailblazer Cambodia Organization
- The Village Support Group
- Cambodian Organization for Women Support

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The guide, released in [English](#) and [Khmer](#) versions, is publicly available for uptake by practitioners or implementers working in rice field fisheries in Cambodia or elsewhere. The guide outlines the phases and the process of integrating nutrition and gender activities into the management of paddy fisheries and the CFR, and the obstacles to implementation and enabling factors for these activities.



The future

Fisheries management continues to be male-dominated. The integration of nutrition and gender equality interventions with rice paddy fisheries management activities has the potential to improve food security and nutrition outcomes, particularly for women and children.

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Citation

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Co-management of community fish refuges (CFRs) to enhance fish production, water security and adaptive capacity to climate change in Cambodia

Innovation description

Community fish refuges (CFRs) are a form of stock enhancement or a fish conservation measure to improve the productivity of rice-field fisheries within rice-dominated multifunctional landscapes. The CFR is a refuge, or sanctuary, for broodfish that is protected from fishing year-round and is especially important as fish habitat during the dry season in seasonally inundated rice fields. During the dry season, fish remain in deeper pools that become disconnected—the CFRs—but emerge during the flood season to breed and feed throughout the rice fields.

Context

Cambodia's rain-fed and flooded rice fields are productive sources of inland fish and other aquatic animals, including frogs and snails, and provide 30% of total inland production. These aquatic resources are important to millions of Cambodians, especially those in rural areas, with key contributions to food and nutrition security, income generation and biodiversity, particularly as rice field fisheries are open-access resources in Cambodia. Rice field fisheries are a safety net for many rural families in the face of climate change, agricultural failures and income insecurity. Despite this apparent richness, poverty and malnutrition (32% of children under 5 years old are stunted) remain unacceptably high. Social and geographic disparities in the availability and accessibility of aquatic foods increase the likelihood of these deficiencies in vulnerable groups, including women and children.

Innovation journey

Fish and rice are the backbone of Cambodian diets, particularly in rural areas. Small, micronutrient-rich fish species are crucial, especially when consumed fresh and whole. Inland fish conservation efforts, such as well-managed CFRs, can help secure wild fish populations, and thus are key to national food and nutrition security. In 2015, well-managed CFRs were



Contribution to impacts

Nutrition, health & food security

Type

Production systems and management practices

Technical field

Fish in multifunctional landscapes

Stakeholders

- Ministry of Agriculture, Forestry and Fisheries, General Directorate of Agriculture
- United States Agency for International Development

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shown to increase the annual average fish catch by the poorest 20% of households by 71%. A total of CFRs have been established in Cambodia, each managed by a trained committee, increasing fish catch (30%) and the proportion of children under 5 eating small fish (50%) in just 1 year. The Government of Cambodia now officially supports scaling of CFRs to enhance fish production, water security and adaptive capacity to climate change, and has included CFRs in [Cambodia's 10-year Strategic Plan for Fisheries Conservation and Management](#). In partnership with the fisheries administration, WorldFish developed a [best practices manual](#) for CFR management covering the selection, design and improvement of CFRs. Overall, CFR management interventions and tailored nutrition activities have contributed to over 6000 farmers applying improved technologies and management practices through CFRs, economic benefits for over 365,000 people (37% women), over 213,000 people (52% women) consuming more fish at home (including small fish eaten whole), almost 21,000 children under 5 years old (49% girls) reached with nutrition-sensitive interventions, and consumption of diets of minimum diversity for 43% of direct beneficiary women of reproductive age and 54% of children.

The future

Rice is grown in more than half the countries in the world with a total harvested area of about 158 million ha, of which about 80 million ha is irrigated lowland rice. These landscapes are commonly managed only for rice, but there is much greater potential for integrated rice-fish systems to contribute to global food system transformation, leading to increased incomes, resilience, and availability of nutritious aquatic foods where they are most needed. Success requires (i) approaches suited to local contexts, (ii) a strong evidence base to inform policy and planning, (iii) governance platforms for integrated, ecosystem-based, cross-sector planning, (iv) effective multiscale stakeholder engagement, (v) targeted rice-fish system innovations coupled with governance and institutional capacities for their adoption, and (vi) strong state, civil society and community networks and partnerships.

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Southeast Asia and the Pacific

Myanmar





Garden-irrigation systems and water and fish (WISH) artificial ponds for fish production in Myanmar

Innovation description

Research has explored novel solutions for using small water bodies for fish production on smallholder farms in Myanmar. Innovations focused on two types of water bodies: (i) garden-irrigation systems and (ii) water and fish artificial ponds lined with tarpaulin, called WISH ponds. These novel solutions are a viable option for fish culture in Myanmar with important contributions to poverty reduction and food and nutrition security, while increasing efficiency and productivity of water systems.

Context

Increases in farmed area and productivity have contributed to the 9% annual growth of aquaculture production in Myanmar since 2004. Aquaculture is important in meeting domestic fish demand, especially as malnutrition remains high, but lags behind capture fisheries production, even as fishstocks decline. Overall, aquaculture development in Myanmar is constrained by unclear land tenure, lack of a comprehensive aquaculture information base, limited proven management approaches and technologies for scaling suitable innovations, and a poorly developed domestic market. One of the most striking features of Myanmar's aquaculture sector is the apparent absence of a vibrant small-scale aquaculture subsector, which has been disproportionately constrained by land use policy despite significant potential to contribute to local and regional livelihoods and nutrition.

Innovation journey

In Myanmar, WorldFish and partners have worked to better understand the adoption of small-scale aquaculture, sustainability of aquaculture investments and scaling of innovations. For this purpose, appropriate small-scale aquaculture technologies were introduced in Myanmar's Ayeyarwady Delta and Central Dry Zone, namely the incorporation of small indigenous fish species with carp or tilapia. This was supported



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- Group for Research and Technology Exchanges
- Livelihoods and Food Security Fund
- Network Activities Group
- PACT

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through capacity building, upgrades to government fish hatcheries, the introduction of Genetically Improved Farmed Tilapia, the establishment of small feed mills and seed nurseries, and the development of pond technologies.

Participatory research with farmers showed that fish production could be substantially increased using available, yet unused, water resources—*chan myaung* (homestead irrigation channels) in rural areas and WISH ponds (artificial ponds lined with tarpaulin) in urban areas—as compared to existing earthen ponds. WISH ponds show particular value in the drought-prone sandy soils of the Central Dry Zone, but both systems have considerable potential as sources of nutritious food and additional household income across Myanmar. In fact, the adoption of both systems has delivered positive impacts on fish production, leading to improved nutrition and incomes for over 3500 households, as well as indirect benefits for 10,000 households through increased awareness, knowledge and sharing.



The future

WISH ponds and *chan myaung* leverage currently unused water resources to effectively increase fish production, with associated impacts on direct consumption, income generation and wider accessibility of fish. These and other contextualized pond technologies have great potential across Myanmar to improve and diversify livelihoods and diets, especially for resource-poor households. To achieve this, complementary efforts are needed to optimize the economic efficiency of small-scale aquaculture systems in each context, revise land use policy, and improve access of fish value chain actors to formal credit, quality and affordable seed and feeds, and infrastructure (e.g. roads, electricity, water control, human capital, extension and veterinary services).

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Photo credit: Manjural Karmy WorldFish

Contextualized better management practices (BMPs) for tilapia hatcheries in Myanmar

Innovation description

Better management practices (BMPs) for hatcheries, based on learning from field experiences, have been developed in Myanmar. A BMPs manual, in both English and Burmese, was published to provide guidelines for tilapia breeding and all-male fry production to support the sustainable intensification of tilapia production systems in Myanmar.

Context

Despite fish being the most important source of animal protein in Myanmar, about one-third of the children suffer from chronic malnutrition. Aquaculture provides only a small proportion of the total fish consumed due to localized production, relatively high prices, difficult logistics and high losses in post-harvest management.

The Myanmar Sustainable Aquaculture Programme (MYSAP) aims to strengthen sustainable aquaculture management in selected areas of Myanmar to improve household nutrition, livelihoods, health, income and security for direct beneficiaries and have other impacts on indirect beneficiaries by making aquaculture fish more readily available in local markets.

This requires the adoption and implementation of BMPs for hatcheries, especially for Genetically Improved Farmed Tilapia (GIFT).

Innovation journey

The implementation of BMPs for hatcheries in Myanmar is customized to local needs and materials and includes guidance on pond preparation, seed selection, transportation and breeding, feed, water quality, fish health, harvesting, post-harvest management and marketing.



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- Deutsche Gesellschaft für Internationale Zusammenarbeit
- Ministry of Agriculture, Livestock and Irrigation, Department of Agriculture (MOALI-DOA)

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In 2020 the “Practical training manual for the tilapia breeding and all-male fry production” was published to support the intensification of tilapia production systems in a sustainable way. The manual has also been translated into Burmese and is available for adoption in Myanmar hatcheries. It represents a reference for hatchery training activities in Myanmar.

In April 2020, 8000 all-male GIFT seeds were sent to a MYSAP Inland nursery farmer to support satellite nurseries and nursery farmers. To encourage BMPs, a protocol was determined with WorldFish disease specialists for testing disease pathogens from GIFT satellite nurseries.

The future

Reaching millions of fish farming households with the introduction of BMPs can provide an improvement in terms of household nutrition, livelihoods, health, income and security for direct beneficiaries and indirect beneficiaries by making aquaculture fish more readily available in local markets.



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Photo: credit: WorldFish

Improved small-scale smoking technology for rohu smoking in Myanmar

Innovation description

The FAO-Thiaroye Processing Technique (FTT), a proven fish smoking technology that originated in Africa and was later introduced to Asia and the Pacific, was adapted to the specific local conditions of Myanmar. Specific construction steps and a guide, both in English and Burmese, were produced for the operation and testing of the FTT smoker.

Context

Despite fish being the most important source of animal protein in Myanmar, about one-third of children suffer from chronic malnutrition. The Myanmar Sustainable Aquaculture Programme (MYSAP) project aims to strengthen sustainable aquaculture management in selected areas of Myanmar to improve household nutrition, livelihoods, health, income and security for direct beneficiaries and have other impacts on indirect beneficiaries by making aquaculture fish more readily available in local markets.

Fish preservation and processing are key elements in achieving these objectives. In particular, hot smoking adds value to rohu (*Labeo rohita*) in Myanmar and is an effective method of fish preservation. "Smoking" is a process of treating fish by exposing it to smoke from smouldering wood or plant materials. During the hot smoking process, fish is exposed to an appropriate combination of temperatures for sufficient time to completely coagulate the proteins in the fish flesh. This process is generally sufficient to kill parasites and destroy bacterial pathogens. However, traditional smoking kilns tend to be inefficient, costly to operate and labor-intensive.

Under the MYSAP project, the FTT was introduced in Kale Township, Sagaing Region of Myanmar, modifying the design to fit the local availability of construction materials.



