Gulf of Mottama Project

Socio-Economic Assessment on Indigenous Wild Fish Aquaculture System in the Gulf of Mottma

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Gulf of Mottama Project

Socio-Economic Assessment on Indigenous Wild Fish Aquaculture Systems in the Gulf of Mottama

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EXECUTIVE SUMMARY

Myanmar's aquaculture sector has evolved and expanded with various methods used including finfish culture system, net cage, shrimp culture, rice fish culture, and indigenous wild fish production system. Despite this, there is little knowledge about traditional wild fish farming system, notably in native small-scale aquaculture. An initial work in GoM revealed the features of indigenous aquaculture specific to this region, which turned out to be one of the profitable activities, using simple traditional ways. The Gulf of Mottama Project has since supported the development of these aquaculture practices by providing technical guidance and credits through Mon and Bago Fishers Development Associations (MFDA & BFDA). However, there is very little information available on the socio-economic importance of these aquaculture systems to the local communities as well as challenges, opportunities, and interests of the communities to further improve these indigenous systems by merging local knowledge and contemporary practices which foster sustainable aquaculture practices.

This study seeks to highlight the economic and social significance of wild fish aquaculture systems for communities in the GoM, who are interested in improving existing indigenous aquaculture practices by using good aquaculture practices. Wild fish aquaculture operators were interviewed in three villages in Mon and in five villages in Bago. The key results included different types of ponds, various fish species, revenue distribution among different groups in this fish farming practices as well as dynamic changes in the system.

The study identified that wild fish aquaculture significantly supplements household income, acting as a stabilizer during agricultural yield fluctuations. The opportunity for improvement was observed in upgrading pond construction, brood stock expansion, and systematic feeding methods. However, financial constraints hinder the maintenance of brood stock and overall improvements; tailored financial support is crucial. Therefore, the study recommended tailored financial aid for pond preparation, fish feeds, and effective management to enable operators to maintain brood stock. As the capacity of the operators are important, technical assistance for pond preparation, promoting brooding practices, and educating on feeding methods to enhance productivity and quality. Most importantly, evaluating the ecological impact of local practices like using invasive species for fish shelter, and promoting sustainable alternatives is required. In order to achieve these, fostering knowledge exchange forums to merge traditional knowledge and practices with contemporary practices for continuous improvement is highly recommended. Addressing these recommendations can bolster the productivity, sustainability, and resilience of wild fish aquaculture in the Gulf of Mottama, enhancing the livelihoods of involved operators.

ACKNOWLEDGEMENT

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TABLE OF CONTENTS

1 INTRODUCTION

The aquaculture sector in Myanmar has expanded and systems of culture diversified into finfish culture, net cage culture, shrimp culture, rice fish culture, indigenous wild fish culture and so on (FAO, 2023). However, the knowledge on small-scaled aquaculture practices in Myanmar is very limited (Oo & MacKay, 2017). Among these aquacultures, indigenous wild fish culture is still little-known in Myanmar. In 2017, Oo & MacKay conducted a preliminary study on the indigenous wild fish aquaculture practices in Bago Region of the Gulf of Mottama (GoM). It is stated that the aquaculture system found in the GoM is similar to rice field fisheries practices throughout floodplain areas in Asia (Gregory & Guttman, 2002; Halwart & Gupta, 2004). The major difference that the system in GoM can be entitled as “Indigenous Aquaculture” is because the fish are not just trapped and then harvested but they are fed, and brood stock is selected for the next year’s production (Oo & MacKay, 2017). According to the study, the indigenous wild fish aquaculture system provides to substantial income compared to the invested efforts and applied simple traditional practices throughout the process of operation.

Since then, the Gulf of Mottama Project is supporting the development of these aquaculture practices by providing credit as financial assistance and technical guidance through Mon and Bago Fishers Development Associations (MFDA & BFDA). However, there is no aggregated information on socio-economic importance of these aquaculture systems to the local communities as well as challenges, opportunities, and interests of the communities to further improve these indigenous systems by merging local knowledge and contemporary practices which foster sustainable aquaculture practices.

