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# Myanmar Fisheries and Aquaculture Research Symposium Proceedings

Yangon, 16–17 November 2017

# Myanmar Fisheries and Aquaculture Research Symposium Proceedings

## **Authors**

Xavier Tezzo, Jessica Scott, Kimio Leemans, Fernando Fernando and Romain Langeard

## **Authors' Affiliation**

WorldFish

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## Forewords

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Fisheries and aquaculture are essential to Myanmar. They provide livelihood opportunities and food and nutrition security for millions of people across the country. Our Department of Fisheries (DoF) recognizes there is an urgent need to improve our understanding of the sector to implement more sustainable management of our fisheries resources. It is expected that an improved knowledge base of the resources will also support better planning to maximize benefits for the people who depend on it. Investment in Myanmar's fisheries and aquaculture research is very important for the long-term and sustainable development of the sector. It is in recognition of this need that the DoF has been making efforts toward improved research collaboration with national and international partners. With the support of WorldFish, we have initiated the Fisheries Research Development Network (FRDN), a collaborative research network that aims at coordinating and disseminating fisheries and aquaculture research in Myanmar. I am very pleased to note that 5 years after its creation, the FRDN still brings so many researchers together to reflect on how the sector can better fulfill its promises for Myanmar's people.

A handwritten signature in black ink, reading "U Khin Maung Maw". The signature is written in a cursive, flowing style.

**U Khin Maung Maw**  
Director General, Department of Fisheries



Fisheries and aquaculture contribute to livelihoods for 800 million people and provide 3.2 billion people with 20% of their animal protein. Fish is a rich source of micronutrients and essential fatty acids, which are critical to cognitive and physical development. In low-income and food-deficit countries such as Myanmar, fish is often the cheapest and most accessible animal-source food. The CGIAR Research Program on Fish Agri-Food Systems (FISH) aims at enhancing the contributions of fisheries and aquaculture to reducing poverty and improving food security and nutrition. The FRDN symposium in Myanmar offered a timely opportunity to reflect on the role of research in catalyzing these development outcomes. Effective partnerships are central to the FISH program, and we aim to pursue our research agenda in close collaboration with national governments and our network of multistakeholder partners. We are very pleased that our co-funding enabled this science meeting to happen successfully. We sincerely believe that the discussions held in Myanmar on the occasion of this important symposium will help to set the basis of a joint research agenda across the fish agri-food system in Myanmar, including aquaculture and fisheries production systems and value chains. By such cooperation, we will be able to support our national partners in harnessing research innovations that enhance sustainability, productivity, livelihoods and access to nutritious fish by those most in need.



**Dr. Michael Phillips**

Director, CGIAR Research Program on Fish Agri-Food Systems  
Director, Aquaculture and Fisheries Science, WorldFish

# Introduction

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The Myanmar Fisheries and Aquaculture Research Symposium was held in Yangon on 16–17 November 2017. The event provided a unique opportunity for national and international researchers to take stock of present sectoral knowledge and jointly identify the most promising pathways for impactful fisheries and aquaculture research in Myanmar. The event was cooperatively organized by WorldFish and the Department of Fisheries (DoF) under the umbrella of the Fisheries Research Development Network (FRDN). The FRDN is a multi sectoral collaborative platform aiming to strengthen the research and development capacity around Myanmar's fisheries and aquaculture. Initiated by WorldFish as a researcher-to-researcher network, the FRDN is overseen by a management committee involving the DoF, Myanmar universities and the private sector. It allows researchers to network and share knowledge, fostering new collaborations for co-research and co-documentation of aquaculture and fisheries research in Myanmar.

The symposium brought together 136 participants from national and international universities, civil society organizations, government and the private sector. The agenda focused on the thematic areas of the CGIAR Research Program on Fish Agri-Food Systems (FISH – see [www.fish.cgiar.org](http://www.fish.cgiar.org)) with the intention to consolidate a research agenda dedicated to reducing poverty and enhancing food and nutrition security in Myanmar. The event consisted of alternating presentations and thematic workshop sessions, during which participants were randomly assigned to one of the three FISH thematic groups and asked to reflect on how future research could better serve sustainable fisheries and aquaculture development in the context(s) of Myanmar. In this report, the first part includes a compilation of abstracts from the research activities presented at the symposium while the second part documents the thematic workshops discussions and provides some suggestions on how research can be used to better understand and catalyze development outcomes.

# Symposium agenda

## Day 1 (16 November)

THURSDAY 16 NOVEMBER 2017		
08.00–08.30	Registration	
PLENARY SESSION		
08.30–09.00	Opening speeches	
	Introduction to the FRDN and symposium agenda	
09.00–10.00	Gareth Johnstone	WorldFish and the FISH research program
	Shakuntala Thilsted	Nutrition-sensitive fish agri-food systems
	Michael Phillips	Feeding the poor: The aquaculture research strategy of WorldFish
10.00–10.30	GROUP PICTURE + TEA BREAK	
10.30–12.00	Tun Thein	Current status of fisheries in Myanmar and forms of cooperation needed
	Ben Belton	The emerging quiet revolution in Myanmar's aquaculture value chain
	Petra Schmitter	Rice-fish and their functionality in the landscape: Beyond water use
	Xavier Tezzo	A short introduction to the afternoon sessions
12.00–13.00	LUNCH BREAK	
12.30–13.15	POSTER SESSION	

GROUP PRESENTATIONS: SESSION 1			
13.15–14.15	Group 1: Sustainable aquaculture	Group 2: Small-scale fisheries	Group 3: Cross-cutting issues
14.15–15.15	TEA BREAK		

GROUP WORKSHOPS: SESSION 1			
15.15–16.30	Group 1: Sustainable aquaculture	Group 2: Small-scale fisheries	Group 3: Cross-cutting issues

GROUP 1 PRESENTATIONS: SESSION 1		
13.15–14.15	Manjurul Karim	Adoption of small-scale aquaculture by smallholder farmers in Myanmar
	Kay Lwin Tun	USAID developing a sustainable seafood infrastructure in Myanmar
	Agboola Jeleel	Status and future roadmap for fish feed ingredients in Myanmar

GROUP 2 PRESENTATIONS: SESSION 1		
13.15–14.15	Ma Win	Fish diversity and physico-chemical factors in Myin-Kin Lake
	Benoit Ivars	Frictions between fishing interests and agriculture
	Kyi Thar Myint	Trends of catches in Duya Inn leasable fisheries

GROUP 3 PRESENTATIONS: SESSION 1		
13.15–14.15	Queenie Rizaldo	Insights from a nutrition-sensitive aquaculture project in the Ayeyarwady Delta
	Myat Myat Thaw	Seasonal changes of fish chemical compositions and spoilage indicators



## Day 2 (17 November)

FRIDAY 17 NOVEMBER 2017		
PLENARY SESSION		
09.00–09.15	A short reflection on Day 1	
	Introduction to the agenda of Day 2	
09.15–09.30	Group rapporteurs	Short feedback from each group's workshop on Day 1 (3 min each)
09.30–10.15	Anton Immink	De-risking aquaculture, especially for small-scale producers: Examples from Asia
	Mam Kosal/Win Ko Ko	Characterizing freshwater fisheries in Myanmar
10.15–10.45	TEA BREAK	
10.45–12.00	Aung Kyaw Thein	Innovation and a politically smart approach for fisheries governance in Myanmar
	Kay Lwin Tun	Aquatic animal diseases in Myanmar
	Behailu Lemlem	Opportunities to promote gender equality in Myanmar's small-scale aquaculture
	Sonali Seratna Sellamutu	Supporting flood-based farming systems in the Ayeyarwady Delta
12.00–13.00	LUNCH BREAK	
12.30–13.15	POSTER SESSION	

GROUP PRESENTATIONS: SESSION 2			
13.15–14.15	Group 1: Sustainable aquaculture	Group 2: Small-scale fisheries	Group 3: Cross-cutting issues

GROUP WORKSHOPS: SESSION 2			
14.15–15.30	Group 1: Sustainable aquaculture	Group 2: Small-scale fisheries	Group 3: Cross-cutting issues
15.30–16.00	TEA BREAK		

PLENARY: FINAL			
16.00–16.45	Group 1: Sustainable aquaculture	Group 2: Small-scale fisheries	Group 3: Cross-cutting issues
16.45–17.00	WorldFish	Wrap-up and closing remarks	

GROUP 1 PRESENTATIONS: SESSION 2		
13.15–14.15	Ken MacKay	Small-scale wild fish aquaculture in Bago Region
	Nilar Shein/U Than Aye	Developing rice-fish business models in disadvantaged flood-prone areas

GROUP 2 PRESENTATIONS: SESSION 2		
13.15–14.15	Thet Thet Lwin	Investigation of fishing operations in the Chindwin River
	Mostapha Hossain	Fish sanctuary: A successful measure of inland fisheries management in Bangladesh
	Soe Soe Aye	Size composition and growth parameters in Taungthaman Lake
	Peter Degem	Piloting coastal fisheries co-management in Myanmar
	Thein Soe	Comparative molecular identification on <i>Cyprinus Intha</i> in Pekon and Demoso

GROUP 3 PRESENTATIONS: SESSION 2		
13.15–14.15	Dawt Tial	Role of women in the inland fishing community of Bogale
	Win Mar	Occurrence of freshwater prawn in Mandalay environ

# Part 1: Presentation abstracts

This section includes the research project abstracts presented at the symposium according to the FISH research thematic areas, namely (a) sustainable aquaculture, (b) small-scale fisheries, and (c) cross-cutting issues.