Contribution to impacts

Nutrition, health & food security

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- Ministry of Agriculture, Livestock and Irrigation Myanmar
- Deutsche Gesellschaft für Internationale Zusammenarbeit
- European Union, European Commission
- Department of Fisheries Myanmar

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Innovation journey

Improved FTT smokers have been constructed and tested in Kale Township, Sagaing Region. The FTT was designed to reduce smoking time and the amount of fuel used.

Two fish processors in Myanmar's Kale Township were supported in constructing FTT kilns and testing the quality of their smoked products. The trial results demonstrated that FTT smokers created products with a superior taste, as determined through sensory evaluations, had high outputs and produced significantly lower greenhouse gas emissions while exposing workers to less smoke.

In 2021, the "Guide for the construction of improved FTT smoker in Myanmar" and the "FTT smoker operation and testing protocol guidelines" were published online, both in English and Burmese. These are illustrated guides, with diagrams and photographs, that describe how to use locally available construction materials in Myanmar to construct an FAO-Thiaroye FTT improved fish smokers for satellite nurseries.

The future

Hot smoking is an effective method of fish preservation. It can improve family nutrition, livelihoods, health, income and security.

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Photo credit: Finn Thilsted

A novel mixed-method approach to climate change vulnerability assessments for fish production systems in Myanmar

Innovation description

The “Participatory rural appraisal: Vulnerability study of Ayeyarwady Delta fishing communities in Myanmar and their social protection opportunities” document was created based on a vulnerability study (VA) developed by WorldFish to interrogate the key vulnerabilities faced by fishers. The VA was created to inform fisheries management about hazards and vulnerabilities in the fisheries sector. The VA was designed to assess “contextual” vulnerability, meaning it approaches socioeconomic conditions and institutional processes contributing to vulnerability, which relies on stakeholder input.

Context

Myanmar is already facing the effects of climate change, with increased average temperatures, changing rainfall patterns, and shorter summer monsoon seasons. Future projections of climate change show an increase in temperature between 1.3 and 2.7 degrees Celsius by 2050, with an increase in the number of days with extreme heat. Rainfall is also expected to increase, along with sea level rise.

In 2012, the government of Myanmar developed a National Adaptation Plan of Action for climate change. It aimed to strengthen adaptive capacities in the fisheries sector, enhance critical adaptation practices, develop and apply adaptation models to strengthen resilience, and disseminate knowledge, training, and adaptation practices. Under the FishAdapt project, WorldFish was tasked with designing a VA to understand exposure to hazards and impacts. This VA and following set of adaptation plans are part of component one of the FishAdapt project, with a methodology developed to assess the vulnerability of fisheries at the regional and national level.

Innovation journey

WorldFish was tasked to “identify national and regional sector priorities and gaps in support of VA methodology design under the FishAdapt



Contribution to impacts

Climate adaptation & mitigation

Type

Social science

Technical field

Fish in multifunctional landscapes

Stakeholders

- Food and Agriculture Organization
- Department of Fisheries Myanmar
- Ministry of Agriculture, Livestock, and Irrigation
- Department of Agriculture

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project.” In consultation with stakeholders, three key issues were highlighted: non climate drivers, sector priorities have potential to impact one another, and responses/adaptation requiring an integrated, multisector response. Considering these issues, the team decided on a modified AR5 IPCC 2014 Risk Assessment Approach. The strategy of this innovation was to assess and understand current vulnerability at different scales. This strategy allows for science-based, cross sector and participatory data, and will impact development, planning and new adaptation practices.

In 2019, the methodology was designed and approved by the Food and Agriculture Organization (FAO). The scope of the Risk Assessment was expected to be conducted in three fisheries subsectors: inland fisheries, inshore fisheries and aquaculture. Scale was determined at a national level through the collection of data at a sub-national level. Thus, data analysis was conducted at the state/regional level. The vulnerability and risk assessment was planned to be used at 5-year intervals. Piloting of the VA commenced in early 2020 with the intention of scaling to three states and regions in Myanmar. Once piloted, the tool was ready for uptake from managers in the fisheries and aquaculture sector in 2020.

The future

Fishing and farming communities in Myanmar already face threats from nature that increase vulnerability. Floods, droughts, crop disease and storms have increased due to climate change, and current regulations and policies do not protect small-scale fishing communities. The intention of this innovation is to understand the links between poverty, social protection and natural resource management. By understanding how these aspects are interconnected, there is the possibility to implement programs to empower rural communities facing vulnerability by providing tools and strategies for sustainable natural resource management and poverty reduction. The objectives of this assessment are to reduce rural poverty by underscoring social protection systems that could be improved, provide information to advise on policy, and provide advocacy and engagement to improve social protection systems, improving capacity development, rural development, poverty reduction and nutrition security.

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Digital applications as aquaculture extension support in Myanmar: Providing information and connection for those along the fish value chain

Innovation description

Mobile technologies are quickly becoming a way to advance the potential of human well-being. Communication and information-sharing technologies have the potential to assist rural and small-scale fishers by providing a network to improve access to information. In Myanmar, new information and communication technologies (ICT) include mobile applications that supply farmers with information, updates, policy information and connections to other fish supply chain members.

Context

In Myanmar, fish accounts for 60% of the animal-sourced food in diets. In communities that rely on small-scale fishers the fishers are often characterized as the poorest, rural and marginalized groups, yet play a key role in the livelihoods and nutrition of communities. Simultaneously, fishstocks are declining due to unsustainable practices and a lack of access to information. It is necessary to develop a sustainable fishing industry in order to meet the demand for fish and minimize potential environmental impacts.

ICT provides a way for fish and aquaculture farmers and supply chain actors to access information, problem-solve and connect. The mobile applications launched in Myanmar provide a platform for members of the aquatic food value chain to learn about new fisheries policies, nutrition and food safety, and better management practices, and communicate with other value chain actors, leading to more food-safe fish and fish products being available at local markets.

Innovation journey

Two new mobile applications have been developed for use to strengthen the fisheries and aquaculture-based food systems in Myanmar. These apps have been designed to deliver information to any farmer with a mobile phone signal or internet. The Greenway app was designed with a local ICT



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Research and communication methodologies and tools

Technical field

Aquaculture systems

Stakeholders

- United States Agency for International Development
- Single Spark
- Department of Fisheries, Myanmar
- International Development Research Centre
- Unit for Social and Environmental Health
- Interdisciplinary research group at Chiang Mai University

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company and is based on a previous app for agriculture and livestock. This app alters farmers, localized weather forecasts. It also delivers messages about sourcing inputs, market prices, trends and potential climate risks. By 2018, the app was in use by over 1000 farmers. As part of the launch of this application, the Department of Fisheries and the private sector Myanmar Fisheries Federation received training in the use of the application. As of March 2020, the total number of registered users was up to 212,945.

The Shwe Ngar (Golden Fish) app was created to disseminate information on fish feed, fish health and aquaculture technologies. The application also provides basic information regarding human nutrition, water sanitation and hygiene practices, as well as serves as a platform for fish farmers, suppliers, traders and buyers to connect. The app also provides a feed calculator to formulate fish feed recipes with local ingredients. The app was launched on the 13th of October 2020.

The future

The vision of these mobile applications is to be a simple way for farmers to handle their daily needs. Small-scale farmers are often at the whim of uncertainty. By providing a simple technology that provides timely and relevant information and connects farmers and other value chain actors, it may be possible to mitigate some of that risk. Further, by providing information on best management practices, farmers can adapt and prepare for the evolution of the fisheries industry. Specific objectives focus on strengthened aquaculture market systems and increased adoption and awareness of nutrition-related behaviors. Digital solutions are an opportunity to reach more people and support Myanmar's most vulnerable communities that rely on fish for household nutrition and income.

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Photo credit: Majaika Samkhin Sogaard/WFP

Social, political, environmental and technical adjustments for viability of rice-fish systems in Myanmar

Innovation description

Integrated rice-fish farming has existed for thousands of years with successful symbiosis between fish, rice and the surrounding environment. In the current context, integrated rice-fish systems use existing rice paddy fields with wetland and aquatic habitats during seasonal flooding. Natural flooding allows wild aquatic species to populate using the nutrients and organic material from the rice fields. Rice-fish farming uses water and land resources more efficiently, maintains biodiversity, and reduces the need for chemical fertilizers and pesticides. Despite this, integrated rice and fish production is not as prevalent, particularly as compared to intensive farming practices and monoculture. Potential benefits of rice-fish farming include increased income per land area, improved nutrition security and sustainable livelihoods.

Context

In the country of Myanmar, rice farming covers 8 million ha of land, and large swaths of this land have water access during the monsoon season. Paddy land productivity and profitability in Myanmar are low compared to the rest of Southeast Asia, suggesting that improved land and water use could improve food production. Particularly in the Ayeyarwady Delta, floodplain river-connected areas offer high viability for the introduction of rice-fish systems.

This type of innovation seeks to optimize fish production systems, reduce inefficiencies in value chains, optimize resource use, and increase and incorporate fish into the diets of mothers, infants and young children. Innovative rice-fish systems offer improved natural resource management and increased biodiversity, which improves the yield of cultured fish and increases the number of aquatic animals available. In Myanmar, one in three children is stunted and there is a high prevalence of micronutrient deficiencies. By increasing the number and species of fish available, it is possible to increase the diversity of food and nutrients available.



Contribution to impacts

Nutrition, health & food security

Type

Production systems and management practices

Technical field

Fish in multifunctional landscapes

Stakeholders

- International Rice Research Institute
- Ministry of Agriculture, Livestock, and Irrigation Myanmar
- International Water Management Institute

Contact

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Michael Akester (M.Akester@cgiar.org)

Innovation journey

By 2019, experimental and demonstration site trials had been conducted in the Ayeyarwady Delta of Myanmar. The research data collected as a result of these sites was compiled and published. These demonstration sites showed that when the rice cultivation area is reduced by 13% to accommodate the introduction of fish, rice production increased by 6%. This is due to the improved management practices accompanying rice-fish systems. The information created by the pilot study contributed to policy decisions regarding policy and land use barriers, allowing for rice-fish innovations to increase in scale. The [Naypyitaw land-use reform agreement](#), created in 2018, approved a reduction in rice fields by 15% to integrate fish. The [results from these trial plots](#) encouraged the Myanmar government to continue the promotion of rice-fish systems in 2019, particularly in the “rice basket” area of Ayeyarwady.

With encouragement from the Myanmar government and research from experimental plots compiled and published, scaling was considered feasible. In 2020, nine new rice-fish sites in Myanmar were established in a limited context. The potential for scaling continues to be monitored, and conversation surrounding best practices and potential barriers continues to take place.

The future

Myanmar is experiencing a shift from intensive monoculture to diversified production. However, economic inequality and nutrition are still important factors to consider, as malnutrition and micronutrient deficiencies are still pervasive problems in poor and rural communities. Further research on the benefits of rice-fish farming could provide policymakers with the evidence necessary to facilitate further encouragement of integrated farming. Not only could rice-fish farming improve rice yields and fish production in Myanmar, but it could also shift the farming mindset to one of improving management practices for a holistic conservation approach that is better for the fisher and for the environment.