Therefore, the goal of the study is to identify the importance of wild fish aquaculture to household income of communities in the Gulf of Mottama (GoM) and investigate interests of communities and opportunities to upgrade the system by applying good aquaculture practices.

The specific objectives are as follows:

- To investigate the status and practices of wild fish aquaculture system in the GoM,
- To identify the economic or social importance of wild fish aquaculture to the communities and their interests to improve existing system,
- To distinguish opportunities to apply good aquaculture practices and to upgrade wild fish aquaculture system.

2 METHODS

2.1 Study Area

The study was conducted in 3 villages of Bago and 5 villages of Mon. The villages were selected in coordination with the Fishery Officer of GoMP and Community Facilitator and Monitor (CFMs) who had local knowledge on wild fish aquaculture. The study villages are shown in Figure 2.1.

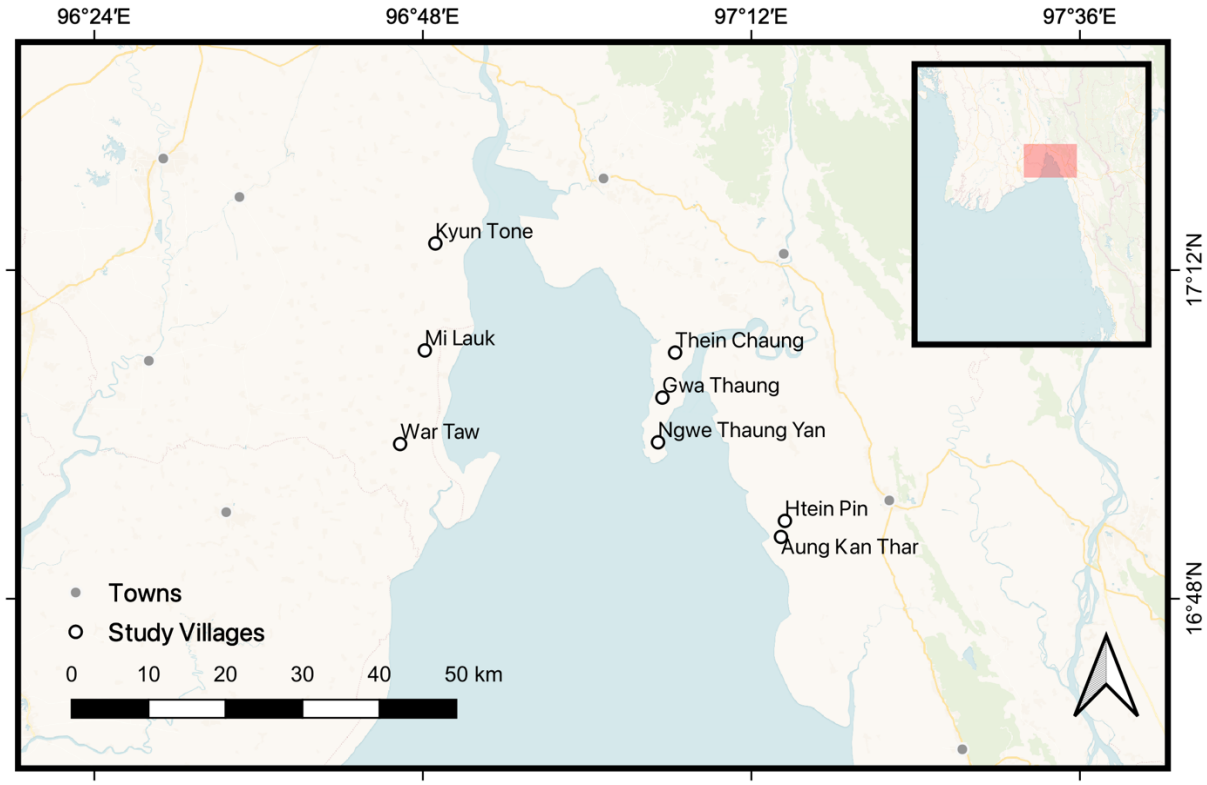

Figure 2.1. The map showing the villages in Mon State and Bago Region where the study conducted.