# Feeding the poor: The aquaculture research strategy of WorldFish

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## A. Sustainable aquaculture

### Author

Michael Phillips

### Author Affiliation

WorldFish

### Abstract

Aquaculture currently supplies around half of the fish consumed globally and is projected to grow from 66.6 million metric tons in 2012 to 93.2 million metric tons by 2030. But significant improvements in aquaculture technologies, farming systems and value chains are needed to achieve this increase in production in ways that are socially and environmentally responsible. The sustainable aquaculture flagship of the CGIAR Research Program on Fish Agri-Food Systems (FISH) focuses on the following key research question: how can productivity-improving technologies and management practices enable aquaculture to achieve its fullest contribution to equitable livelihoods and food and nutrition security while delivering environmental benefits? To answer this, FISH conducts aquaculture research in three clusters: (1) fish breeds and genetics, (2) feeds, fish nutrition and health, and (3) aquaculture systems. Research is focused in countries with low and medium Human Development Indicators and a high dependence on fish for food. In these countries, aquaculture is either (1) in the early stages of development but needs accelerated growth to fill projected shortfalls or (2) is already established but opportunities exist to sustainably intensify to the supply levels required to meet growing domestic or regional demand. Research advances in these areas will contribute to sustainable growth, while ensuring that poor farmers, their families and communities access direct nutritional and economic benefits from a sustainably growing aquaculture sector. Impacts are delivered through the widespread dissemination and use of improved tilapia and carp seed, application of best management practices, adoption of fish disease control measures, sustainable aquafeeds and adoption of production systems with reduced greenhouse gas emissions and improved water and nutrient use.

# The emerging quiet revolution in Myanmar's aquaculture value chain

## A. Sustainable aquaculture

### Author

Ben Belton

### Author Affiliation

Michigan State University

### Abstract

Myanmar is among the world's leading aquaculture producers, but less is known about its fish farm sector than any other major aquaculture-producing country in Asia. The literature has characterized aquaculture in Myanmar as strongly export oriented and dominated by very large farms. Past literature assumed that small-scale fish farms were almost nonexistent due to land-use regulations that were thought to have blocked the conversion of paddy land to ponds, and that technologies on big farms were "traditional" and extensive. We tested these conventional wisdoms by undertaking the largest (and first survey-based) aquaculture value chain study ever conducted in Myanmar. There were five major findings. First, the great majority of farmed fish produced in Myanmar is sold to the fast-growing domestic market—only a small share is exported. Second, although large fish farms dominate in terms of total pond area, a small/medium farm segment has emerged quickly. This has given rise to a "dualistic" fish farm sector, with many small/medium farmers and nurseries existing alongside large farms. Third, the take off of small/medium farms has been helped by the "informal relaxation" of restrictions prohibiting the conversion of paddy land to ponds in the main fish farming zones. Fourth, the upstream segments (feed and seed) of the supply chain have grown fast, as have the midstream segments (wholesale and logistics). Most of this growth is due to a "quiet revolution" driven by private investments of small and medium enterprises. Fifth, some farms (small as well as large) are intensifying, resulting in the adoption of a mix of traditional and more modern farm technologies.

# Adoption of small-scale aquaculture by smallholder farmers in Myanmar

## A. Sustainable aquaculture

### Authors

Karim Manjurul, Michael Akester, Behailu Lemlem Aregu and Michael Phillips

### Authors' Affiliation

WorldFish

### Abstract

In Myanmar, aquaculture has been growing rapidly, at a rate of around 9% per year since 2004, driven by an increase in production. Today, aquaculture contributes 33% of the fish consumed nationally. However, the growth of aquaculture has been disproportionately influenced and constrained by several factors including existing land-use policy, despite the sector's significant potential to contribute to improved incomes and nutrition. In the search for ways to engage smallholders in small-scale aquaculture (SSA), a new avenue alongside homestead pond aquaculture for fish farming has emerged: irrigation channels. Known in the local language as *chan myaung*, these channels (both freshwater and brackish water) crisscross the Ayeyarwady Delta, providing irrigation water for plants and trees grown on the embankments. To harness this opportunity, the Promoting the Sustainable Growth of Aquaculture in Myanmar project, funded by the Livelihoods and Food Security Trust Fund, has introduced small-scale aquaculture technologies in these untapped potential resources and attempted to assess the impacts of such technologies on the income and nutrition of smallholder households. The performance of the different pond systems (*chan myaung*, pond and WISH ponds) was assessed at the end of production cycles. The highest average yield in *chan myaung* systems was 5.8 metric tons/ha, followed by WISH (5.5 metric tons/ha) and traditional earthen ponds (4.7 metric tons/ha). Despite the lowest average yields, ponds have the highest gross margin (USD 828±283/ha). Production in *chan myaung* was highest in systems stocked with pangas catfish, followed by silver barb and pangas together, and rohu carp. These species combinations had an average yield of 13.4 metric tons/ha, 8.1 metric tons/ha and 8 metric tons/ha respectively. The gross margins (total revenue minus the direct costs of production) of these three groups were USD 6,546±5,260/ha, USD 8,363±9,517/ha and USD 6,842±4,523/ha respectively. The benefit-cost ratio (BCR) of pond aquaculture (>2) was also higher when compared to *chan myaung* (1.58) and WISH ponds (0.98). On average, a BCR at 1.75 suggests that SSA is profitable. Promotion of such commercial systems may thus be useful in bringing positive changes in the overall aquaculture production and livelihood gains for the poor people of Myanmar.

# USAID developing a sustainable seafood industry infrastructure in Myanmar

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## A. Sustainable aquaculture

### Authors

Kay Lwin Tun,<sup>1</sup> Soe Tun,<sup>2</sup> May Myat Noe Lwin<sup>3</sup> and Kevin Fitzsimmons<sup>4</sup>

### Authors' Affiliations

<sup>1</sup> University of Distant Education, Mandalay

<sup>2</sup> Myanmar Fisheries Federation

<sup>3</sup> University of Auburn

<sup>4</sup> University of Arizona

### Abstract

The partnership between the University of Arizona, University of Yangon, Patheingyi University and other institutions is designed to address the Feed the Future and UN Sustainable Development Goals related to food security and health through collaborative activities that expand the capacity of higher education institutions in Myanmar to support the development of a strong marine and inland fisheries sector. Capacity building aspects have been directed to higher education institutions and to the extension/training components of the Myanmar Fisheries Federation. Within three years of the project, we developed the Seafood Safety Laboratory in Yangon University. It has been established as a teaching and research laboratory as well as a training and service laboratory for students and farmers. More than 450 faculty members and students from 44 universities under the Ministry of Education have been trained in using the research facility during the first three years of the project. We successfully facilitated 122 internships for students with local and regional businesses operating in the seafood industry. Students, including 58 women, from Yangon, West Yangon, Sittwe, Shwebo, Meiktila, and Patheingyi universities completed internships at seafood farms in Myeik, Sittwe and a processing plant and feed mill in Yangon. Students are taking pre-qualification training at the new Yangon University Seafood Laboratory in the proper use of laboratory equipment, water quality testing, disease management, breeding, and industry compliance measures. This is the first time in Myanmar that the private sector is joining with public education institutions to offer opportunities to university students for hands-on learning while developing a professional workforce to advance the seafood sector. Several host businesses have expressed intent to hire interns full time once they complete their studies.

# Status and future roadmap for fish feed ingredients in Myanmar

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## A. Sustainable aquaculture

### Author

Jeleel Agboola

### Author Affiliation

Wageningen University

### Abstract

Over the past few decades, aquaculture in Myanmar has witnessed tremendous improvement and progressed from extensive systems to more improved semi-intensive or intensive systems. Besides this, the enactment of various government policies, introduction of new technologies and emergence of new improved breeds are other contributory factors toward the expansion of this sector. Despite this significant development, the use of commercial compound feed is in its infancy, as nearly 80% of farmers still depend on farm-made diets to feed their fish. In general, depending on fish species, farm-made feeds contain around 19%–20% crude protein whereas commercial feeds contain 28%–35%. Irrespective of the feed type, the ingredients used differ from one species to another. In general, the commonly used feed ingredients are rice bran, wheat bran, peanut oil cake, sesame oil cake, cotton seed cake and mustard oil cake—all of which are locally available. In addition, soybean meal, fishmeal, rape seed meal, corn gluten meal, feather meal, fish oil and premix are imported. There is huge potential for further development of aquaculture in Myanmar. This is expected to impose additional demand on fish feed ingredients. Therefore, there is a need to look inward and use the nonconventional feedstuffs available within the country in the most sustainable manner to reduce the dependency on imported feedstuffs. Before being considered fish feeds, these nonconventional materials should be readily available, affordable and nutritionally adequate, with no negative impact on the environment. There are a variety of plant sources such as chick pea, gram meal, tour whole, mung and black bean that can be used in aquaculture feed formulations. Additionally, other agro-industrial byproducts with promising prospects are blood meal, poultry meal, prawn meal, feather meal and insect meal. Future research should be directed at investigating the nutritional values of these ingredients in different fish species.

# De-risking aquaculture, especially for small-scale producers: Examples from Asia

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## A. Sustainable aquaculture

### Author

Anton Immink

### Author Affiliation

Sustainable Fisheries Partnership

### Abstract

Aquaculture has the potential to produce high quality food while protecting livelihoods and the natural resources it relies upon, but only if management is at the right scale. Farms need the tools to grow food, and governments need the tools to protect livelihoods and natural resources at scale. Industries should be structured to recognize the interconnection between farms and the risks everyone shares, especially around disease and water quality. Delivered correctly, this can protect livelihoods and ensure continuous supplies of food to ever-growing markets. Governance approaches need to keep pace with the amazing potential of aquaculture development, and there are some strong examples emerging around Asia: assessing farm interconnections to understand disease risks across Thailand; creating associations to support the development of codes of good practice in China; and strengthening cooperatives to manage waste water quality in Indonesia. Various tool kits and approaches are available and will be summarized.