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Southeast Asia and the Pacific

Timor-Leste





Contextualized better management practices for Genetically Improved Farmed Tilapia (GIFT) in Timor-Leste

Innovation description

Better management practices (BMPs) for Genetically Improved Farmed Tilapia (GIFT) in Timor-Leste were developed based on learning from Farmer Field Schools and demonstration ponds, including empirical evidence from elsewhere. A contextualized BMPs manual was published, in both English and Tetum, in partnership with the Timor-Leste Ministry of Aquaculture and Fisheries to provide guidelines for sustainable intensification of tilapia production systems and serve as a handbook for aquaculture technicians and practitioners, nongovernmental organizations and the private sector.

Context

Combating poverty and malnutrition has been a top priority of the government in Timor-Leste since acquiring independence in 2002. Aquaculture development has been identified by the government as key for improving food and nutrition security as well as augmenting income of inland and coastal households. The [National Aquaculture Development Strategy for 2012-2030](#), developed by the Ministry of Agriculture and Fisheries with assistance from WorldFish, sets development goals and strategies for promoting aquaculture to increase domestic availability and consumption of fish. In alignment with this, research on BMPs for GIFT, developed under the CGIAR Research Program on Fish Agri-Food Systems (FISH) with a bilateral investment from the Ministry of Foreign Affairs and Trade from New Zealand, has been pivotal. These BMPs have been developed at the global level and contextualized at the country level to support sustainable GIFT farming.

Innovation journey

Starting in 2016, WorldFish, in partnership with the Ministry of Agriculture and Fisheries, conducted on-farm trials of GIFT farming using BMPs. The practices were tested and validated by over 250 farmers in Ermera, Baucau and Bobonaro municipalities through a group-based participatory



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- New Zealand Ministry of Foreign Affairs and Trade
- Timor-Leste Ministry of Agriculture and Fisheries

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approach known as Farmer Field School, under the [Partnership for Aquaculture Development in Timor-Leste](#) project. The BMPs manual for GIFT in Timor-Leste was developed based on learning from these Farmer Field Schools and demonstration ponds, including empirical evidence from Bangladesh, Cameroon, DR Congo, Egypt, Ghana, India, Malawi, Myanmar and Zambia.

The BMPs for Timor-Leste, available in Tetum and English, aim to enhance the capacity of grow-out farmers and extension service providers to support sustainable scaling of GIFT for improved food and nutrition security and rural livelihoods. They detail a range of on-farm practices, including pond design and management, seed selection, feed management, water quality, post-harvest handling, and marketing. The 257 farmers that continue to follow the BMPs report increased total production and productivity, from 1.2 t/ha/cycle to 4.3 t/ha/cycle with potential to produce up to 7.0 t/ha/cycle. This has directly contributed to their household food and nutrition security and income. In August 2019, the BMPs were endorsed by the Ministry of Agriculture and Fisheries at the [2nd National Aquaculture Forum](#) and are now widely used by all stakeholders involved in promoting tilapia aquaculture in Timor-Leste.

The future

Fish farming was a new enterprise for most Timorese farmers, and its introduction in crop-livestock-based farming systems has increased agro-ecological and social resilience, total production and productivity. Fish sold by farmers has also extended access to and availability of fish to other consumers. These outcomes directly contribute to household food and nutrition security as well as income generation and diversification. Fish farmers have expressed strong interest in expanding and intensifying GIFT production, which requires continued efforts to scale successful GIFT farming innovations, including improved farming clusters, feed, seed and market linkages.

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Public-private partnership model for a Genetically Improved Farmed Tilapia (GIFT) hatchery for scaling aquaculture in Timor-Leste

Innovation description

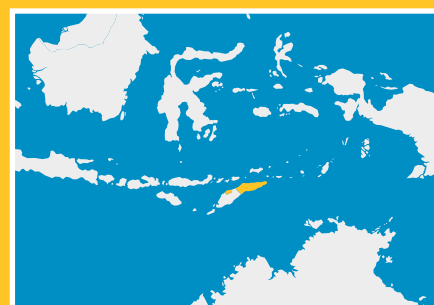
Improving accessibility and availability of quality seed is a prerequisite for scaling aquaculture in Timor-Leste. The first public-private partnership (PPP) model hatchery, regulated by a public and private stakeholder agreement, was established in Leohitu in western Timor-Leste. This has helped narrow the supply-demand gap for seed and demonstrated the role of the private sector in national scaling of aquaculture.

Context

Combating poverty and malnutrition has been a top priority of the government in Timor-Leste since acquiring independence in 2002. Aquaculture development has been identified by the government as key for improving food and nutrition security as well as augmenting income of inland and coastal households. The [National Aquaculture Development Strategy for 2012-2030](#), developed by the Ministry of Agriculture and Fisheries with assistance from WorldFish, sets development goals and strategies for promoting aquaculture to increase domestic availability and consumption of fish. Driven by a locally tested and proven [aquaculture approach](#) as well as better access to quality [Genetically Improved Farmed Tilapia \(GIFT\)](#) seed, increasing numbers of rural households in Timor-Leste have begun farming fish. However, demand for quality GIFT seed has outpaced supply. Improving accessibility and availability of quality seed is a prerequisite for scaling aquaculture in Timor-Leste.

Innovation journey

GIFT was introduced in Timor-Leste in 2015 when WorldFish shared broodstock with a government hatchery in Gleno. In response to the supply-demand gap for GIFT seed, a [PPP model GIFT hatchery](#) was established in Leohitu in 2019 by the We Lekun company and the Ministry of Aquaculture and Fisheries. The hatchery uses broodstock from Gleno to produce over three million monosex GIFT fingerlings throughout the



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Other

Technical field

Aquaculture systems

Stakeholders

- New Zealand Ministry of Foreign Affairs and Trade
- Timor-Leste Ministry of Agriculture and Fisheries

Contact

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year—enough to supply the needs of 300 fish farmers in Timor-Leste while prioritizing farmers and nurseries in the local community. The government and WorldFish continue to provide technical support. The hatchery has greatly improved access to quality GIFT seed and demonstrated the role of the private sector in scaling aquaculture in Timor-Leste. This model was also replicated in Lospalos, a city in the eastern part of the country, which began operating in 2020.

The future

The PPP model in GIFT seed production and dissemination is helping Timor-Leste achieve its National Aquaculture Development Strategy targets, including increasing fish supply from aquaculture and per capita consumption of fish. Additionally, other non-governmental organizations in the country have been able to connect communities in need with the PPP model hatchery to address poverty and malnutrition. The partnership between the private sector, government and community has led to a sustainable hatchery model that is now being replicated across Timor-Leste, with expectations that four PPP model hatcheries (Leohitu, Parlamento, Hera, Colocao) will produce over 10 million fingerlings annually by 2023.



Photo credit: Jharedu Pant/WorldFish

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Photo credit: Octavian Lopes/WorldFish

PeskAAS: Big data technology and systems to improve small-scale fisheries management in Timor-Leste

Innovation description

A digital catch documentation system combined with tamper proof, solar powered trackers provides near real-time small-scale fisheries production and effort information to government fisheries managers in Timor-Leste on a decision dashboard using open-source software.

Context

Approximately half of global fish catch is landed in small-scale fisheries, but massive data gaps on this catch and associated contributions to food and nutrition security and livelihoods inhibit evidence-based decisions-making regarding these resources. The integrated data pipeline for small-scale fisheries, **PeskAAS**, was developed by WorldFish in Timor-Leste in response to this need for information. Like many countries, especially in Asia, where more than 80% of the small-scale fishing fleet is active, the Government of Timor-Leste had only a patchy understanding of numbers of active boats, fishing locations and type of catch. This was mainly due to limited funding and historical prioritization of farming above fishing. However, fish was highlighted in the [National Strategic Development Plan \(2012-2030\)](#) as a critical resource in combating severe malnutrition in the country, so new data systems for the fishery were required.

Innovation journey

WorldFish scientists worked with government fisheries officers to develop a digital catch reporting system that could gather fisheries landings information from remote sites around the country in near real-time. In partnership with Pelagic Data Systems, WorldFish also began to gather high resolution spatial information about the fishery and fishing behavior using 500 vessel tracking devices involving 5000 fishers, providing much more accurate measures of relative fish abundance in space and time. The combination of these two datasets through **PeskAAS** allowed for the first calculation of national fisheries production including small-scale fisheries.



Contribution to impacts

Environmental health & biodiversity

Type

Research and communication methodologies and tools

Technical field

Resilient coastal fisheries

Stakeholders

- Bioersity International
- CGIAR Platform for Big Data in Agriculture
- International Institute of Tropical Agriculture
- Pelagic Data Systems
- Timor-Leste Ministry of Agriculture and Fisheries, National Directorate for Fisheries and Aquaculture
- Wilderlab

Contact

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In May 2019, the Government of Timor-Leste announced the launch of PeskAAS as the [official national monitoring system](#), and the National Directorate for Fisheries and Aquaculture hired 11 dedicated fisheries landings enumerators, one per municipality. The transparent co-creation of PeskAAS was essential for building local ownership of the system, and greatly enhances its sustainability.

Timor-Leste now has one of the most sophisticated data collection systems for small-scale fisheries in the world. Its national fleet is currently limited to small-scale vessels in territorial waters (<12 km from coast), covering an area of [15,690 km²](#), all of which is [under improved fisheries management](#) informed by PeskAAS. The system has already highlighted previously unknown fishing areas, patterns and productivity in Timor-Leste, and has been particularly valuable through the COVID-19 pandemic to visualize effects of movement restrictions and market closures on food production and livelihoods in coastal areas.

The future

PeskAAS, which had previously been donor-funded and supported by Pelagic Data Systems, was [fully adopted by the Government of Timor-Leste in 2021](#), with 13 paid full-time field enumerators and uptake of the commercial contract with Pelagic Data Systems. The government has allotted USD 150,000 of the national budget to ensure sustainability of the system moving forward. As the official fisheries national monitoring system of Timor-Leste, outputs from PeskAAS will help guide the sustainable use of fishery resources that influence the livelihoods of small-scale coastal fishers and national food and nutrition security. They will inform national annual fisheries statistics provided to the Food and Agriculture Organization and development of specific fisheries management plans for high value species.

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Photo credit: Jharendu Pant/WorldFish

Contextualized better management practices (BMPs) for monosex tilapia seed production in Timor-Leste

Innovation description

Better management practices (BMPs) for producing high-quality Genetically Improved Farmed Tilapia (GIFT) monosex seed were developed to support the scaling of fish farming to contribute to food and nutrition security in Timor-Leste. These simple and low-cost methods and recommendations, including biosecurity, have been tested and proven over 5 years of research and development in Timor-Leste.