2.2 Household Interviews

The research applied a qualitative technique to examine the status and practices of wild fish aquaculture system in the GoM, recognizing wild fish aquaculture as a source of side income for communities, their interests, and ideas to improve existing system as well as distinguishing opportunities to apply good aquaculture practices to upgrade wild fish aquaculture.
This household interview involved visiting selected households and their fishponds. Interviews which normally lasted between 30 to 45 minutes were generally carried out face to face in respondents' houses by a trained interviewer and a notetaker. The reason for conducting household interviews was to collect specific information from each respondent. Moreover, the interviewer requested respondents to visualize the structure of fishpond to gain solid information. The field visits were taken from 20th to 30th April 2023 for Bago region and from 9th to 11th May 2023 for Mon state. The sample households where the data collected are described in Table 2.1.

2.3 Data Analysis

The field data were entered into an Excel file which was uploaded on dashboard after gathering data. To interpret patterns in qualitative data, the research team utilized thematic

analysis which captured themes in terms of codes. The encrypted data were analyzed in Excel using a Pivot Table.

Table 2.1. Sample size of wild fish aquaculture operators participated in the study villages.

Sr.	Village	Township	Sample size	Male	Female
1	Aung Kan Thar	Thaton	5	3	2
2	Htein Pin	Thaton	10	5	5
3	Gwa Thaung	Bilin	5	2	3
4	Ngwe Thaun Yan	Bilin	10	4	6
5	Thein Chaung	Bilin	5	4	1
6	Kyune Tone	Thanatpin	5	3	2
7	Mi Lauk	Kawa	10	9	1
8	War Taw	Kawa	10	9	1
	Total		**60**	**39**	**21**

3 RESULTS

3.1 Demographic Information

The study was conducted with a total of 60 wild fish aquaculture operators, of which 35 (Male = 18 and Female = 17) from five villages in Mon state and 25 (Male = 21 and Female = 4) from three villages in Bago region. All of the operators participated in the study has previous experience in wild fish aquaculture. Among them, only 13% of the farmers expressed aquaculture as the main source of income as it contributed more than 50% of annual income. Even so, they do not receive all the income from aquaculture as shown in Figure 3.1. The remaining farmers are operating the wild fish aquaculture as additional source of income. Therefore, most of them receive less than 50% of annual income from aquaculture as in Figure 3.1.