# Aquatic animal diseases in Myanmar

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## A. Sustainable aquaculture

### Author

Kay Lwin Tun

### Author Affiliation

University of Distant Education, Mandalay

### Abstract

The success of the implementation of aquaculture development programs depends, to a certain extent, on the intensification of fish parasitological research. However, relatively little work has been done to study the fish and shellfish diseases of cultured species in Myanmar. Over a period of nine years, parasite, bacteria and virus diseases in cultivated fish, shrimp and wild molluscs from the Yangon, Ayeyarwady, Mandalay, Rakhine, Patheingyi and Myeik areas were investigated. Besides farmed specimen from Myanmar, postlarvae of *Penaeus monodon* and *Machrobrachium rosenbergii* imported from Thailand were sampled and checked for OIE-listed diseases. In freshwater fish, 22 species of parasite, including 5 species of Myxozoa, 3 species of Ciliophora, 11 species of Monogenea, 2 species of Arthropoda, 1 species of nematode and 2 types of bacterial diseases, were recorded. In shrimp farms, low prevalence of infections of Infectious hypodermal and haematopoietic necrosis virus (IHHNV) and White Spot Syndrome Virus (WSSV) were found in Myeik, while Early Mortality Syndrome (EMS) was detected from PL shrimps imported from Thailand. Neither parasite nor bacterial infection was detected in molluscs. High mortalities of fish in production ponds were found in summer; however, those mortalities are more related to water quality than to parasitic and bacterial infection.

# Small-scale wild fish aquaculture in Bago Region

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## A. Sustainable aquaculture

### Authors

Kenneth T. MacKay<sup>1</sup> and Soe Min Oo<sup>2</sup>

### Authors' Affiliations

<sup>1</sup> Network Activities Group

<sup>2</sup> Department of Fisheries

### Abstract

Recent work in Bago Region, Myanmar, has uncovered a widely practiced system of local/indigenous aquaculture. This system is similar to rice field fisheries in nearby Asian countries where fish spawn and feed in the flooded rice fields during the monsoons then move to ponds as flooding declines, where they are harvested. This Myanmar system is unique as the trapped fish are fed and broodstock is selected for the next year. This differs from conventional aquaculture as stocking relies on natural spawning and indigenous species rather than hatcheries. The ponds are small, 80% are fewer than 0.25 acres (1112 m<sup>2</sup>), but also numerous, ranging from 50 to over 150 per village. The fish trapped in the ponds are fed and then harvested after 5 months. During harvest, 10%–20% of the fish are selected and saved for the next year's broodstock. Harvested fish are primarily black fish—*Channa* (snakehead), *Clarius* (catfish) and *Aanabas* (climbing perch)—but 15 other species have been identified. Fish are sold to local township markets, traded with fellow villagers in exchange for harvesting and sold within the village. The ponds are also multiuse, being used for household water, watering animals, and growing trees, fruit trees and vegetables on the pond banks. Extrapolated yields of 2000–5000 kg/ha are impressive, and while relying on a larger area of floodplain they are at the lower range of commercial aquaculture. Estimated economic returns are impressive with low input costs and a return on operating cost of 50%–440%, which is 15.6 times more profitable than monsoon rice production. This low input system offers potential for expansion as a supplementary income and food security strategy for small-scale farmers in other areas. This system should also be documented in areas with similar conditions like the Ayeyarwady Delta and Mon State.

# Developing rice-fish business models in disadvantaged flood-prone areas

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## A. Sustainable aquaculture

### Author

Nilar Shein

### Author Affiliation

Department of Fisheries

### Abstract

In collaboration with the Department of Agriculture, the International Rice Research Institute and WorldFish, we conducted research on integrated rice-fish systems in Tar Pat West village (Maubin township) from July 2016 to October 2017. The goal of the project was to assess the potential of integrated rice-fish business models to increase the income of farmers in the disadvantaged flood-prone areas of the Ayeyarwady Delta. Three rice varieties (Thee Htat Yin, Yaeanelo 4 and Yaeanelo 7) were transplanted. After one week of rice transplantation, a total of 2400 silver barb fingerlings (about 17 g each) and 2100 tilapia fingerlings (about 45 g each) were stocked in 3 rice-fish plots. Water parameters were monitored on a fortnightly basis. Stocked fish were fed with commercial pellet feed twice daily at 2% body weight (15 days sampling interval). According to the results, the yield of Yaeanelo 4 compared with that of Yaeanelo 7 was 32% higher in the rice-fish system and 9% higher in the mono rice crop. The yield of Yaeanelo 4 compared with that of the farmer variety Thee Htat Yin was 7% and 13% higher in the rice-fish system and mono rice crop, respectively. Yaeanelo 4 was identified as the most suitable summer rice variety for both rice-fish and mono rice crop systems in Maubin township. Regarding fish production, a total of 185 kg of fish was harvested from the three plots a week after the rice was harvested: 83 kg of silver barb and 102 kg of tilapia. Overall, the survival rate of stocked fish was 68%. The mean yield of rice in rice-fish and rice monoculture plots was 3567 kg/ha and 4120 kg/ha, respectively. The combined net income for the rice-fish system was MMK 273,532/ha (~USD 203/ha), a gain of about USD 100/ha compared with the mono rice crop only. Our research concludes that integrated rice-fish farming has great potential in Myanmar given extensive water availability and wild fish resources in many of the rice ecosystems in the country. Further research is necessary to get scientific results on the impact of rice and fish yields, selection of suitable rice varieties and fish species, sharing of paddy land for fish refuge, and nutrient and pest management.

# Current status of fisheries in Myanmar and forms of cooperation needed

## **B. Small-scale fisheries**

### **Author**

Thun Thein

### **Author Affiliation**

Department of Fisheries, Myanmar

### **Abstract**

Fishery resources in Myanmar waters are typical of Southeast Asia with a large quantity of fish and shrimp in the exclusive economic zone (a national fishing area jurisdiction). However, studies on marine wildlife in their natural habitats in terms of population size, distribution, migratory patterns, threats and conservation status are rather limited. Most existing studies are based on reported sightings and bycatch. The worrying results brought by a recent survey of Nansen research vessels are clear indications that marine fisheries research is nonexistent in Myanmar. Furthermore, a considerable increase in the abundance of jellyfish was observed in 2015, and this was not recorded in any of the previous surveys. These alarming developments call for urgent research and management measures in Myanmar. To address this lack of data, the Department of Fisheries (DoF) is drawing up plans for improved collaboration with international and local organizations and development partners. All concerned stakeholders should be involved in managing inland and marine ecosystems, and networks of researchers, managers and lawmakers should work hand-in-hand toward the improved management and monitoring of fisheries resources in Myanmar. The presentation discussed possible ways forward to that end and recommended a series of activities aimed at improving fisheries management in Myanmar. These are (1) to carry out institutional reforms toward an effective fisheries management system, (2) to establish the Centre for Marine Fisheries and Environmental Research; and (3) to carry out stock assessment and monitor resources as part of routine programs. This presentation further highlighted the important lack of coordination between the growing number of fisheries researchers working in Myanmar. To that end, it was recommended that more efforts are needed to improve the exchange of information and intersectoral collaboration (i.e. between the DoF, academics and the private sector) in the fisheries sector.

# Rice-fish and their functionality in the landscape: Beyond water use

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## B. Small-scale fisheries

### Author

Petra Schmitter

### Author Affiliation

International Water Management Institute

### Abstract

Paddy rice in Southeast Asia continues to be a high competitor for water and nutrient resources. Hence, improved water management strategies are being introduced to increase water productivity of one of the main staple foods in Southeast Asia. However, the landscape function that these systems take up is often neglected. This study combines experiences from Vietnam and Thailand to explain the importance of paddy rice cultivation in Southeast Asia and its role in sediment, carbon and nitrogen capturing. In Vietnam, 44%, 88% and 93% of sediments and associated carbon and nitrogen from eroded upland areas were captured in paddy fields. Aside from the sediment and nutrient buffering effect, paddy rice was a crucial component in flood mitigation during the Bangkok flooding in 2011. Currently, research is being conducted in the Ayeyarwady Delta in Myanmar to understand the importance of deep water rice. With the ongoing push for alternate wetting and drying, as well as other water management practices, the sustainability at the landscape level needs to be re-addressed. Hence, suitable landscape-based rice indicators are needed to accommodate the changes of new management strategies in paddy rice cultivation.

# Fish diversity and physico-chemical factors in Myin-Kin Lake

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## B. Small-scale fisheries

### Author

Ma Win

### Author Affiliation

Magway University

### Abstract

Composition of fish species, diversity and some physico-chemical factors of Myin-Kin Inn (Lake) were collected in two sessions from September 2008 to August 2010. A total of 57 species belonging to 41 genera, 20 families and 7 orders was recorded. Fifty-five species belonging to 39 genera, 20 families and 7 orders were identified in the first session and 50 species under 38 genera, 19 families and 6 orders were recorded in the second session. Simpson's index ('D') and the Shannon-Weiner index ('H') of diversity were calculated for every month. The values of 'D' ranged from 0.127 to 0.066 and 0.508 to 0.089; and the values of 'H' ranged from 2.40 to 2.90 and 2.36 to 2.66 and were evaluated during the first and second sessions respectively. Average values of some physico-chemical parameters included atmospheric temperature (26.57°C and 27.85°C); water temperature (27.15°C and 27.35°C); turbidity (298.2 NTU and 300.03 NTU); conductivity (120 $\mu$  mhos/cm and 328.33  $\mu$  mhos/cm); calcium (34.66 mg/L and 25 mg/L); total hardness (67.33 mg/L and 81.33 mg/L); magnesium (6.67 mg/L and 12.33 mg/L); chloride (10.83 mg/L and 47 mg/L); total alkalinity (88 mg/L and 149.33 mg/L); iron (>0.2 mg/L each); manganese (0.02 mg/L each); sulphate (<273.33 mg/L and <206.67 mg/L); dissolved oxygen (4.59 mg/L and 5.28 mg/L); and biological oxygen demand (5.49 mg/L and 10.19 mg/L) for the first and second sessions respectively. Although physico-chemical aspects and environmental factors fluctuated, they were within the tolerable limit for fish and this lake is still productive. The information obtained in the context of our investigation is recommended to serve as a baseline for future monitoring and management of fish species in Myin-kin Inn (Lake).