Context

Since its independence, the government in Timor Leste has set poverty reduction and malnutrition as major priorities. The development of aquaculture has been identified by the government as crucial for improving food and nutrition security and increasing the income of inland and coastal households.

The National Aquaculture Development Strategy (NADS) for the period 2012-2030, developed by the Ministry of Agriculture and Fisheries (MAF) with the assistance of WorldFish, sets out objectives and develops strategies to promote aquaculture and increase fish availability and consumption. In line with NADS, the BMP research for GIFT, developed under the CGIAR Research Program on Fish Agri-Food Systems (FISH), played a key role in addressing key aspects of aquaculture development.

Innovation journey

BMPs were launched by the Minister of Agriculture and Fisheries at the 2nd National QA Forum held in Dili on August 8, 2019 and were identified as an important extension resource for governmental and nongovernmental organizations (NGOs) that train and provide support to fish farmers.

BMPs for producing high-quality GIFT monosex seed were developed to support the scaling of fish farming in the country.



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- Ministry of Foreign Affairs and Trade (New Zealand)
- Timor-Leste Ministry of Agriculture and Fisheries

Contact

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In 2020, these were published as “Better management practices for monosex tilapia seed production: An illustrated guide,” which is available in both Tetum and English. The guideline is available for adoption and is intended as a resource for governments, international / NGOs and private sector actors involved in tilapia seed production and grow-out systems in Timor-Leste and more widely in tropics across the Asia Pacific region.



The future

The adoption of new BMPs by farmers can provide an improvement in nutrition, food security and family health, making aquaculture fish a crucial element.

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Photo credit: Octavio Soares Lopes/WorldFish

Fish powder for new livelihood opportunities for women in Timor-Leste

Innovation description

Women's groups in different villages of Timor-Leste had the idea to make a fish-based powder. The fish-based powder consists of fish, moringa leaves, dried shrimp, roasted sesame seeds, onion powder, salt, pepper, sugar, oil and cooked chilli. Having previously received training in fish-based powder production, these women decided to utilize their existing skills. Fish-based powder represents a new opportunity to improve women's and families' livelihoods.

Context

Alleviating poverty and reducing the high rates of malnutrition, particularly among women and children, are some of the main challenges for Timor-Leste.

The country's natural resources have the potential to improve the living conditions of families and, in particular, fish and seafood represent a key source of income and nutritious food for many families. The consumption of locally acceptable, nutrient-rich fish powder contributes to improving the quality and diversity of diets for all family members.

Innovation journey

In Timor-Leste, WorldFish has been doing research with communities for many years, training local women on making fish-based powder.

Thanks to the participatory approach, the women decided in 2018 to build on these existing skills. The idea to make fish-based powder came from the women themselves. The women's groups learned to use local ingredients to develop new food products like nutrient-rich dried fish powder, creating new business opportunities and providing nourishment in rural communities.



Contribution to impacts

Gender equality, youth & social inclusion

Type

Production systems and management practices

Technical field

Resilient coastal fisheries

Contact

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The project has been replicated across the country and, currently, women groups in different villages in Timor-Leste are preparing recipes with nutritious powder and have started selling the products to several markets.

The powder also provides a way to extend the shelf life of fish, which is highly perishable and cannot reach domestic markets due to a lack of hygienic storage and poor transportation conditions.

Following an analysis of the nutrients in fish powder, a dialogue was recently initiated with the Ministry of Health about getting the fish powder into the feeding programs of primary schools and hospitals.

The future

The introduction of fish powder can be a key tool to alleviate poverty and reduce high malnutrition rates, particularly among women and children, while creating new livelihood opportunities for women.



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Photo credit: Alex Tilley/WoRldfish

Nearshore fish aggregating devices (FADs) for food and nutrition security and distributive justice in Timor-Leste

Innovation description

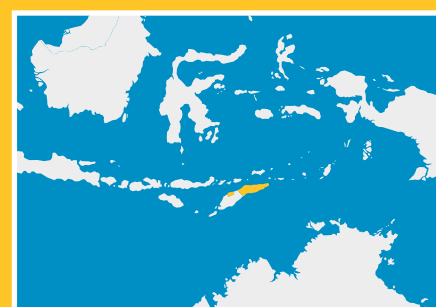
Small-scale fisheries in small island developing states rely on coral reef habitats for their livelihoods and nutrition. Yet coastal development and overfishing degrade coral reefs, creating vulnerability for fishers and decreasing natural resources and benefits. This is particularly true in communities where there are limitations to resources available, such as boats and fishing gear. Fish aggregating devices (FADs) have been used in the Pacific to make the pelagic stock more accessible to small-scale fishers. In these contexts, FADs have improved catch rates, which has improved livelihoods, and the reduction of dependence on coral reef environments has improved biodiversity and reef degradation.

Context

Timor-Leste is ranked 10th on the Global Hunger Index and has a high prevalence of stunting and chronic malnutrition. Communities in Timor-Leste also face challenges with micronutrient deficiency, as many lack a diverse diet. Mitigating this malnutrition is high priority, as addressing health, particularly within the first 1000 days of life can address population and health and overall well-being.

Fish production and farming is a crucial resource for island economies by providing jobs and diversifying livelihoods. In addition, fish is a high-quality animal protein that has high qualities of micronutrients and Omega-3 fatty acids. However, increasing development has exploited maximum sustainable levels of fishing, leading to a decrease in fisheries production, particularly as artisanal and small-scale fishers rely on coral reef systems for their food source. Additionally, despite high participation in the fisheries sector, fish consumption is low compared to neighboring island countries at an average of 6.1 kg per capita as compared to 20.2 kg per capita.

Anchored FADs are objects deployed in the ocean to attract fish. These anchored FADs attract pelagic fish, making it easier for fishers in small



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Resilient coastal fisheries

Stakeholders

- Ministry of Foreign Affairs and Trade (New Zealand)
- Timor-Leste Ministry of Agriculture and Fisheries

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boats to find them. This allows fishers to spend less time fishing and transfers fishing efforts from coral reefs to FADs attracting oceanic fish, making them a practical and efficient way to improve local food security and reduce pressure on reefs by making oceanic fish more available.

Innovation journey

In Timor-Leste, communities have traditionally built their own FADs out of bamboo. It was hypothesized that enhancing FAD technology could increase the productivity of small-scale fisheries while contributing to food security by increasing the production rate of fish within a smaller time period. FADs were deployed, and by 2019 three out of four early trial sites had proved a higher catch rate and return investment. Catch rates are significantly higher for FAD fishing than any other habitat area, and catch species diversity is significantly lower, with most of the FAD fishing comprising small-bodied, semi-pelagic mackerel.



The future

FADs provide an alternative to fishing bans or closed fishing areas that would limit the short-term catch and income of local fishers. Response to new FAD technology has been positive, with other communities in Timor-Leste expressing interest in employing similar systems and techniques. Continued work with these communities and in Timor-Leste allows WorldFish to further disseminate FAD technology and improve opportunities for local fishers. This innovation also allows for local governments to take the reins regarding the future of their populations. General Directorate of Fisheries officers in Timor-Leste were trained in constructing and deploying FADs and are now in control regarding any further deployments.

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Africa

Eastern and Southern Africa

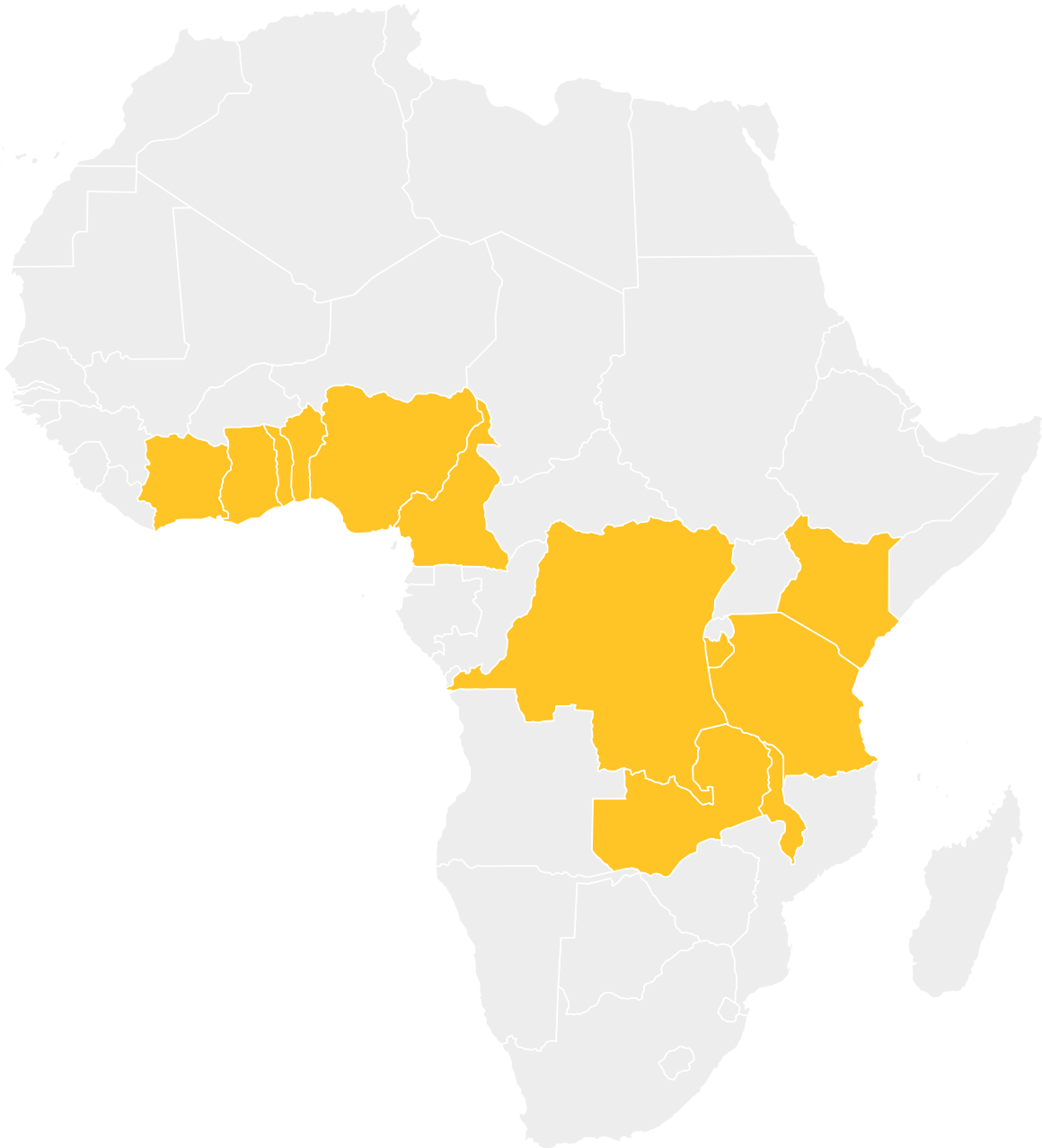




Photo credit: Babina Mujib/WaterFish

Methodologies and training techniques defined to support the delivery of extension to farmers for the production and management of monosex tilapia

Innovation description

New knowledge, methodologies and training techniques have been developed and are available to assist practitioners and other trainers in facilitating and providing improved technologies to tilapia breeders to achieve profitable results. Training materials have been packaged for hatchery and nursery staff to acquire the knowledge and skills needed to run a successful hatchery operation.