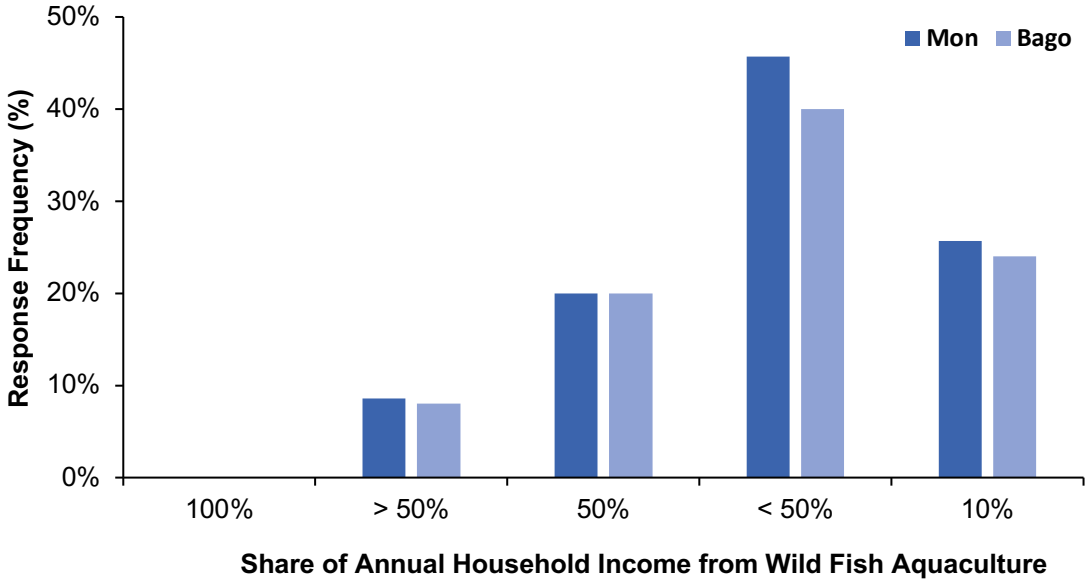

Figure 3.1. Percentage of response frequencies on share of annual household income from wild fish aquaculture in Mon and Bago.

3.2 Wild Fish Aquaculture Systems in the Gulf of Mottama

3.2.1 Wild Fish Aquaculture Practices

3.2.1.1 Types of Ponds

The different types of fishponds operating in the GoM are classified into four categories: integrated farming pond, aquaculture pond, irrigation pond and multi-purpose pond depending on the location of pond and manner of irrigation. An integrated pond is a type of pond mostly located in farm where the farmers dig a pond to store the necessary water for the farm and connect the farm and pond via a canal (FAO, 1998). According to the study, an integrated farming is the most common type of pond in the GoM (72% in Mon and 46% in Bago). Multi-purpose pond means a type of pond in yard or farm which is not connected with the farm and is used for miscellaneous supply of water for household (FAO, 1998). This type of pond is more common in Bago (about 28%) than in Mon (only 9%). An irrigation pond mostly located near the flowing water source, able to be irrigated the water directly, and irrigation is dependent on the tide (FAO, 1998). In the study, the irrigation pond was found only in Mon (16% of total ponds in Mon). An aquaculture pond mainly is to store rainwater and breed bloodstock (FAO, 1998) and they are the least common type of pond (4% in Mon and 2% in Bago) of the study area.

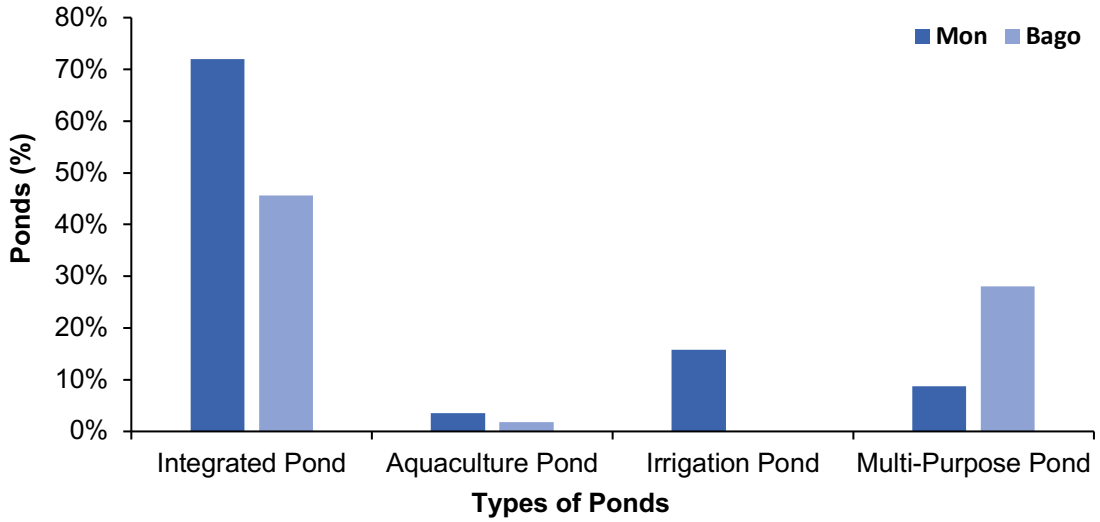

Figure 3.2. Different types of ponds currently operating in Mon and Bago.