# Frictions between fishing interests and agriculture

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## B. Small-scale fisheries

### Author

Benoit Ivars

### Author Affiliation

University of Cologne

### Abstract

The Ayeyarwady Delta has earned a reputation as the rice bowl of Myanmar, a farmland frontier where the interests of agriculture, particularly rice cultivation, have historically been paramount. Disproportionately little attention has been paid to the inland and semi-permanent fisheries of the delta. This research seeks to fill the gap by drawing attention to the interlinkages that bind the interactions between agriculture and fisheries in the region. The sequence of flooding, fish migration, agricultural rhythms and topography all mix to form the intricate hydrological setting of the delta, shaping interactions between the interests of cultivators and fishers, who are brought into one closely interrelated drainage system. The leasable fisheries, also known as Inn fisheries, are mostly seasonal waters that recede into smaller permanent water bodies or dry up completely. The Inns are leased annually for fishery activities through an auction system. The water bodies fill up in the monsoon season and drain out in the dry season, becoming sites of frictions between the leaseholder and the cultivator, who have different interests in the use and management of water and land. In many cases, farmers want to pump water from the Inn zones at harvesting time and strongly determine how the fisheries are managed. Frequently, leaseholders complain of cultivators ploughing right down to the slopes or directly in the Inn zone when it dries up, disturbing the water and the fish. On the other hand, and especially in interconnected seasonal waters, leaseholders may claim rights on the fish that migrate into the flooded lands. In this presentation, we draw the contours of the Inn-farm interactions highlighting the potentially conflicting and diverging interests between rice cultivators and fishery lessees. We conclude that the shared rights between Inn and farms should be better assessed and monitored, notably the demarcation of their respective boundaries, with the objective of achieving a harmonious and sustainable coexistence between fishing and agricultural interests.

# Trends of catches in Duya Inn leasable fisheries

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## B. Small-scale fisheries

### Authors

Kyi Thar Myint and Lin Lin Maw

### Authors' Affiliation

Yangon University

### Abstract

Duya Inn is a leasable fishery located in Hinthada township and covering about 1000 acres. It used to be connected with the Ayeyarwady River, but a flood prevention dam is now interrupting the migration path of wild fish and there is anecdotal evidence that fish landing has been declining since. In response to that decline, the Department of Fisheries (DoF) promoted culture-based capture through the stocking of hatchery-produced carps, mainly rohu (*Labeo rohita*), mrigal (*Cirrihinus mrigala*), catla (*Catla catla*), blue barb (*Barbodies gonionotus*) and tilapia (*Oreochromis niloticus*). This practice has seemingly led to an increase in artificially stocked fish production. In 2014, the DoF allocated Duya Inn as a “research lease” for a period of 5 years extending from 2014 to 2019. In that context, our study consisted of investigating the impact of stock enhancement on both stocked and wild fish naturally present in the lease in two time segments of 3 years separated by a period of 5 years. There are 23 natural species grouped under 16 families belonging to 6 orders found in the lease, of which 2 species are peculiar: freshwater halfbeak (*Hyporamphus limbatus*) and an unidentifiable species likely to be under the *Stolephorus* genus. During the first segment (2006–2009), the maximum annual landing was 2025 metric tons, of which 1956 metric tons (96.6%) consisted of stocked fish species. During the second segment (2014–2017), we observed a drastic decline in landing, with a maximum annual landing of 49 metric tons, of which 29 metric tons (59.1%) consisted of stocked species. Notably, wild fish specimens captured during that period were too small to identify the corresponding species, likely indicating that unsustainable fishing practices were carried out during that period. In the context of long lease management as recently promoted by the DoF, our study advances some key recommendations toward such an undertaking. We recommend a more systematic identification of natural species populations and enforcing strict control on fishing capacity to prevent the capture of young specimens. These should be implemented together with affordable stock enhancement strategies and the demarcation of conservation measures such as no-take zones, thereby maximizing the productivity of both natural and artificial fishstock populations.



# Characterizing freshwater fisheries in Myanmar

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## B. Small-scale fisheries

### Authors

Mam Kosal<sup>1</sup> and Win Ko Ko<sup>2</sup>

### Authors' Affiliations

<sup>1</sup> WorldFish

<sup>2</sup> Department of Fisheries

### Abstract

Myanmar inland fisheries have never been characterized and described systematically. The resource system as well as how the resources and their management changes have never been well documented. The research summarizes the findings from a WorldFish study, funded by the Australian Centre for International Agricultural Research, into the inland fisheries in the Ayeyarwady Delta and Central Dry Zone. The study focused on characterizing the fishery systems and their management typology with the objectives to understand the current resources and management contexts and, ultimately, identify innovative management options. With a focus on leasable fisheries, three main management aspects were considered, including the lease granting process, technical interventions and the governance of fisheries systems. Analysis of the granting process looked at how a leasable fishery is granted to a holder, be it as an individual or a group. The technical interventions are described as how the resources are protected and enhanced through a set of different access regimes and stocking, along with what measures are commonly taken to protect the environment in which the resources are exploited. Governance relates to access rights, how decisions are made to control access and how to share the benefits arising from it. The findings show that the fisheries granting system is largely revenue-oriented while a management system consists of multiple technical and governance components, highlighting the need for more collaborative management.

# Innovation and a politically smart approach for fisheries governance in Myanmar

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## B. Small-scale fisheries

### Author

Aung Kyaw Thein

### Author Affiliation

Pyoe Pin

### Abstract

This presentation describes the changing face of Myanmar's fisheries governance that has taken place over the past 10 years and the role of the Pyoe Pin project in supporting pro-equitable and sustainable fisheries governance reform. Pyoe Pin has effectively engaged with local champions and many key stakeholders on fishery and resource governance issues to work together to improve governance through forming partnerships, coalitions and networks. The Rakhine Fisheries Partnership has been a pioneer and a useful example to influence key stakeholders from other states and regions to replicate the partnership approach in Ayeyarwady, Bago, Mon and Tanintharyi. The process has been catalyzed by Pyoe Pin and the local NGO Network Activities Group to enable the environment and space for local key actors to drive change for both formal and informal institutions. This ensures equitable access to resources and better state-citizen relations across the country. Through the collective efforts of the Department of Fisheries, development partners and subnational fisheries partnerships, the Myanmar Fisheries Partnership has been formed and is actively providing much-needed technical support and policy guidance.

# Investigation of fishing operations in the Chindwin River

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## B. Small-scale fisheries

### Author

Thet Thet Lwin

### Author Affiliation

Monywa University

### Abstract

The present study was conducted to assess the species composition of, and observe the socioeconomic status of fishery communities from, the Chindwin River, Sonekyin village segment, Yinmarbin township. Interviews were conducted with 20 locals, along with surveys into the fishing grounds. The study period was from October 2014 to March 2016. A total of 52 species of freshwater fish were recorded during the study period. Among the recorded fish species, *Cabdio morar* was the dominant species, and *Johnius coitor* was identified as a very rare species since only a single specimen was encountered during the study period. According to the field and questionnaire survey with local fishers, the common fishing gear employed in this area are the beach seine net and the drift gill net. The majority of the villagers were found to be fishers (70%) and the remaining (30%) were comprised of cultivators. Most fishers were literate and a few had reached a metric educational level. Their socioeconomic status was generally rated low. Overall, it was found that the Chindwin River segment near Sonekyin village is an important fishery sector for local people, so there is a need to maintain the sustainability of the fish fauna in this study area.

# Fish sanctuary: A successful measure of inland fisheries management in Bangladesh

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## B. Small-scale fisheries

### Authors

Mostapha Hossain<sup>1</sup> and Karim Manjurul<sup>2</sup>

### Authors' Affiliations

<sup>1</sup> Bangladesh Agricultural University

<sup>2</sup> WorldFish

### Abstract

Fisheries and aquaculture are important contributors to global food supply, food security and livelihoods—particularly in countries like Bangladesh. Aquaculture has increasingly played a major role in fish supply, accounting for more than half (56.8%) of the total production in Bangladesh, equating to approximately 2.20 million metric tons. Over the past two decades, aquaculture has become one of the fastest-growing economic subsectors of Bangladesh's economy. Inland open water fisheries in the country, however, have experienced a significant decline during the past four decades due to manmade and natural causes such as destructive fishing and overfishing, loss and destruction of fish habitats, and poor policy, planning and management. Stock of many indigenous fish species has depleted to below a replaceable level. As a result, fish production, biodiversity and fishing communities have been affected. The government has taken different measures to protect, conserve and manage the open water fisheries. Where perennial water bodies have turned seasonal due to several factors, establishing a fish sanctuary (refuges where fish are protected during the dry season) helps to restore the fish habitat and ecosystem diversity. Since 1960, the Bangladesh Government has established several hundred fish sanctuaries under different development projects, many of which were established over the past decade. Among all conservation measures, a fish sanctuary has been found to be the most effective and important tool for conserving open water fisheries when other measures are difficult to implement due to the present administrative and social contexts. Several nongovernmental organizations have also been involved in stock enhancement strategies by establishing sanctuaries in the *beels* and rivers of Bangladesh. The fish sanctuaries helped to restore the diversity of several once-endangered fish and shellfish, as well as supported an increase in fish production and the socioeconomic status of fishers living in the part of the river/*beel* where sanctuaries are established.