Context

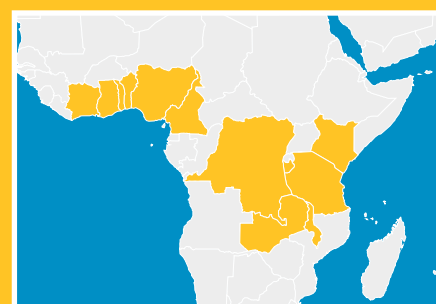
The CGIAR Research Program on Fish Agri-Food Systems (FISH) led by WorldFish is developing better management practice (BMP) guidelines at the global level and contextualized BMP resources at the country level to support sustainable farming of Genetically Improved Farmed Tilapia (GIFT) in WorldFish focal and scaling countries.

Fish breeders and growers often face many challenges in tilapia production, including lack of access to quality fish seed, high mortality of fry and fingerlings, and lack of knowledge about fish health management in hatcheries. The adoption of BMPs is crucial to improving fish production, contributing to food security and reducing poverty and malnutrition.

Innovation journey

In 2021, a new manual, titled “[Extension manual on monosex tilapia production and management](#),” with new knowledge, methodologies and training techniques was published and made available to assist extension workers and other trainers in facilitating and delivering improved technologies to tilapia farmers.

The manual can contribute to (i) enhancing knowledge on broodstock selection, management and artificial breeding methods, (ii) acquiring experience of BMPs in a hatchery for increased productivity, (iii) building



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- International Institute of Tropical Agriculture
- Forum for Agricultural Research in Africa
- Institute of Agricultural Research for Development
- National Agricultural Extension and Research Liaison Services
- Ahmadu Bello University

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entrepreneurial skills in business plan development for a sustainable hatchery venture, and (iv) learning skills on how to share knowledge with other hatchery operators and fish farmers in their respective areas for increased tilapia production.

The future

Tilapia (*Oreochromis niloticus*) is a good candidate species for breeding to increase fish production in domestic and global markets, although the early sexual maturity and prolific nature of tilapia often result in stunted growth, becoming a major obstacle to realizing the full potential of tilapia breeding.

The improvement of knowledge and methods through the adoption of a specific manual can contribute to enhancing the productivity of tilapia, increasing farmers' income and improving food (fish) security and nutrition.



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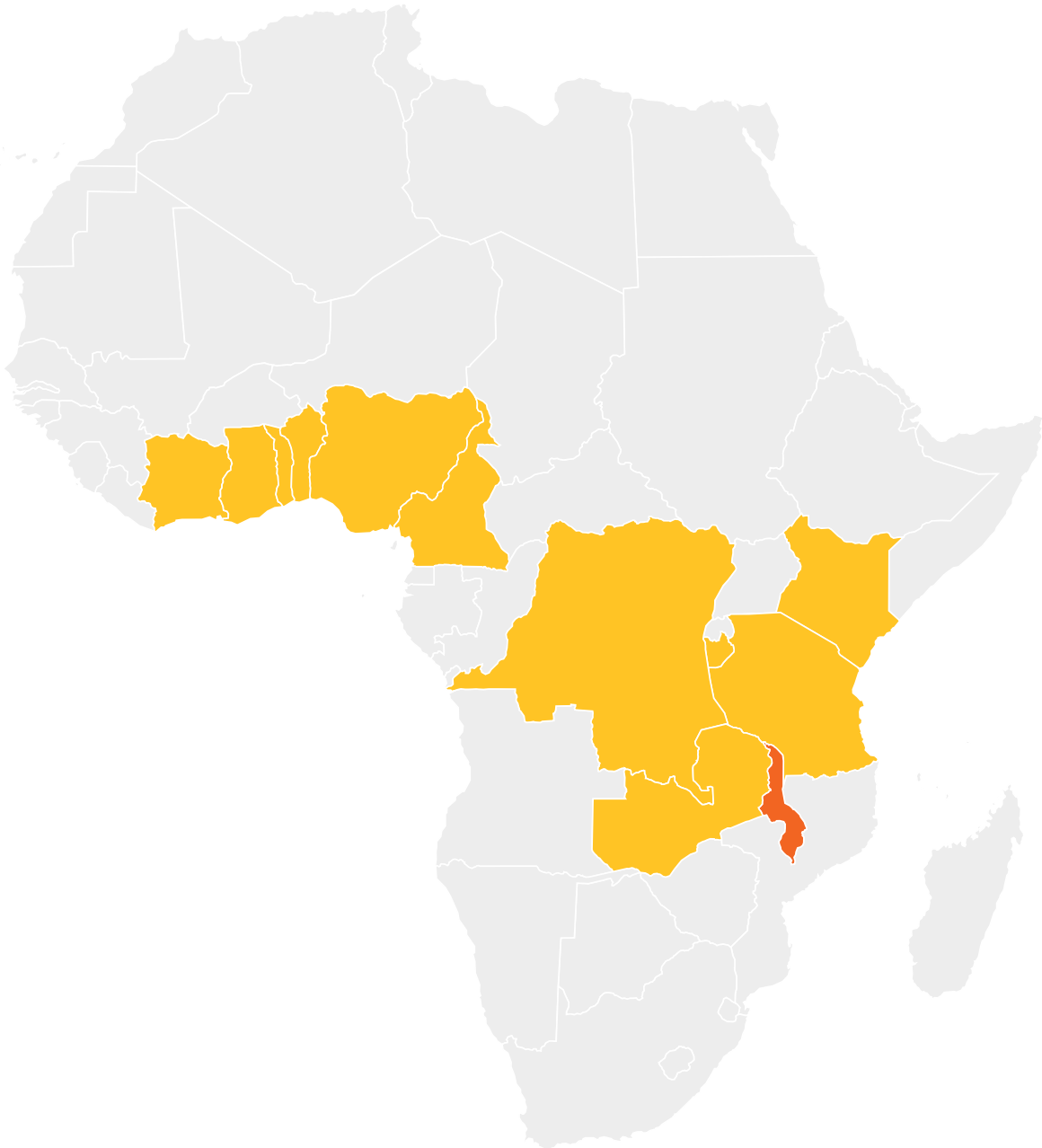
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Eastern and Southern Africa

Malawi





Contextualized better management practices (BMPs) for smallholders farming tilapia in pond-based systems in Malawi

Innovation description

Better management practices (BMPs) for smallholders farming tilapia in pond-based systems in Malawi were developed based on learning from field experiences, including empirical evidence from elsewhere. A BMPs manual was published to provide guidelines for sustainable tilapia production systems in Malawi and to serve as a handbook for aquaculture technicians/practitioners from different stakeholders such as (international) nongovernmental organizations (NGOs) and private sector.

Context

Fish farming in Malawi started in 1906 with the introduction of rainbow trout (*Onchorhynchus mykiss*) for sport fishing. More recently, Malawi has shown growth in the aquaculture sector, to the extent that the country produces 5% of the fish grown in the Southern African Development Community (SADC) region. This contributes to poverty reduction and improved food security in the country.

The Fisheries Conservation and Management Act (1997) outlines how fisheries and aquaculture are governed in Malawi. The introduction of BMPs can lead to a significant improvement in the whole aquaculture sector.

Innovation journey

Field experiences have led to the dissemination of BMPs in the Malawi aquaculture sector. In 2021, a BMPs manual, "Better management guidelines for smallholder fish farmers in Malawi," was published both in [English](#) and [Malawi](#) versions.

This manual is a comprehensive guide to managing a tilapia hatchery. It includes tips on site selection, site preparation, hatchery design and construction, rearing practices (broodstock management, spawning, sex reversal, hormone feed preparation and feeding), fingerling collection



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- Deutsche Gesellschaft für Internationale Zusammenarbeit;
- Norwegian Agency for Development Cooperation

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and marketing, biosecurity and fish health management, good farm management practices and record keeping, all of which are critical to a successful tilapia hatchery operation. It is available as a handbook for aquaculture technicians/practitioners from different stakeholders, such as INGOs, NGOs and the private sector.

The future

BMPs can lead to a significant improvement of the entire aquaculture sector in Malawi, contributing to poverty reduction and improved food security in the country.



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Better management guidelines for smallholder fish farmers in Malawi. <https://hdl.handle.net/20.500.12348/5070>

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Citation

This publication should be cited as: Ceccarelli V and Cullhaj M. 2022. Contextualized better management practices (BMPs) for smallholders farming tilapia in pond-based systems in Malawi. Penang, Malaysia: WorldFish.



Photo credit: Randall Bummery/WorldFish

Gender-sensitive financing mechanism for the fisheries sector in Malawi

Innovation description

While women in Africa are involved in the fish value chain at many points, their limited access to capital, skills and technologies is a barrier to being part of the formal fish-related business. This innovation seeks to provide new financial mechanisms for women by providing access to loans. These loans are targeted toward women in the fisheries sector and consider interest rate, seasonality of fish production, and credit risk assessment specifically for the fisheries sector.

Context

African aquatic food systems employ over 20 million people, yet there is little information about the nature of the work women do with small-scale fishery value chains, particularly in Malawi. Women are intrinsically part of the dynamics in fishing communities and often play key roles in fish processing and marketing. These roles often generate supplemental income to support their households. Despite this, their role in decision-making and leadership is very limited, and they often face exploitation at various points in the fisheries value chain.

Adoption of good capital-intensive strategies is a challenge, particularly for women and youths. This is partially due to challenges that negatively affect engagement in small-scale value chains like gender discrimination. Women are often not provided the information or capacity development to overcome the constraints of formally engaging with the fisheries process. Barriers to financial capacities and information result in exclusion and restrict women's access to a number of inputs and resources.

Innovation journey

The innovation strategy aims to promote financing products from commercial banks and microcredit firms. This involves establishment of Village Savings and Loans Associations (VSLAs) to increase savings and



Contribution to impacts

Gender equality, youth & social inclusion

Type

Social science

Technical field

Fish in multifunctional landscapes

Stakeholders

- University of Malawi
- FDH Bank Malawi
- Fisheries Research Institute, Malawi

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sustainable investment culture. The innovative financing system requires that individuals work in group to provide peer support in repayment of loans. This innovation also seeks to address environmental factors that will support the financial packages, including sociocultural norms. Using gender-transformative tools, the innovation seeks to promote positive change in gender dynamics by critically examining gender roles, norms and power dynamics.