3.2.1.2 Water Sources and Drainage Systems

The water source for fishpond in the study area is categorized into four main types: diversion, pump-fed, seepage, and rain-fed, and are shown in Figure 3.3. In diversion pond, the water from nearby water bodies is collected through an irrigation canal (FAO, 1998). This is the most common water source in the study area (74% in Mon and 72% in Bago). About 2% of the total fishpond in Mon and Bago was pump-fed pond in which water is collected by pumping, and pond is normally higher than the water level. The seepage pond was only found in Mon (about 2%), where water is collected from the water-table by seepage into the pond. About 4% of fishpond in Mon and 2 % in Bago were rain-fed as water from rainfall and surface runoff as they need freshwater to culture brood stock fish.

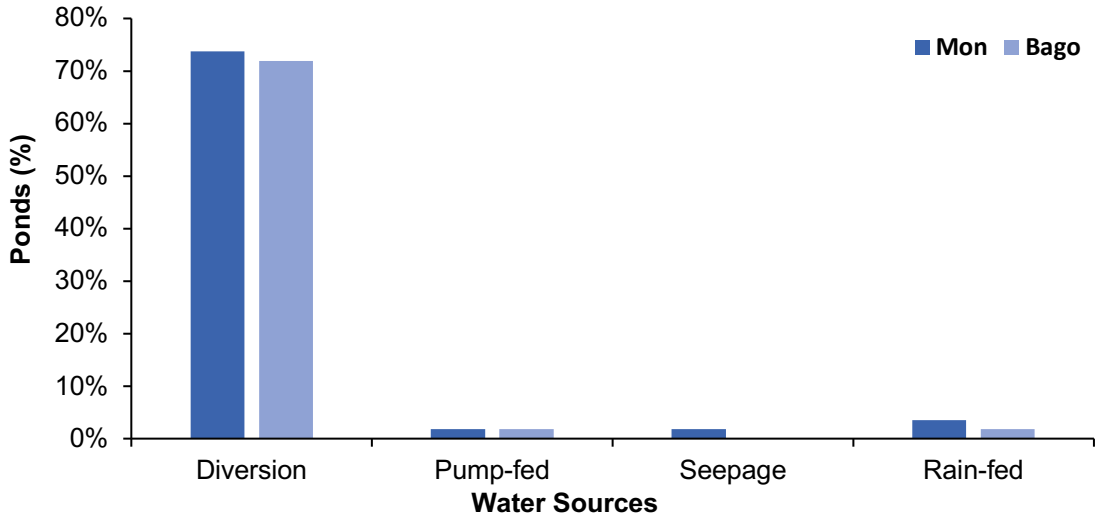

Figure 3.3. Source of water for wild fish aquaculture ponds in Mon and Bago.

3.2.1.3 Construction of Ponds

In Mon, 98% of the total fishpond is dug-out pond in which soil are excavated from an area to form a pond which is filled with rainfall, surface runoff or groundwater while only 2% is cut-and-fill pond that are built by a mix of excavation and embarkment on sloping ground (FAO, 1998). In Bago, all the fishponds are dug-out pond.

3.2.1.4 Size of Ponds

The area and depth of pond in Bago and Mon are shown in Figure 3.4. The fishpond area less than 1,000 square meters is the most common size of ponds in GoM (Mon = 63% and Bago = 56%). However, only 11% of the fishponds in Mon had an area greater than 5,000 square meters (Fig. 3.4 (a)). About 72% of fishponds in Mon and 47% in Bago had a depth of less than 5 meters and 2% of fishponds had the deepest depth of greater than 20 meters (Fig 3.4 (b)).