# Size composition and growth parameters in Taungthaman Lake

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## B. Small-scale fisheries

### Author

Soe Soe Aye

### Author Affiliation

Yadanaporn University

### Abstract

A total of 1936 specimens were examined during the study period: 670 rohu (*Labeo rohita*), 201 freshwater shark (*Wallago attu*) and 1065 tilapia (*Oreochromis niloticus*). The study was implemented from December 2013 to March 2014 and consisted of investigating the size composition and growth parameters of these three species sampled from Taungthaman Lake. Among the collected specimens, the maximum length was 37 cm in rohu, 63 cm in freshwater shark and 23 cm in tilapia. Most the harvested fish were 25 to 29 cm in rohu, 50 to 60 cm in freshwater shark and 20 to 22 cm in tilapia. In rohu, the length-weight relationship, growth parameters ( $L_{\infty}$ , K) and growth performance index ( $\Phi'$ ) values were estimated at  $W = 0.0197 L^{3.069}$ , 47.25 cm, 38 per year and 2.929. The corresponding values for freshwater shark were  $W = 0.0057 L^{3.006}$ , 80.25 cm, 0.38 per year and 3.395, while tilapia had  $W = 0.0007 L^{3.965}$ , 28.35 cm, 1.3 per year and 3.019 respectively. All the growth parameters for the three fish species were fitted into the Von Bertalanffy growth model. In the present study, the growth parameters obtained from rohu and tilapia showed lower values than the previous study (2007) in this area. The research observed that the growth rates of rohu and tilapia have decreased gradually. The parameters measured through our study will support the future management of fisheries and stock assessment from a biological perspective.

# Piloting coastal fisheries co-management in Myanmar

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## B. Small-scale fisheries

### Author

Peter Degen

### Author Affiliation

DANIDA

### Abstract

Recent ecosystems surveys and inquiries with fishers along the Myanmar coast give evidence that fishstocks have severely declined, reportedly 50%–70% as compared to a decade ago. In response to this situation, the Department of Fisheries (DoF) has been drafting a new Marine Fisheries Law and is strengthening its efforts to implement its National Plan of Action to prevent, deter and eliminate illegal, unreported and unregulated (IUU) fishing. It is also developing an approach to proactively engage coastal fishing communities in local co-management schemes. The DoF's commitment to working with local communities is a paradigm shift from its traditional command-and-control style of fisheries management that has contributed to drastic resource depletion during the past decades. Fisheries co-management is a new approach to fisheries management for the DoF. Making it work requires both human resource development and institutional development at all levels of management decision-making, including at the community level. This is piloted through its Sustainable Coastal Fisheries (SCF) program. Stock-taking of the social and economic contexts of the local fisheries for village profiling is followed by the formation of community fisheries working groups. These groups are enabled to develop and consult its institutional bylaws and rules and regulations, develop their organizational structure, delineate their fishing grounds and develop their local fisheries management plans. Throughout this process, the institutional and human capacity of the DoF is strengthened in a way that promotes the delegation of rights and responsibilities to coastal communities under the new Marine Fisheries Law and the respective regulatory framework, which still needs to be developed. Thus, the co-management pilot activities undertaken under the SCF program not only support the development of co-management arrangements between the DoF and communities, but the lessons learned will also inform the drafting process of the fisheries co-management regulatory framework.

# Comparative molecular identification on *Cyprinus Intha* in Pekon and Demoso

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## B. Small-scale fisheries

### Authors

Thein Soe, Thida Win and Moh Moh Say Myar

### Authors' Affiliations

Loikaw University

### Abstract

In Myanmar, Inle carp (*Cyprinus intha*) of order Cypriniformes is endemic to Inle Lake. This species is impacted by competition, hybridization and by other introduced *Cyprinus* species. Inle carp is listed on the International Union for Conservation of Nature Red List of threatened species. Pekon Inn is a lake situated in Southern Shan State. Fishers catch inle carp from this lake during the whole year. In Demoso, situated on the southern Loikaw township in Kayah State, specimens of Inle carp were observed in most fish farms. The present study was aimed at comparing Inle carp specimens from both sites to confirm that they were from the same species and further compare these with specimens of common carp (*C. carpio*) to identify DNA sequencing that can be used to identify fish species. These two study sites were chosen to enable the comparison of morphology and molecular identification. Specimens were collected from both sites from June 2016 to March 2017. To confirm the molecular level identification, COX 1 region of Inle carp was conducted. According to the NCBI database, it was found that COX 1 region of inle carp is exactly the same as common carp. The distinct characteristics were further established through a detailed comparison of their respective DNA sequences. This study concluded that COX 1 sequencing or barcoding can be used to identify fish species.

# Nutrition-sensitive fish agri-food systems

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## C. Cross-cutting issues

### Author

Shakuntala Thilsted

### Author Affiliation

WorldFish

### Abstract

Through the UN Sustainable Development Goals, the world has committed to ending all forms of malnutrition. Reorienting food systems across all actors and levels toward improving nutrition outcomes (nutrition-sensitive food systems) is central to achieving this goal. CGIAR has also committed to improvements in food and nutrition security with specific targets for increasing the dietary diversity of women and reducing micronutrient deficiencies up to 2030. Fish is uniquely placed to contribute to this goal, yet has received inadequate attention in debates on nutrition-sensitive food systems. This presentation proposes to critically review current aquaculture and capture fisheries developments, their respective contribution to diets and the implications for food and nutrition security. It is argued that small fish are generally richer in several essential micronutrients, calling for a policy shift from increased fish production to nutrition-sensitive food systems. The presentation further illustrates nutrition-sensitive food system approaches by providing examples of how such an approach is articulated in development approaches in the region.



# Insights from a nutrition-sensitive aquaculture project in the Ayeyarwady Delta

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## C. Cross-cutting issues

### Author

Queenie Rizaldo

### Author Affiliation

WorldFish

### Abstract

In line with the UN Sustainable Development Goals and the Myanmar Government's commitment to improved child nutrition, WorldFish is addressing the immediate causes of undernutrition of children less than 5 years old in Myanmar, where 29% are stunted, 7% are wasted and 19% are underweight. Undernutrition increases the likelihood of impaired physical and cognitive development resulting in diseases later in life. In addition, nearly half of all women in Myanmar are suffering from anemia. In the Ayeyarwady Delta where the project is implemented, a lack of dietary diversity and diseases are the immediate causes of undernutrition, particularly for young children. The aim of the project is to improve the nutrition and livelihoods of poor, rural households in aquatic agricultural systems—and address these nutrient gaps—through the increased intake of micronutrient-rich small fish and vegetables from their own production. Approaches encompass the promotion of micronutrient-rich small fish culture in homestead and community ponds, growing vegetables on dikes and in homestead gardens, nutrition education and behavior change communication, women's engagement and empowerment, and capacity building of the Department of Fisheries, national universities and (international) nongovernmental organizations. In implementing this, the project acknowledges that there is a need to strengthen monitoring at the community level, intensify nutrition behavior change messaging through the training of key women in the community, conduct training on stocking and partial fish harvesting at the community level, and enhance documentation of success stories, challenges and good practices for replication through community sharing/meetings. This presentation discusses these key insights and further shares recommendations for future interventions toward WorldFish's commitment to achieving its nutrition-specific development outcomes in Myanmar.

# Seasonal changes of fish chemical compositions and spoilage indicators

## C. Cross-cutting issues

### Author

Myat Myat Thaw

### Author Affiliation

Yangon University

### Abstract

This research explores the seasonal changes in the chemical compositions and spoilage indicators in some non-scombroid fish (Bombay duck, gold spotted grenadier anchovy, butter catfish and tilapia). Fish is a key part of the diet of the people of Myanmar, providing an important nutritional share of the food basket, including protein, fat, ash, water, amino acids, and vitamins and minerals needed for healthy living. Freshwater fish specimens (butter catfish and tilapia) were collected from the Ayeyarwady region and marine water fish (Bombay duck and gold spotted grenadier anchovy) were collected from Rakhine State. For Bombay duck, gold spotted grenadier anchovy, butter catfish and tilapia, crude protein and fat content were found to be the highest in the summer season compared with the other two seasons. Water content in these fish were the highest during the rainy season compared with the other two seasons. Spoilage indicators (TVB-N, TMA-N and  $\text{NH}_3$ ) were found to be the highest in summer. Histamine, one of the biogenic amines for chemical hazard, was measured by the spectrophotometric method and found to range from 5.30 ppm to 31.44 ppm during the summer season, compared with 4.16 ppm to 30.98 ppm and 3.32 ppm to 15.35 ppm in the rainy and winter seasons respectively. Concentration of histamine in seawater fish species (Bombay duck and gold spotted grenadier anchovy) were observed to be higher than freshwater fish (tilapia and butter catfish) for all seasons together. Concentrations of trace elements in all fish were determined by atomic absorption spectroscopy for each season. The concentrations were found to be Cu (0.25–0.63 ppm), Pb (0.18–0.81 ppm), Zn (2.34–2.82 ppm), Cd (0.41–0.57 ppm), As (16.92–18.69 ppm) and Fe (19.01–21.16 ppm) during summer; Cu (0.18–0.28 ppm), Pb (1.04–1.42 ppm), Zn (1.62–2.21 ppm), Cd (0.25–0.50 ppm), As (17.66–19.05 ppm) and Fe (16.88–19.19 ppm) during the rainy season; and Cu (0.11–0.44 ppm), Pb (0.22–0.72 ppm), Zn (1.01–1.84 ppm), Cd (0.23–0.41 ppm) and As (12.04–17.13 ppm) during winter.