This innovation was developed in consultation with stakeholders and potential users. In 2019, negotiations with FDH Bank Limited, the financing institution, were concluded. The financing mechanism was approved by the senior management of FDH Bank, and many beneficiaries opened bank accounts, fulfilling one of the requirements for accessing financing.



The future

This strategy provides several potential approaches and methods to overcome barriers. The intention is to increase the number of formal actors in the fisheries value chain and the volume of processed fish as a result. In addition to promoting women to have more control of their livelihoods, this strategy also involves communication systems to disseminate the work of gender-transformative approaches to increase participation of women and youths by transforming the current power structures and their inherent inequities.

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Photo credit: Asatu Chijere/Woodliff

Malawi Gold Standard Aquaculture Production System

Innovation description

While fish farming has a long history in the country of Malawi, the smallholder aquaculture sector has immense potential for growth. Historically, Malawi has relied on capture fisheries from inland water bodies. This practice has declined due to the lack of availability of wild-caught fish despite increasing demand. Despite ongoing innovations, problems in the value chain limit the ability of farmers to have success in freshwater pond culture, particularly with limited hatcheries capable of producing and rearing quality fingerlings. Improvements in the practices of Malawian fish farmers could create a new supply of healthy fish for income and consumption, and this innovation could reach new users who do not currently have the capacity to become part of the aquaculture value chain.

Context

Aquaculture production of smallholders in Malawi is extensive and characterized by inbred and cross-bred tilapia species fed with maize and kitchen waste. These practices result in low yields of fish at smaller sizes, contributing to low farm income. Because of this, fish production is currently practiced as a secondary income generation activity behind other more productive practices. The primary limitations to sustainable aquaculture growth are a lack of quality inputs and low financing for investment and working capital. Despite this, there is still high demand for farmed fish.

Fish provide vital nutrients and protein for families and children and are the main source of animal food available. Micronutrient deficiencies are an existing problem on Malawi at a rate of 37%, and 25% of child deaths are related to undernutrition. Pond-based aquaculture systems could replace the existing fish practices with sustainable, market-oriented fish production that increases income generation for communities.

The objective of the Gold Standard innovation is to support the development of Malawi's aquaculture sector to increase the production and availability of fish and fish products from small and medium-sized



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Fish breeds and genetics

Stakeholders

- United States Agency for International Development
- University of Malawi
- Deutsche Gesellschaft für Internationale Zusammenarbeit
- Ministry of Agriculture Irrigation and Water Development, Department of Fisheries

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aquaculture businesses. This innovation particularly focuses on small-scale farmers and early adopters. Farmers can learn about farm complexities from consultations as well as learn among themselves through comparison of farm data and exchange. From these innovative guidelines, farmers will develop their capacity for aquaculture production and business planning.

Innovation journey

In 2020, the Malawi Gold Standard Aquaculture Production System was developed. In this document, eight training modules were developed in the following categories: (1) introduction to fish farming and production systems, (2) fish farming technologies and practices, (3) site selection, designing and construction of fishponds, (4) selective breeding and fingerling production practices, (5) pond stocking and restocking, (6) fish feeds and feeding, (7) fingerling handling and transportation, and (8) identification and management of fish diseases and parasites.



The future

Supporting aquaculture and small-scale hatcheries could be an effective way to implement change in the aquaculture production system of Malawi. In developing the country's aquaculture sector, food security has the potential to improve, developing resiliency for both current situations and future times of climate change shocks. This will ensure nutrition is available to more people and income for fishing communities is bolstered.

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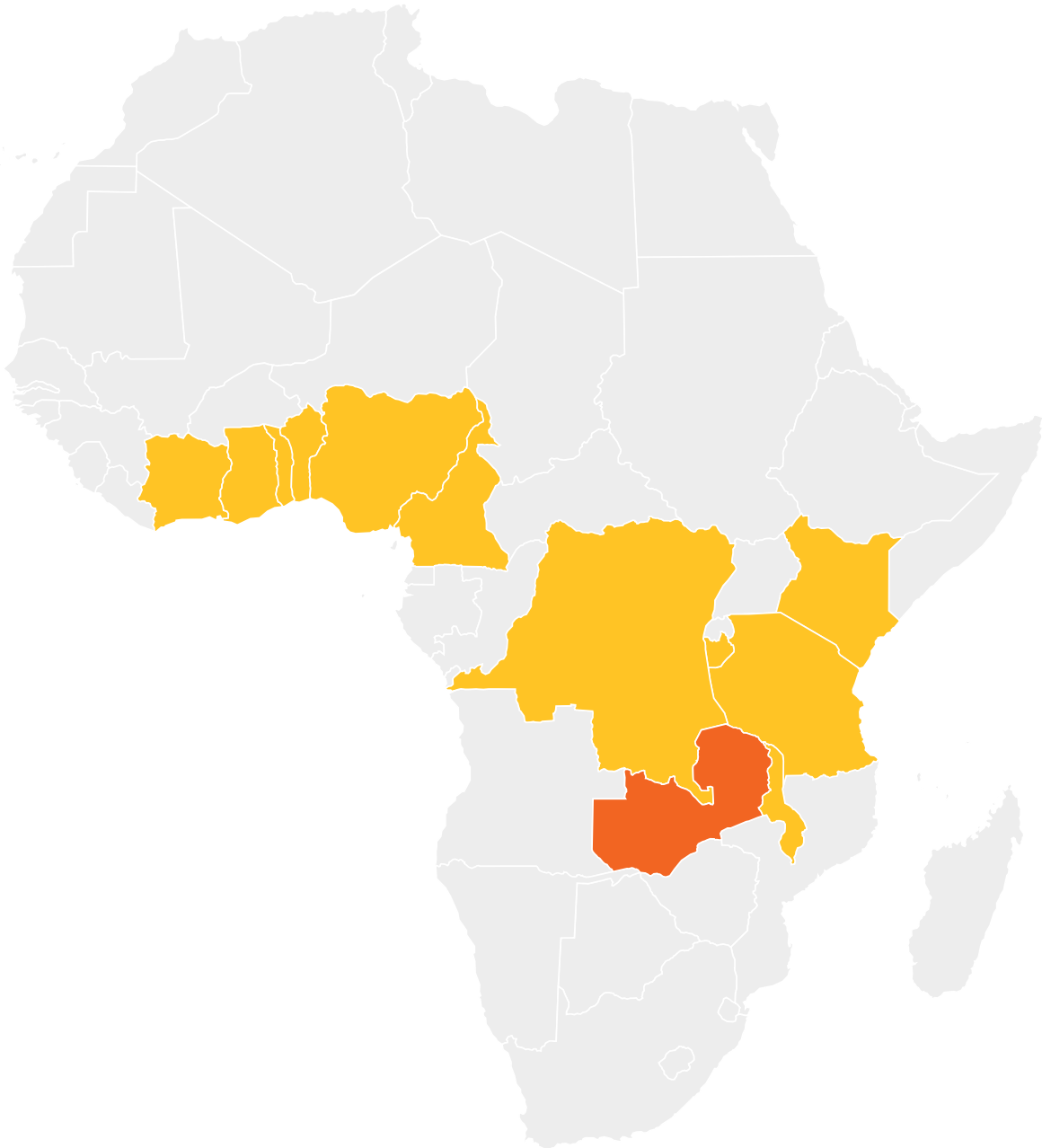
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Eastern and Southern Africa

Zambia





Contextualized better management practices for Genetically Improved Farmed Tilapia (GIFT) in small-scale pond-based systems in Zambia

Innovation description

Better management practices (BMPs) for smallholders in Zambia farming Genetically Improved Farmed Tilapia (GIFT) in pond-based systems were developed based on learning from Farmer Field Schools and demonstration ponds, including empirical evidence from other countries. The [contextualized BMPs manual](#) provides guidelines for sustainable intensification of GIFT farming in Zambia and serves as a handbook for aquaculture technicians and practitioners from international and nongovernmental organizations, the private sector and other stakeholders.

Context

In recent years, aquaculture in Zambia has been crucial to reducing the large fish deficit caused by declining yields from capture fisheries and rapid population growth. This was mainly achieved by medium and large commercial cage farms for tilapia on lakes Kariba and Tanganyika. Small-scale farms continue to produce mainly for home consumption and profits are low, exacerbated by a recent decline in production and productivity. The main factors constraining aquaculture development include access to feeds, training, quality seed, extension services and capital. As such, efforts are needed along the aquaculture value chain to deliver sustainable and profitable pro-poor, gender- and youth-responsive market services to smallholders, including the provision of inputs and technologies, output marketing opportunities and extension, vocational training and technology transfer.

Innovation journey

Under the [Aquaculture Technical Vocational and Entrepreneurship project](#), WorldFish supported the development of aquaculture knowledge and practical skills of students and small-scale fish farmers, especially women and youths, participating in technical education, vocational and entrepreneurship training. Researchers found that building the capacity



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- BluePlanet
- International Crops Research Institute for the Semi-Arid Tropics
- International Food Policy Research Institute
- International Institute of Tropical Agriculture
- Musika Development Initiatives
- Natural Resources Development College

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of small- to medium-sized enterprises is a suitable way to transfer new technologies and knowledge to smallholders, especially since they provide employment for 88% of Zambia's population. Thus, capacity development initiatives targeted small- to medium-sized aquaculture enterprises (e.g. feed companies, hatcheries, fish traders) that would disseminate training and extension services to smallholder fish farmers, notably including the contextualized BMPs manual.

The BMPs manual focuses on tilapia culture in pond-based systems, with modules on farm preparation, farm operation, post-harvest management, business and training, and is tailored to the conditions and needs of smallholders in Zambia. More than 800 farmers have adopted these BMPs to improve productivity and profitability of small-scale tilapia farms, and the manual has contributed to harmonizing aquaculture training in Zambia, with six companies (feed millers: Aller Aqua Zambia Limited, Novatek Animal Feed Limited, Zhonkhai International; fish breeder: Kasakalabwe, Hope Ways; off-taker: Triple Blessings Centre) already using the BMPs as a basis for capacity building in Zambia.



The future

Northern Zambia's growing small-scale aquaculture sector offers new opportunities to improve food and nutrition security and livelihoods. When farmers have access to extension services, knowledge and resources, they invest in their farming business and diverse actors along the value chain can reap the benefits. The full potential of rural smallholder farms can be realized through investment in partnerships, especially between smallholders and the private sector, key inputs, like quality seed and feeds, and services, including training, extension services and market linkages, along value chains.