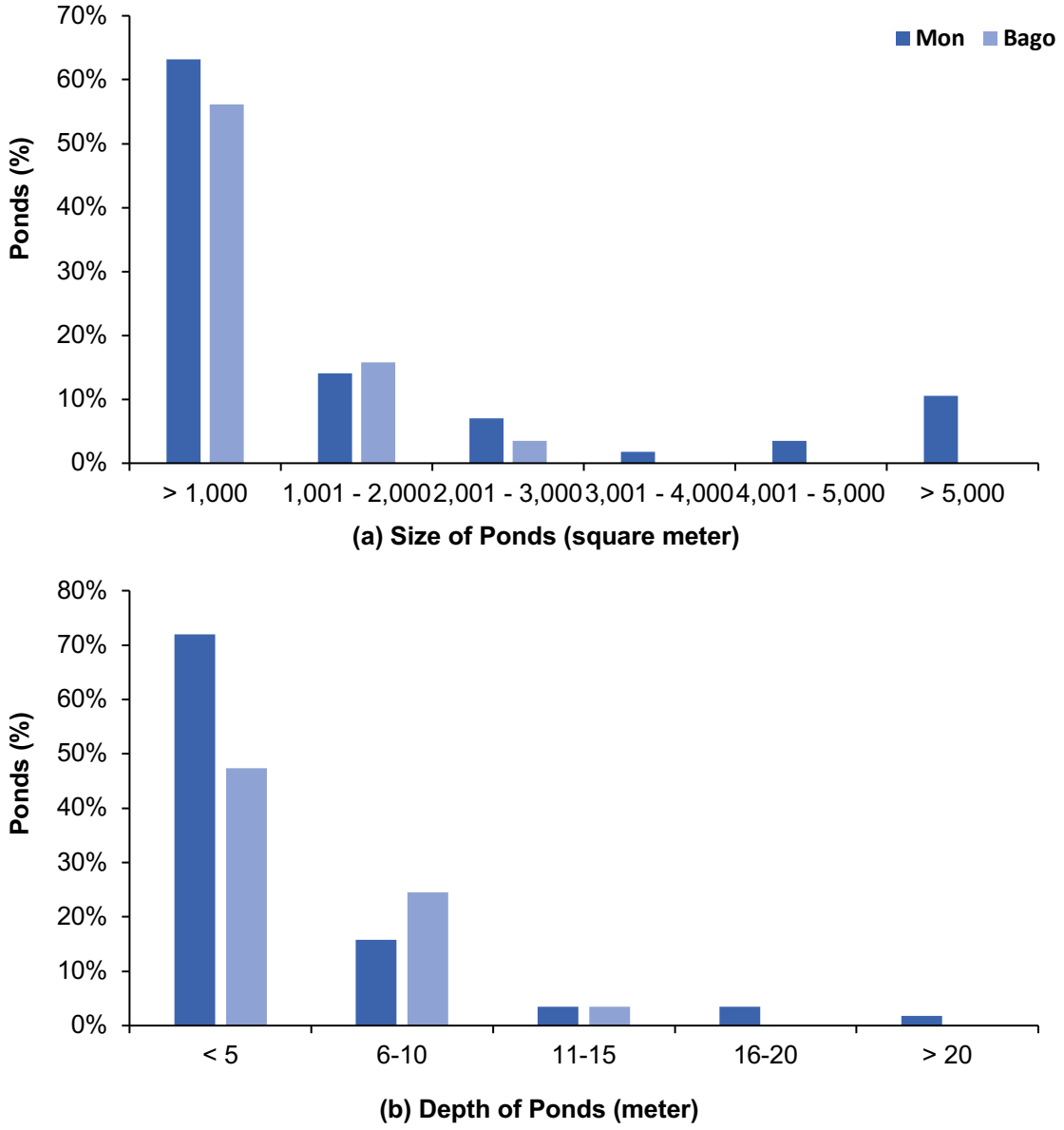

Figure 3.4. Comparison of size of the wild fish aquaculture ponds in Mon and Bago in terms of (a) area, and (b) depth.