# Opportunities to promote gender equality in Myanmar's small-scale aquaculture

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## C. Cross-cutting issues

### Author

Behailu Lemlem

### Author Affiliation

WorldFish

### Abstract

Gender inclusiveness in small-scale aquaculture has proven to support more gender equality, bringing a wide range of benefits for sectoral development. However, due to a lack of sex-disaggregated information on aquaculture in Myanmar, very little is known on how gender relations and gender norms influence women's involvement and their benefit from small-scale aquaculture development. This presentation explores the implication of gender norms on small-scale aquaculture and presents the gender-associated opportunities and challenges in terms of ensuring equal participation of women and men and their benefits from small-scale aquaculture development. The presentation is based on empirical evidence from the gender benchmarking study conducted by two development projects (i.e. MYCulture and MYNutrition) in four communities in the Ayeyarwady Delta and Central Dry Zone. The study highlights small-scale aquaculture as a suitable entry point for empowering women, since small-scale aquaculture can be carried out around homesteads in backyard plots, where women have greater access and control over resources than in the main farmlands. They can also integrate small-scale aquaculture activities with the household responsibilities they are socially expected to accomplish. Women's involvement in small-scale aquaculture may also increase household incomes through the sale of surplus catch, and that benefit would accrue directly to women because, traditionally, fish processing falls under women's responsibilities. However, the study identifies several socioeconomic factors that limit women's engagement in and benefits from small-scale aquaculture. Notably, these include social norms and traditional gender roles that assume men as the "breadwinner" and women as the "caregiver" resulting in women having limited access and control over essential resources like land and ponds. Finally, the study concludes that small-scale aquaculture can be a well-suited livelihood activity for women, particularly if their needs are accounted for in initiatives and if they are provided with extension services equal to men. Yet, the successful and balanced integration of women throughout the aquaculture value chain will require addressing the deep-rooted gender inequalities arising from social/gender norms, traditional gender roles and institutional failures. Thus, successful development of gender-inclusive small-scale aquaculture in Myanmar should be supported by gender-transformative approaches ensuring that the underlying constraints of gender inequality are addressed in a long-lasting fashion and that the benefits are equally shared between women and men.

# Role of women in the inland fishing community of Bogale

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## C. Cross-cutting issues

### Author

Dawt H. Tial

### Author Affiliation

Central Luzon State University

### Abstract

This study investigated the role of women in inland capture fisheries in five different villages of Bogale township, which account for important fisheries communities, namely Ywa Thit, Pha Ya Chaung, Sat San, Than Lite and Hi Sii. The study found that women in the Ayeyarwady Delta play an important role in sustaining inland fisheries activities by engaging in actual fishing activities (92.5%), despite their dominant involvement in household chores. Yet dedicated trainings provided by the government turned out to be attended mostly by men. Surveyed women earned the mean daily income of MMK 7131 (USD 6) in the wet season and MMK 5914 (USD 4.98) in the dry season. Most of them owned at least one boat and fishing net. The major concerns were reported as poor health, unemployment, the lack of power supply, the lack of cooperation among villagers, limited transport facilities, the distant location of school from home and an inadequate supply of drinking water. Women are more prone to poor health issues than men. Relatives/friends and pawnshops usually lend them money at an interest rate of 1% to 20%, while 58% of the population enjoys credit loans from the government and nongovernmental organizations at an interest rate of MMK 1 to 5. Men were also found to be the main recipients of formal and informal credit loans. Some of the survey respondents reported an ongoing increase in the income and gender equalities in fisheries activities (36.5% and 23%). The study further shows that despite the important resources collected by the Department of Fisheries in Bogale Township through bidding and tax collection, there was no public investment in fisheries infrastructure and the livelihood improvements of fishing communities. The study also found that there was no gender-sensitive training or seminars, which could encourage women to participate and better benefit from livelihood support programs and credits. The study concluded that the Myanmar government is relatively weak at implementing the Convention on the Elimination of all Forms of Discrimination against Women and the National Strategist Plan for the Advancement of Women, which both focus on eliminating all forms of gender discrimination against women and promote the advancement of women.

# Occurrence of freshwater prawn in Mandalay environ

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## C. Cross-cutting issues

### Authors

Win Mar, Khin Khin Lay, Mya Mya Thin, Pann Myintzu Tun and Zin Mar Phy

### Authors' Affiliation

Mandalay University

### Abstract

This study involved collecting freshwater prawn specimens from the Mandalay environ, Upper Myanmar, from 2002 to 2015, and deducing their taxonomy. The study showed a total of 24 species of the genus *Macrobrachium* (Bate 1865). Among the 24 species, three could not be identified down to the species level. Among those identified species, *M. lamarrei*, *M. lanchesteri* and *M. palaemonoides* were recorded to be predominant in the study area. With respect to *M. bendersoni*, *M. formonense*, *M. idea*, *M. javanicum*, *M. johnsonii*, *M. lanceifrons*, *M. nobilii*, *M. oenone* and *M. scabriculum*, there are no previous record and information about their presence. As such, we advance that our study represents the first account of these species' presence in the studied areas. To date, a total of 41 species of the genus *Macrobrachium* were recorded in Myanmar. We conclude that further taxonomic studies of Myanmar's shrimp and prawn should be investigated to get a comprehensive list of the presence of palaemonid species. The authors hope that the study contributes substantially to a better regional understanding and further conservation efforts in Myanmar.

# Part 2: Thematic workshop discussions



Over the two days of the symposium, participants were randomly assigned to one of the three FISH thematic groups and asked to reflect on how future research could better serve sustainable fisheries and aquaculture development in the context(s) of Myanmar. The group allocation is provided in the Annex together with the list of participants. In each of the thematic groups, the participatory discussions aimed to identify the key issues and favorable pathways for future research to support and catalyze development outcomes. Toward that end, the discussions were articulated following a four-step iterative process (see Figure 1)

In the section that follows, we successively present the main outcomes of the discussions for the three thematic groups.

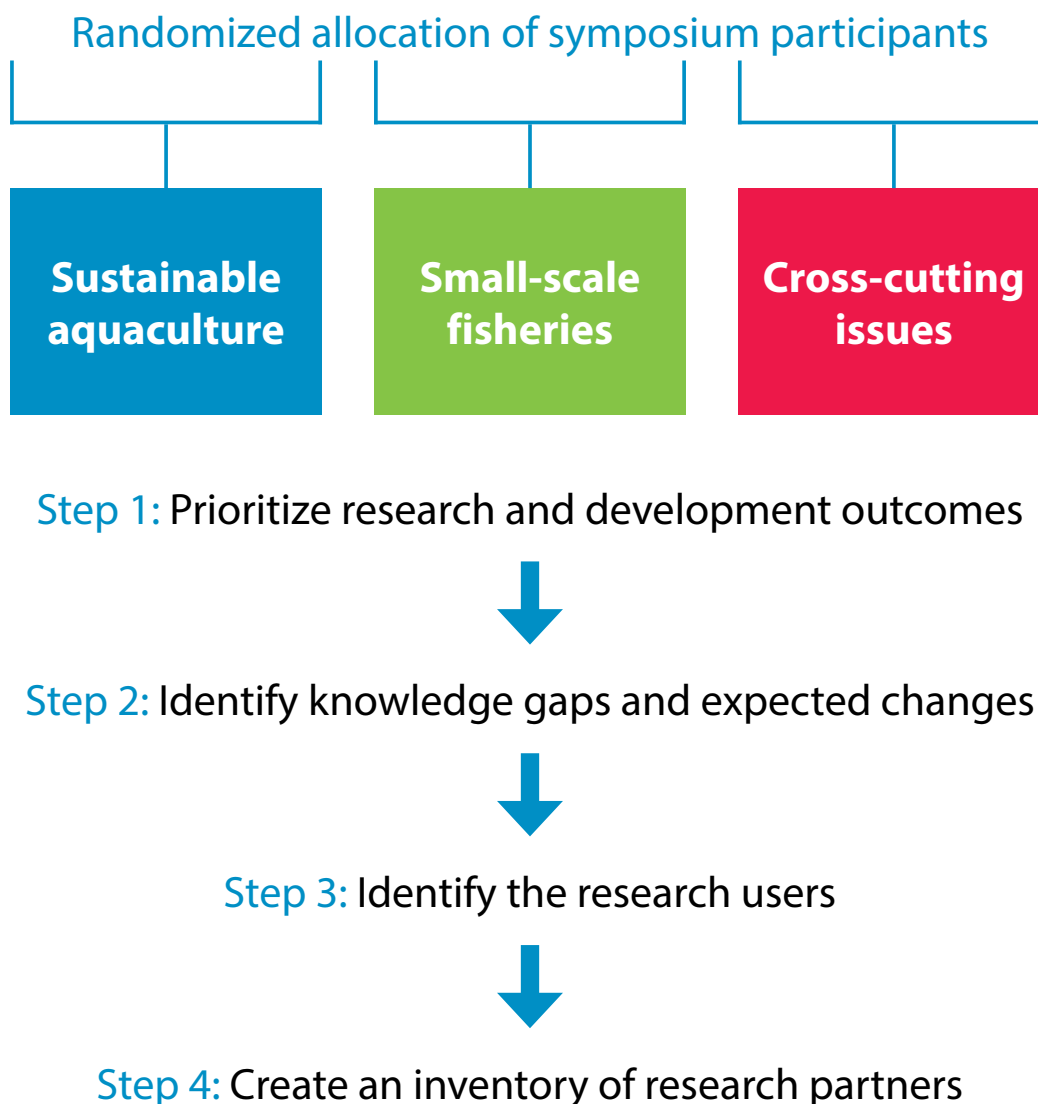


Figure 1. Four-step iterative process used for thematic group discussions.

## Sustainable aquaculture

In Myanmar, demand for fish is growing quickly as the country urbanizes and incomes rise. Aquaculture is ideally placed to meet this demand, while also raising farm incomes and creating employment. However, Myanmar's recent aquaculture growth has been driven mainly by large enterprises, which have historically been favored by the government. The sector is also very limited geographically, with 90% of inland fishponds located close to the capital, Yangon. Unfavorable regulatory frameworks, poor access to quality farm inputs and technologies, as well as limited knowledge and extension services, have limited the inclusive growth of aquaculture in the country.