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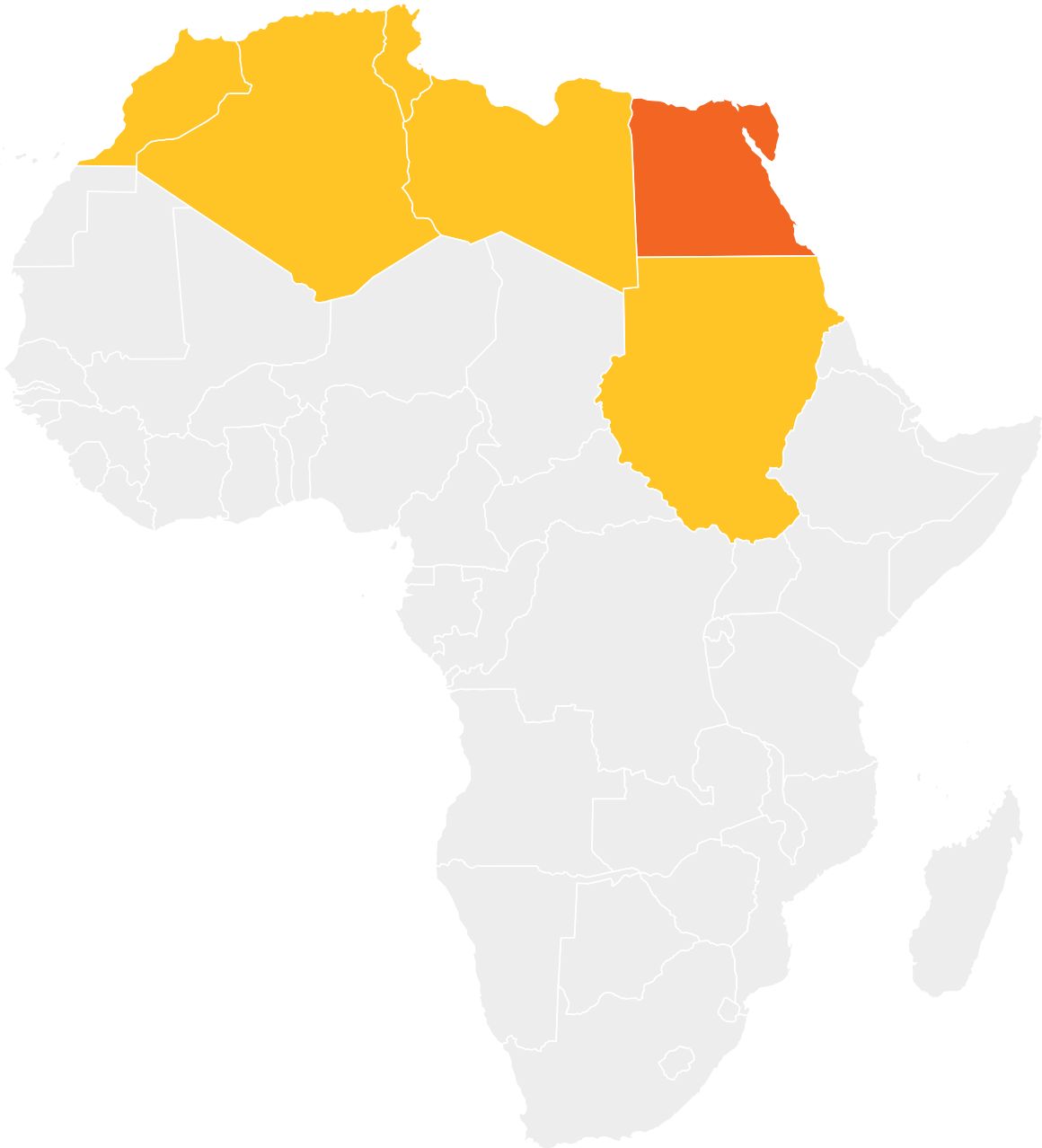
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North Africa

Egypt





Better management practices for tilapia hatcheries in Egypt

Innovation description

The CGIAR Research Program on Fish Agri-Food Systems (FISH) led by WorldFish is developing better management practice (BMP) guidelines at the global level and contextualized BMP resources at the country level to support sustainable and responsible tilapia farming. A BMP instruction manual, produced as part of this approach, is hoped to enhance the capacity of grow-out farmers and extension service providers in Egypt.

Context

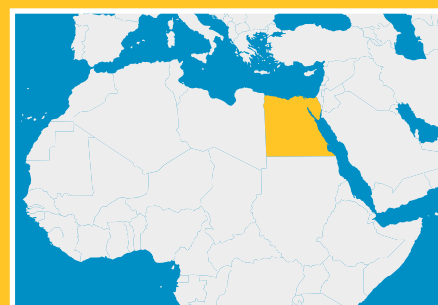
Although the aquaculture sector is growing rapidly in Egypt, representing one of the main sources of food, one of the main challenges facing the country is significant population growth. In this context, small-scale aquaculture systems offer an opportunity to generate income and improve family nutrition for millions of poor Egyptians.

Through FISH, WorldFish has developed BMPs to support sustainable and responsible tilapia farming in WorldFish focal and scale countries, including Egypt.

BMPs refer to a set of standardized management guidelines that are developed based on existing practices and associated risks, as determined in consultation with farming practitioners and relevant industry stakeholders. Innovations are also routinely incorporated into BMPs to facilitate continuous improvement in farming practices.

Innovation journey

The first version of the guidelines for BMPs was developed in 2013 through the Improving Employment and Income through Development of Egypt's Aquaculture Sector (IEIDEAS) project.



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

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In 2021, a new version of the “Better management practices for tilapia culture in Egypt” guidelines were released, both [English](#) and [Arabic](#). It contains advice on site selection and pond design, pond preparation and stocking, fingerling collection and marketing, biosecurity and fish health management, good farm management practices and record keeping.

The future

BMPs can provide an improvement in terms of household nutrition, livelihoods, health, income and security for direct beneficiaries and indirect beneficiaries by making aquaculture fish more readily available in local markets.

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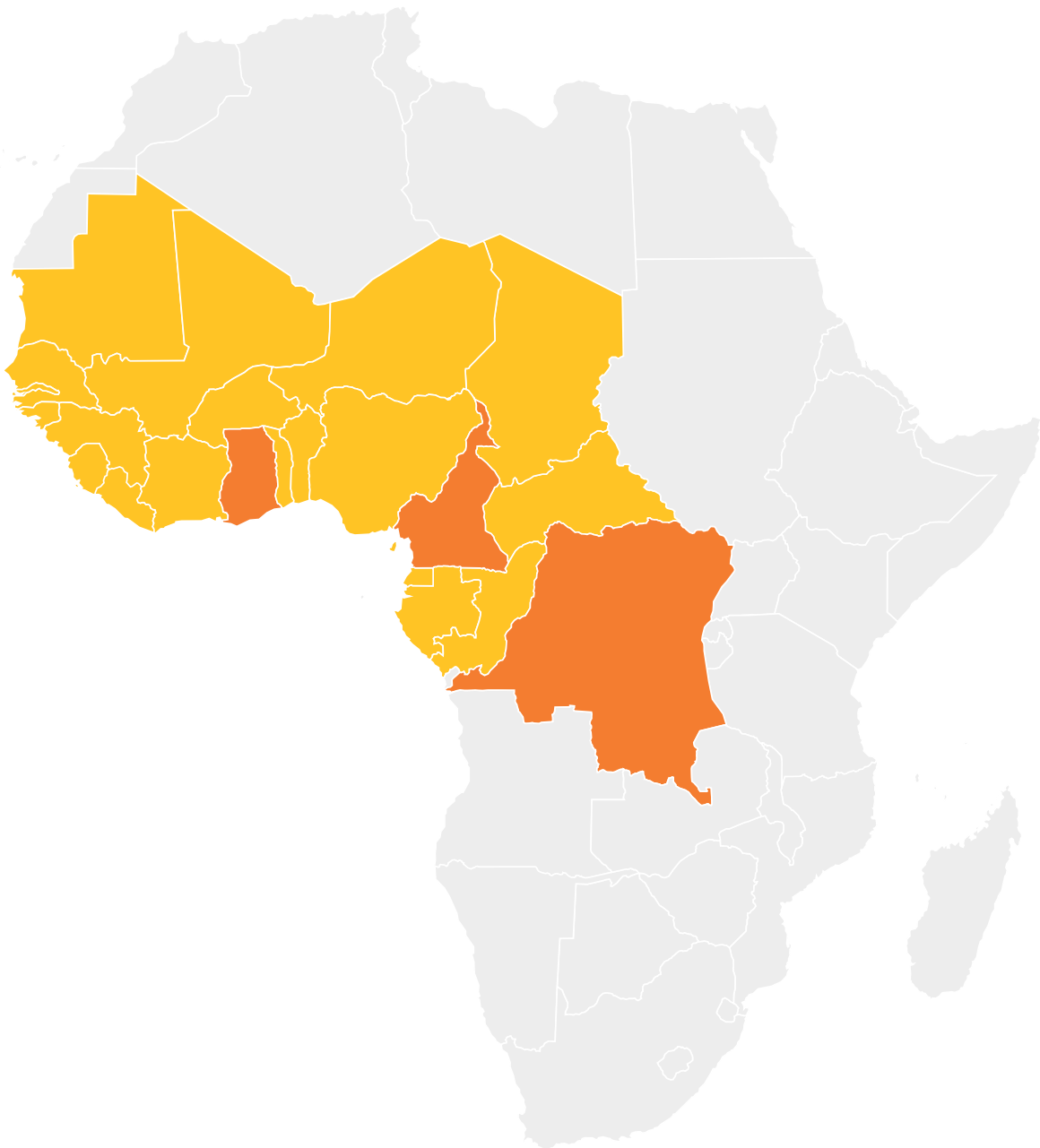
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Citation

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West and Central Africa





Photograph: Choadi Mwenba/WorldFish

Better management practices (BMPs), including production of monosex tilapia and use of probiotics, to enhance tilapia production in Cameroon

Innovation description

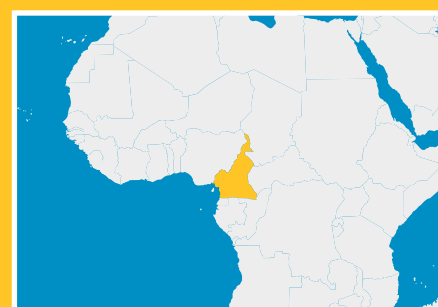
This innovation has been developed as part of the aquaculture compact of the Technologies for African Agricultural Transformation (TAAT) project. This project seeks to improve yield and benefits in aquaculture for 12 countries in Africa. Improving management practices and farming systems in African countries can provide more efficiency in tilapia farming. The systems and management practices developed boost fish immunity and decrease the cycle of production, leading to a higher survival rate of tilapia throughout their life cycle, and improving profitability.

Context

Tilapia is a freshwater fish species that has been introduced to fish farming across Southeast Asia and Africa. As one of the oldest fish species to be cultured, tilapia can be cultured in either fresh water or salt water and can adjust to both tropical and subtropical climates. Genetically Improved Farmed Tilapia (GIFT) have been researched and developed as part of WorldFish projects to provide farmed fish that are more resilient to disease, grow faster and have improved maturation rates. While tilapia is a prolific species, female tilapia use metabolic energy for reproduction. Thus, developing monosex (all-male) tilapia culture serves production purposes better, because their metabolic energy is used for growth.