3.2.2 Important Fish Species for Wild Fish Aquaculture

3.2.2.1 Wild Fish Species

According to the wild fish aquaculture operators' responses, about 23 wild fish species naturally entered the pond. The top 10 wild fish species entered are snakehead murrel, catfish, seabass, climbing perch and tilapia, mullet, Manipur osterobrama, striped dwarf catfish, wallago and Panaw snakehead. Snakehead murrel (18%) and Seabass (18%) are the most

occurred species followed by catfish (16%), climbing perch (14%) and tilapia (6%) in Mon State. In Bago region, tilapia (21%) is the most abundant species and snakehead murrel (14%), catfish (14%), climbing perch (13%) and seabass (8%) are also caught in the fishponds.

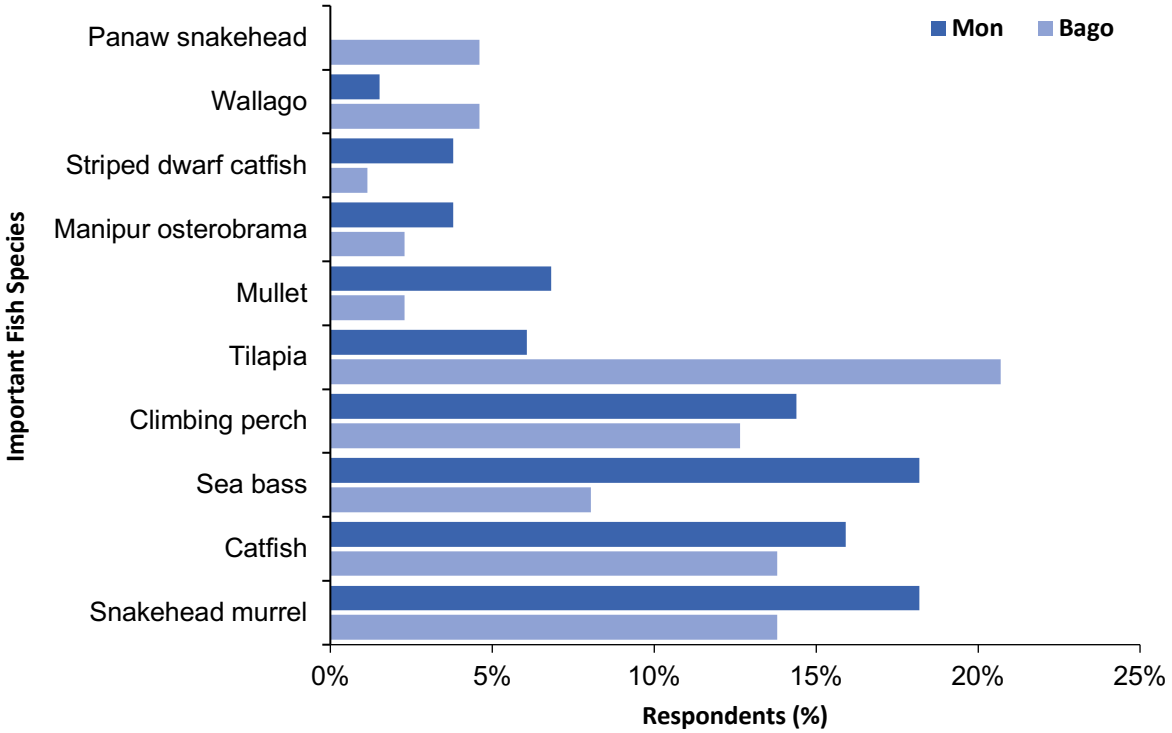

Figure 3.5. Top 10 important wild fish species found in the aquaculture ponds of Mon and Bago

3.2.2.2 Important Wild Fish Species

Among a variety of wild fish species, climbing perch, tilapia, Pangus catfish, barb and carp were reported as important commercial fish species in the study. Among them, only two species: tilapia (75%) and Pangus catfish (25%) were found as commercial fish species in Bago Region. Of all the 5 fish species reported in Mon State, climbing perch (42%) was the most commercial species followed by Pangus catfish (17%), carp (17%), barb (17%), and Tilapia (8%).