The importance of aquaculture is in contradiction with prevailing policies and laws regulating the sector in Myanmar. Under the current land-use legislation, it is estimated that over 80% of ponds are illegal. The titular conversion of paddy land to aquaculture ponds is a long, slow bureaucratic process and is curtailing small-scale farmers from legally converting their land use to aquaculture. Furthermore, aquaculture is not considered in the national food security program and the national agriculture development plan, the focus lying predominantly on rice production. Next to the limitations at policy level, there are challenges at the industry level in terms of accessibility to inputs and extension services. There are currently no extension service providers at the field level in most producing hubs. The absence of a national university aquaculture curriculum is also responsible for the scarcity in adequately trained human resources. Currently, only some courses deal specifically with aquaculture, mainly under the umbrella of the Department of Zoology. Furthermore, there is a geographical concentration of production and an overall limited access to necessary inputs (high quality fish feed, seed and fertilizers), particularly for small-scale producers operating far from the main producing hubs. Finally, there is a lack of access to financial services owing to the high investment cost and a widespread low level of trust in aquaculture operations. As a result, despite the important potential for small-scale producers to engage in the sector, prevailing policy and technical constraints tend to favor large-scale aquaculture developments.

More research is needed to identify opportunities for integrating aquaculture into traditional agricultural systems. *Chan myaung* (i.e. fresh and brackish water irrigation channels crisscrossing the Ayeyarwady Delta region) offer an example of an untapped potential fish producing system, widely available (especially in the Ayeyarwady Delta region) but currently not used effectively for fish rearing. Integration of fish and rice farming to increase profitability per acre of rice farm is another line of research worth pursuing. In addition, a long-term selective breeding program for native species should be developed to enhance the quality of available genetic resources. The focus should be on locally available low-cost fish species that have a short lifecycle, a high growth rate and a high feeding efficiency. To address the limited access to commercial feed, research should further explore alternatives relying on farm-made fish feed, encompassing specific investigations on locally available agricultural byproducts. In addition, feasibility studies at the local level should be conducted to assess the economic viability and profitability of aquaculture operations to be integrated into microfinance loan schemes.

Generally, it was acknowledged that there is a lack of reliable data, which is curtailing the effective planning and management of aquaculture in Myanmar. Government and research and development institutions should generate and make use of science-based evidence to support better-informed aquaculture policy discussion and support an overall recognition of the sector's potential to support rural development. Notably, there is a need to develop maps including for the road network, existing aquaculture ponds, and major urban centers to further incorporate aquaculture development policy into existing rural development plans.

Participants agreed that research emphasizing the importance and potential of aquaculture in Myanmar should be communicated to the Ministry of Agriculture, Livestock and Irrigation (MoALI) to support a policy reform allowing aquaculture to develop in a more inclusive fashion, thereby directly contributing to broader rural development objectives. Notably, these include increasing rural households' income and food and nutrition security. At a more practical level, research supporting the tailoring of low-cost production technologies, improved access to quality inputs (fertilizer, seed, feed), and greater knowledge transfer (i.e. extension services) should be implemented in collaboration with the private sector, the Department of Fisheries (DoF), appropriate university departments (i.e. zoology, chemistry and others), and relevant (international) nongovernmental organizations to further improve agricultural productivity and the rearing of fish by small farmers throughout the country. Toward that end, it was noted that improving research capacity within universities and the DoF should be a priority.



## Small-scale fisheries

The extensive networks of rivers and floodplains have historically supplied the bulk of fish for domestic consumption in Myanmar, and they are essential to the economy and people's livelihoods. The sector is faced with increasing problems of resource exhaustion, and there are growing concerns regarding the equity of prevailing management regimes. The recent decentralization process allows states and regions to enact their own freshwater fisheries policies and legislations. Propelled by an increasing dialogue between the government and resource users, this process has led to more consideration for the sustainability and equity of fisheries resource management. However, the substantial lack of knowledge on the resource-base, together with the poor monitoring capacity of national institutions, further complicates the task of improving freshwater fisheries governance in Myanmar.

The participants agreed that reinforcing the knowledge base of inland fisheries resources should be made a priority to improve the long term-management of this vital resource for the people of Myanmar. At present, there is an important lack of information on the status of the resources. General ecological knowledge—including species identification, stock bases, migration and spawning patterns as well as related ecosystem information—is very low, making it difficult to fully grasp their overall importance and identify the most appropriate management measures. Contrary to aquaculture, it is perceived that freshwater fisheries are undeservedly receiving less attention by the donor community. Beyond the improved understanding of the freshwater resources base, there is a need for a reform in the management of freshwater fish resources throughout the country. Of particular concern is the centralized and production-driven management of productive rivers and floodplains creating access barriers for dependent fisheries communities and seemingly leading to unsustainable practices. The group noted that there have been some initiatives from both the government and civil society organizations to promote community management approaches as part of the ongoing reform that allows states and regions to enact their own legislation.

Collaborative research is very much needed to support the ongoing reform. Researchers investigating inland fisheries should maximize the exchange of information (and the alignment of methodologies) to support a better and integrated understanding of the Myanmar freshwater fish resource base in the different agro-ecologies of the country. This should be accompanied by the capacity building of DoF human resources and the promotion of science-based evidence to effectively plan and enforce a more sustainable management of inland fisheries resources throughout the country. In the current contexts, where resource management is progressively being transferred to the regional level and community-management initiatives are being experienced, there is an urgent need for research to capitalize on these experiences. Co-management initiatives should be given attention and their outcomes should be monitored and assessed from environmental, social and economic perspectives, allowing the reform to be evidence-based and implemented gradually, using trial, evaluation and adaptation. Finally, there was a consensus in the group that additional research efforts should be devoted to postharvest practices and food quality controls for freshwater fish resources, which are believed to be the main contributor to domestic fish as food throughout the country and are poorly documented at present.

Despite the overall lack of national research capacity acknowledged by the participants, it is largely recognized that universities in Myanmar have a relatively good fish biology and taxonomic knowledge base (through their zoology departments). Hence local universities should be closely involved in aligning their methodologies and maximizing research collaborations toward the improvement of knowledge on the freshwater fish resource base. It is notably recommended for universities to formulate and implement their research in close collaboration with the DoF.

Like aquaculture research, the fisheries research should be communicated to the MoALI, thereby supporting an overall recognition of the importance of this resource, central in Myanmar's food baskets and ecosystems. As much as possible, experimental research on integrated co-management should be grounded in the local context(s) and maximize the involvement of dependent communities in their formulation and implementation. At the same time, such trials should capitalize on similar experiences from the region, which could be supported by exchange visits and increasing collaborations between the DoF, fishing communities and relevant (I)NGOs.

## Cross-cutting issues

Women in Myanmar make up about half of the workforce in fisheries and aquaculture; however, like in most developing countries, they face substantive challenges to engage in and benefit equitably from these sectors. Women generally face more severe constraints than men in accessing productive resources, markets and services. Closing this gender gap in fisheries and aquaculture systems is necessary to leverage a lasting impact toward reducing poverty and increasing food and nutrition security. It was further emphasized that Myanmar has one of the highest rates of undernutrition in Southeast Asia, presenting a risk for pregnant and lactating women as well as young children.

From a gender perspective, participants highlighted the value of household survey research to support the identification of livelihood activities that women are currently involved with as well as their decision-making power within the household. If female household members are better educated, for example, in the topic of food and nutrition, it will allow them to improve their decisions regarding the household diet. This in turn could improve nutrient intake and diet diversity for the household. A way of educating women could be through the organization of cooking demonstrations and nutrition workshops. Unfortunately, a barrier reported by various participants was the low number of female participants in these activities. It was acknowledged that women are also involved in the fisheries sector, although usually exclusively in processing and marketing activities. It was suggested that these could also serve as an entry point for engaging with women toward improved postharvest practices, with the potential to further support them with tailored business trainings and associated financial services when needed. Channeling such support through women could provide an opportunity for enhancing women's empowerment while directly benefiting whole households. Regarding nutrition, there is no published nutrient composition data of Myanmar's fish species from local samples. Consumption data, highlighting the range of dietary patterns that differ between geographical locations and cultures, and which affects local food supply, is also unavailable. Food safety risks around (fresh and dried) fish and fish-based products were well understood and acknowledged by participants, but of concern was the lack of rigorous and regular testing of such products, particularly for the domestic market. Knowledge in these areas could have the additional benefit of improving production of nutrient-dense fish products that are safe for human consumption. Anecdotal evidence of low acceptance of fish as a complementary food for infants (older than 6 months) was described due to mothers' concerns regarding food safety issues including parasites, diarrhea and choking risk.

Nutrition-related research on fish and fish products should be implemented in collaboration with local universities, some of which are already engaged in such research (mostly through their chemistry and medical studies departments). Given the importance of fish as food in Myanmar, there is an opportunity for researchers to collaborate toward a better understanding of the challenges and opportunities of fish to fulfill its central contribution to domestic food baskets. The knowledge generated should be communicated to the MoALI but also to the Ministry of Health and Sports, thereby supporting an overall recognition of the importance of this resource to achieve food and nutrition security. On the other hand, the DoF, universities and (I)NGOs working in the fisheries sector should recognize the central role of women and better mainstream gender in their interventions.

## Conclusion

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In comparison to other major fish producing countries, there is very limited research data available on fisheries and aquaculture in Myanmar. There is also very little sectoral coordination and exchange of knowledge between the different stakeholders involved in the sector. This makes it difficult to not only assess its importance, but also to further support evidence-based policymaking that harnesses fisheries and aquaculture toward critical development outcomes. The Myanmar Fisheries and Aquaculture Research Symposium provided a unique opportunity for national and international researchers to take stock of present sectoral knowledge and jointly identify the most promising pathways for impactful sectoral research in Myanmar. The initiative was the first of its kind in the country and built on the 5 years of experience of WorldFish and the DoF in organizing yearly fisheries and aquaculture conferences with national research partners. FISH provided a valuable and timely framework to base the discussions around the issues of poverty reduction as well as food and nutrition security, which are central in Myanmar development policies. Importantly, the event also coincided with and marked the institutionalization of the Fisheries Research and Development Network, a multisectoral collaborative researcher-to-researcher platform aiming to strengthen the research and development capacity around Myanmar's fisheries and aquaculture. As such, it is hoped that the symposium only marked the beginning of a long series of symposia, aiming to foster new collaborations for co-research and co-documentation of aquaculture and fisheries research in Myanmar.