In addition to the adaption of monosex tilapia production, better management practices (BMPs) mitigate the disadvantages to tilapia culture. BMPs include how to properly select a site, how to construct a pond and managing a pond, including broodstock selection, seed collection, feed preparation and proper harvesting.

As one of the greatest constraints on the aquaculture sector, low production of fingerlings is a focus of this innovation. Fish seed production in Africa often relies on local supply from natural wild sources. This decreases the likelihood of quality metrics, such as species. This unavailability of quality fish seed is one of the major constraints that



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- Institute of Agricultural Research for Development

Contact

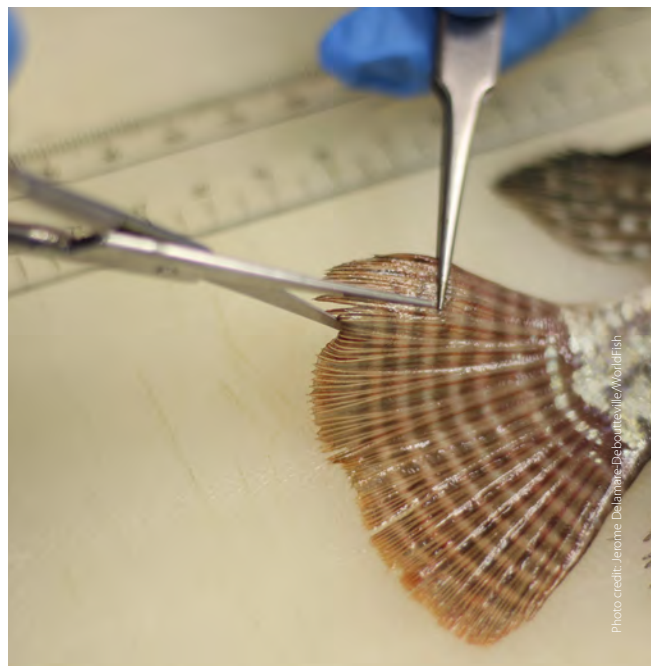
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aquaculture faces specifically in African countries. Scaling GIFT production, introducing monosex tilapia production, and improving management practices are the focus of improving aquaculture production in Africa.

Innovation journey

This innovation is based on demonstration ponds and evidence derived from other projects in the CGIAR Research Program on Fish-Agri-Food Systems (FISH) in focal and scaling countries like Zambia, Kenya and Nigeria. In 2019, demonstrations were provided to fish farmers in Cameroon. These demonstrations offered insight into BMPs for monosex tilapia production. Materials have been compiled to provide a manual for fish farmers and tilapia breeders to ensure profitability in high quality seed production. This innovation highlights several BMPs, including the introduction of probiotics. Probiotics can be used to enhance the health of fish in hatcheries by eliminating water fouling waste, providing a healthier environment for fish growth.



The future

Farmed tilapia is staple food in many parts of the world. It is a healthy source of protein and has a higher content of micronutrients and Omega-3 fatty acids than other meats. WorldFish has spent nearly three decades doing research on fish breeding and genetic improvement and has convened people from across the world to discuss BMPs regarding tilapia and other genetically modified fish production. It is estimated that GIFT and GIFT-derived strains contribute to approximately 50% of global tilapia production. Innovations regarding GIFT seek to close yield gaps through improved agro-economic and animal husbandry practices while decreasing the amount of necessary inputs for improved efficiency in aquaculture.

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Citation

This publication should be cited as: Burcham L and Cullhaj M. 2022. Better management practices (BMPs), including production of monosex tilapia and use of probiotics, to enhance tilapia production in Cameroon. Penang, Malaysia: WorldFish.



Contextualized better management practices (BMPs) for small-scale tilapia pond farming in Ghana

Innovation description

A comprehensive step-by-step guide to running a tilapia hatchery operation has been released in Ghana. It includes advice on site selection, site preparation, hatchery design and construction, farming practices, fingerling harvesting and marketing, biosecurity and fish health management, good farm management practices and record keeping—all of which are critical elements of a successful tilapia hatchery operation.

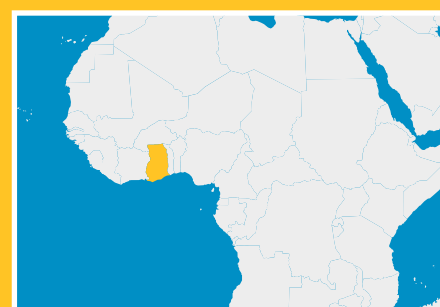
Context

Aquaculture has existed in Ghana since the 1950s, although large-scale commercial production began in the 2000s. Today, aquaculture plays a key role in the nation's prosperity, contributing to poverty reduction and enhancing food security.

Despite the aquaculture sector's increase over the years, small-scale farmers still need to improve basic farming practices. Dissemination of better management practices (BMPs) can contribute to the improvement of the sector, providing farmers with the knowledge and tools to increase fish domestic production and create jobs.

Innovation journey

Within the framework of the dissemination of BMPs in the aquaculture sector, in 2020 the "Farmers' manual on small-scale tilapia cage farming in Ghana" was published and is available to support small-scale fish farmers and catalyze sustainable growth of aquaculture in Ghana.



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- International Food Policy Research Institute
- Royal Tropical Institute
- Council for Scientific and Industrial Research
- Netherlands Organisation for Scientific Research, NWO
- WOTRO Science for Global Development

Contact

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The future

BMPs can help improve the aquaculture sector by providing farmers with the knowledge and tools to increase domestic fish production and job creation.

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Citation

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Photo credit: Agnes Chiley/WorlDFish

Contextualized better management practices (BMPs) for African catfish (*Clarias gariepinus*) spawning and fingerling production in the Democratic Republic of Congo (DRC)

Innovation description

Despite major constraints, there is enormous potential for scaling aquaculture in Africa. Since 2000, aquaculture production in sub-Saharan Africa has grown almost twice as fast as other countries in the world at a rate of 11% annually. Sustainable aquaculture development in Africa requires strategies that consider the effects of climate change, biosecurity and fish health concerns. This requires management practices that encourage high standards of regulation. Aquaculture innovations in better management practices (BMPs) provide management practices for sustainable aquaculture intensification in a standardized and optimal format.

Context

In the Democratic Republic of Congo (DRC), consumer demand is high for African catfish (*Clarias gariepinus*). This demand has increased in recent years, as African catfish are highly suitable for aquaculture. Current demand sources African catfish from rivers like the Congo River, as well as fish imports from Uganda, Zambia and Rwanda. However, recent interventions have established new hatcheries in the DRC, creating an opportunity for growth of the catfish industry with proper guidelines and BMPs. African catfish are easy to reproduce, do not require specialized feed, and tolerate high stocking densities. Despite their high potential for production, there are constraints to scaling production. The industry is not well established and has poor management practices, resulting in difficulty with reproduction, low survival rates and inefficient post-harvesting and marketing systems.

BMPs are necessary to prevent common and avoidable mistakes during commercial production. BMPs include practices at every stage of the production process, including broodstock feeding and handling, egg rearing, fry nursing and water quality management. Particularly for African catfish, reproduction is not spontaneous, and must have conditions that mimic their natural habitat for success. By integrating BMPs, fisheries



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- International Institute of Tropical Agriculture

Contact

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have the opportunity to avoid low survival rates that are commonplace in African catfish production, particularly regarding catfish fingerlings.

Innovation journey

In 2021, BMP guidelines were established to provide information to prevent mistakes in the catfish fingerling production process. These [guidelines for BMPs for African catfish spawning and fingerling production](#) were produced and made available for adoption and are intended for use in capacity development initiatives. These guidelines serve as a reference document for fisheries production and provide in-depth information on seed production, hatcheries, water quality, biosecurity, broodstock ponds and feeds, and preparing fish for spawning.



The future

With BMPs available for open use, there is potential for aquaculture production to improve in the DRC. When BMPs are not followed, there is the potential for total loss of stock in hatcheries. The objective of this innovation is to provide information that will grow the African catfish industry to its potential.

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Citation

This publication should be cited as: Burcham L and Cullhaj M. 2022. Contextualized better management practices (BMPs) for African catfish (*Clarias gariepinus*) spawning and fingerling production in the Democratic Republic of Congo (DRC). Penang, Malaysia: WorldFish.



Photo credit: Daniele Jumu/WorldFish

Contextualized better management practices (BMPs) for tilapia broodstock conditioning and mass spawning in hapas in ponds in the Democratic Republic of Congo (DRC)

Innovation description

Guidelines have been developed to optimize the conditioning and spawning of tilapia broodstock for improved fry and fingerling production in Ghana. WorldFish worked in cooperation with the International Institute of Tropical Agriculture (IITA) in Bukavu and Kinshasa to build the capacities of technicians and hatchery operators from hatchery sites in the country. The partnership has helped increase access to high-quality aquaculture inputs, particularly seed and feed.

Context

The hapa-in-pond system hatchery technique has been introduced in Africa, but the practice is still limited in many countries, including the Democratic Republic of Congo (DRC), where there is hardly any existing systematic production of quality fry and fingerlings for tilapia.

In 2017, most fish consumed in the DRC and, in particular, South Kivu was imported. This was partly due to the unavailability of quality seed and feed accessible to farmers for fish food production. IITA and WorldFish came together to provide a solution through the establishment of hatcheries and feed mills.

Innovation journey

From 2017 to 2020, WorldFish worked in cooperation with IITA to assist fish farmers and value chain actors, improve the productivity of existing farms, develop profitable new fish value chains, and build the capacities of technicians and hatchery operators from the hatchery sites in the DRC. Better management practices (BMPs) were disseminated throughout the regions to support fish farmers.



Contribution to impacts

Poverty reduction, livelihoods & jobs

Type

Production systems and management practices

Technical field

Aquaculture systems

Stakeholders

- International Institute of Tropical Agriculture

Contact

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In 2020, the “Guidelines for better management practices (BMPs) for tilapia broodstock conditioning and mass spawning in hapas in ponds in the Democratic Republic of Congo (DRC)” were produced and made available for adoption.

These guidelines were initially developed to optimize the conditioning and spawning of fish to improve the production of fry used in research, but also in the production of fry and fingerlings for the two regions where the hatcheries are located. The guidelines are used for capacity development initiatives.



The future

The introduction of BMPs for the productivity of existing farms can help to develop profitable new fish value chains, enhancing the capacities of technicians and hatchery operators.

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Citation

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About WorldFish

WorldFish is an international, not-for-profit research organization that works to reduce hunger and poverty by improving aquatic food systems, including 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.

WorldFish headquarters is in Penang, Malaysia, with regional offices across Africa, Asia and the Pacific. The organization is a member of CGIAR, the world's largest research partnership for a food secure future dedicated to reducing poverty, enhancing food and nutrition security and improving natural resources.

For more information, please visit www.worldfishcenter.org