## Annex: List of participants

No.	Names	Affiliation	Group allocation
1	Agboola Jeleel	Wageningen University	Sustainable aquaculture
2	Amy Chit	DANIDA	Cross-cutting
3	Anthony Douglas John Hayment	WorldFish Board	Sustainable aquaculture
4	Anthony Roger Long	WorldFish Board	Sustainable aquaculture
5	Anton Immink	Sustainable Fisheries Partnership	Sustainable aquaculture
6	Aung Kyaw Thein	Pyoe Pin	Small-scale fisheries
7	Aung Myo Chit	Smithsonians	Sustainable aquaculture
8	Aye Aye Khaing	Dagon University	Cross-cutting
9	Aye Aye Lwin	WorldFish	Sustainable aquaculture
10	Aye Aye Tin	Hinthada University	Sustainable aquaculture
11	Aye Mo zan	De Heus	Sustainable aquaculture
12	Aye Mu Khin	Kyaukse University	Cross-cutting
13	Ayman Anwar Mohamed Ammar	WorldFish Board	Cross-cutting
14	Behailu Lemlem	WorldFish	Cross-cutting
15	Ben Belton	Michigan State University	Sustainable aquaculture
16	Benoit Ivars	Koeln University	Small-scale fisheries
17	Chern Kang	Myanmar Times	Press
18	Chit Hsu Mon	Skynet	Press
19	Dawt H. Tial	MMIID	Cross-cutting
20	Donald Griffiths	WorldFish	Sustainable aquaculture
21	Ei Ei Khaing Nyein	Meikhtilar University	Sustainable aquaculture
22	Elizabeth Jean Woods	WorldFish Board	Sustainable aquaculture
23	Fernando Fernando	WorldFish	Sustainable aquaculture
24	Gareth Johnstone	WorldFish	Small-scale fisheries
25	Hannah Baleta	WWF	Small-scale fisheries
26	Hla Moe Aung	MYCulture Project - GRET	Sustainable aquaculture
27	Hla Ngwe	Yangon University	Cross-cutting
28	Htay Htay	Lashio University	Cross-cutting
29	Htay Htay Sein	Magway University	Sustainable aquaculture
30	Jessica Scott	WorldFish	Cross-cutting
31	Johan van den Ban	De Heus	Sustainable aquaculture
32	Jongsoo Shin	International Rice Research Institute	Sustainable aquaculture
33	Jonhathan Bird	International Labor Organization	Small-scale fisheries
34	Kay Khine Tint	Department of Fisheries	Sustainable aquaculture
35	Kay Lwin Tun	Arizona State University	Sustainable aquaculture

36	Kay Thi Thin	Meikhtilar University	Cross-cutting
37	Kenneth MacKay	Network Activities Group	Sustainable aquaculture
38	Khin Maung Oo	Magway University	Cross-cutting
39	Khin Maung Soe	WorldFish	Small-scale fisheries
40	Khin May Nyo	Yadanaporn University	Cross-cutting
41	Khin Sabae Htut	West Yangon University	Cross-cutting
42	Khin Soe Win	Monywa University	Cross-cutting
43	Khine Thazin	Department of Fisheries	Small-scale fisheries
44	Kimio Leemans	WorldFish	Sustainable aquaculture
45	Kyi Thar Myint	Yangon University	Sustainable aquaculture
46	Kyu Kyu	Department of Fisheries	Support team
47	Kyu Kyu Win	Yangon University	Cross-cutting
48	Lars Joker	DANIDA	Small-scale fisheries
49	Lauren Banks	WorldFish	Sustainable aquaculture
50	Lu Lu Aung	Dagon University	Sustainable aquaculture
51	Mam Kosal	WorldFish	Small-Scale Fisheries
52	Manjurul Karim	WorldFish	Sustainable aquaculture
53	May Thu Kyaw	WorldFish	Support team
54	May Wah Htwe	WorldFish	Cross-cutting
55	Michael Akester	WorldFish	Small-scale fisheries
56	Michael Phillips	WorldFish	Sustainable aquaculture
57	Min Min Oo	De Heeus	Sustainable aquaculture
58	Min Thu Aung	East Yangon University	Cross-cutting
59	Mo Mo Aung	WorldFish	Sustainable aquaculture
60	Moe Moe Dwae	Lashio University	Small-scale fisheries
61	Moe Moe Myint	Department of Fisheries	Cross-cutting
62	Moe Thandar	Arizona State University	Sustainable aquaculture
63	Mu Mu Myint	Pathein University	Small-scale fisheries
64	Mustafa Hossain	Bangladesh Agricultural University	Small-scale fisheries
65	Mya Than Tun	Wildlife Conservation Society	Cross-cutting
66	Myint Myint Khaing	West Yangon University	Small-scale fisheries
67	Myint Zin Htoo	Department of Fisheries	Cross-cutting
68	Myo Khaing	MYCulture Project - NAG	Sustainable aquaculture
69	Naing Naing Oo	Arizona State University	Sustainable aquaculture
70	Nann Ohu Kham	WorldFish	Support team
71	Nawaraj Neopanae	Koeln University	Small-scale fisheries
72	Nay Thah Paw	WorldFish	Support team
73	Nilar Shein	Department of Fisheries	Sustainable aquaculture

74	Nu Nu Wai	Kyaukse University	Sustainable aquaculture
75	Ohn Ohn Soe	Yangon University	Cross-cutting
76	Ohnmar Khaing	Australian Centre for International Agricultural Research	Cross-cutting
77	Peter Degen	DANIDA	Cross-cutting
78	Petra Shmitter	International Water Management Institute	Small-scale fisheries
79	Phayko	International Water Management Institute	Cross-cutting
80	Pyae Phyo Aung	BANCA	Small-scale fisheries
81	Pyaw	Tender license holder	Small-scale fisheries
82	Pyi Soe	Myanmar Fisheries Federation	Small-scale fisheries
83	Queenie vi Rizaldo	WorldFish	Cross-cutting
84	Romain Langeard	WorldFish	Capture Fisheries
85	San San Hmway	Hinthada University	Cross-cutting
86	Saw La Pah Wah	Department of Fisheries	Sustainable aquaculture
87	Sein Moh Moh Paing	Maubin University	Cross-cutting
88	Shakuntala Thilsted	WorldFish	Cross-cutting
89	Soe Min Oo	Network Activities Group	Small-scale fisheries
90	Soe Myint	Department of Fisheries	Sustainable aquaculture
91	Soe Pyae	WorldFish	Support team
92	Soe Soe Aye	Yadanaporn University	Capture fisheries
93	Soe Win	Leasable fisheries license holder	Small-scale fisheries
94	Sonali Senaratna Sellamuttu	International Water Management Institute	Small-scale fisheries
95	Tariq Islam	Building Resources Across Communities	Sustainable aquaculture
96	Than Aye	International Rice Research Institute	Small-scale fisheries
97	Than Pale	Yangon University	Cross-cutting
98	Thanda Win	Maubin University	Sustainable aquaculture
99	Thant Zin	Mandalay University	Small-scale fisheries
100	Thein Soe	Loikaw University	Sustainable aquaculture
101	Thein Soe	MRTV4	Press
102	Thet Oo	WorldFish	Support team
103	Thet Thet Lwin	Monywa University	Small-scale fisheries
104	Thet Thet Myaing	East Yangon University	Sustainable aquaculture
105	Thet Thet Tun	West Yangon University	Small-scale fisheries
106	Thet Thet Tun	Meikhtilar University	Small-scale fisheries
107	Thida Ei	Yangon University	Small-scale fisheries
108	Thida Oo	West Yangon University	Sustainable aquaculture
109	Thidalay Thwai	Yangon University	Sustainable aquaculture
110	Tin Htut	Ministry of Agriculture, Livestock and Irrigation	Sustainable aquaculture

111	Tin Oo	Maubin University	Sustainable aquaculture
112	Tin Tin Mar Aye	Mandala Degree College	Cross-cutting
113	Toe Toe Soe	Yangon University	Cross-cutting
114	Tun Thein	Department of Fisheries	Cross-cutting
115	Tun Win Myint	Department of Fisheries	Sustainable aquaculture
116	Ulrich Lepel	Deutsche Gesellschaft für Internationale Zusammenarbeit	Cross-cutting
117	Uwe Scholz	Deutsche Gesellschaft für Internationale Zusammenarbeit	Sustainable aquaculture
118	Waing Hmein	Department of Fisheries	Cross-cutting
119	Win	Magway University	Small-scale fisheries
120	Win Aung	MYCulture Project - GRET	Cross-cutting
121	Win Ko Ko	Department of Fisheries	Small-scale fisheries
122	Win Kyaing	Myanmar Fisheries Federation	Sustainable aquaculture
123	Win Mar	Mandalay University	Cross-cutting
124	Win Maw Oo	Yadanaporn University	Small-scale fisheries
125	Win Naing	MYCulture Project - NAG	Sustainable aquaculture
126	Win Naing	Leasable fisheries license holder	Small-scale fisheries
127	Wynn Phyo	WorldFish	Support team
128	Xavier Tezzo	WorldFish	Small-scale fisheries
129	Yaung Naung	Yangon University	Sustainable aquaculture
130	Yin Yin Moe	Department of Fisheries	Cross-cutting
131	Yong Hee Kong	WorldFish Board	Cross-cutting
132	Yu Wai Hlaing	Yangon University	Sustainable aquaculture
133	Yusuf Abubakar	WorldFish	Small-scale fisheries
134	Yvonne Maria Pinto	WorldFish Board	Small-scale fisheries
135	Zaw Lin Tun	Department of Fisheries	Small-scale fisheries
136	Zizawah	Department of Fisheries	Small-scale fisheries



Michael Alister/WorldFish

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