According to the responses, about 10 fish species were stored as fish seeds. Among them, catfish, snakehead murrel, climbing perch and Tilapia are most common fish seed species in both Mon and Bago. The other fish species were found naturally only in irrigation pond. Although the sample size of wild fish operators in Bago region is less than those in Mon, the percentage of storing fish seed is relatively the same as in Mon and Bago. It is pointed that more operators in Bago store fish seed than in Mon.

3.2.3 Process of Operating Wild Fish Aquaculture

3.2.3.1 Preparation of Pond

The preparation of pond took place mostly in March and May when the water dried out of the pond. About 98% of the operators stated that pond has to be prepared every 3 years while 2% of the operators mentioned that the ponds were prepared every 4 to 6 years. About 43% reported that pond was dug by backhoe and 7% with manpower. The ditch connected between nearby water and pond was dug with backhoe (25%) and manpower (15%) depending on the

access of machine or financial capability. After that, about 22% of the respondents cleaned the pond by removing the trash or dried leaves in the pond, trimming the branches of trees around the pond, and fencing with bamboo poles and small meshed net. In addition, 10% of the operators sprinkled quicklime (calcium oxide) powder to balance pH level, 5% spread cow manure and fertilizer to grow algae as fish food, and another 5% put branches of mangrove or plant small aquatic plants such as water hyacinth to hire the fish. Some farmers took loans with 5% interest from fish collector for preparation of the ponds. About 2% of the respondents (from Htein Pin) reported that they did nothing for preparation.

3.2.3.2 Fish Seedlings

The wild fish seedlings were managed or collected in two different ways as shown in Steps 2 of Figures 3.6 and 3.7. The first method is shown in Figure 3.6, between June and August, water channel access from nearby sources due to floods or rainfall allowed the release of fish from the ponds for spawning or migration to adjacent water bodies like creeks or rice fields. When rainfall subsided, and the channels began to dry, the fish returned to the ponds, undergoing growth until the period from December to February. In Figure 3.7, the irrigation was regulated by deploying bamboo traps, or nets to prevent the escape of seedlings from the pond but allow entry of fish from surrounding areas. As required, the opening will be completely blocked to prevent saltwater intrusion. Only 5% of respondents bought brood stock.

3.2.3.3 Feeding

The fishpond operators feed the fish from June to December and the feeding methods were based on traditional local knowledge. The study recorded about 20 different products used as fish feed including bran, broken rice, raw bran, coconut, fish paste, broken peas, sheaves, and oil extracted from horse. Among them, bran is the most common feed (90% of farmers fed) in Mon and Bago followed by broken rice (67%) and raw bran (22%). In terms of feeding, the farmers mixed these different products according to their local practices. Two types of feeding techniques are putting the mixture of the ingredients like bran, raw bran, and horse oil, etc.., and scattering of broken rice, rice, leftover rice, bran and so on. Most of the respondents do not need to buy the food as they produced from their own farms. About 7% of wild fish operators in Htein Pin, Gwa Thaung and Ngwe Thaung Yan villages in Mon State reported that they did not feed anything throughout the operation.

3.2.3.4 Harvesting

Between December and February, the water started to recede and 62% of the respondents mentioned that water is pumped out for harvest. And 5% of the respondents harvested the fish when they require water for farming of green gram. Although most of the respondents pumped out with their own pump, some of the respondents (12%) rented pumps from others. After pumping the water, 32% of the respondents hired wage labor, 18% of the respondents reported that neighbors help in harvesting and 15% harvest with family members. About 13% of the respondents sell the whole pond as it is more profitable and reduce operational costs.

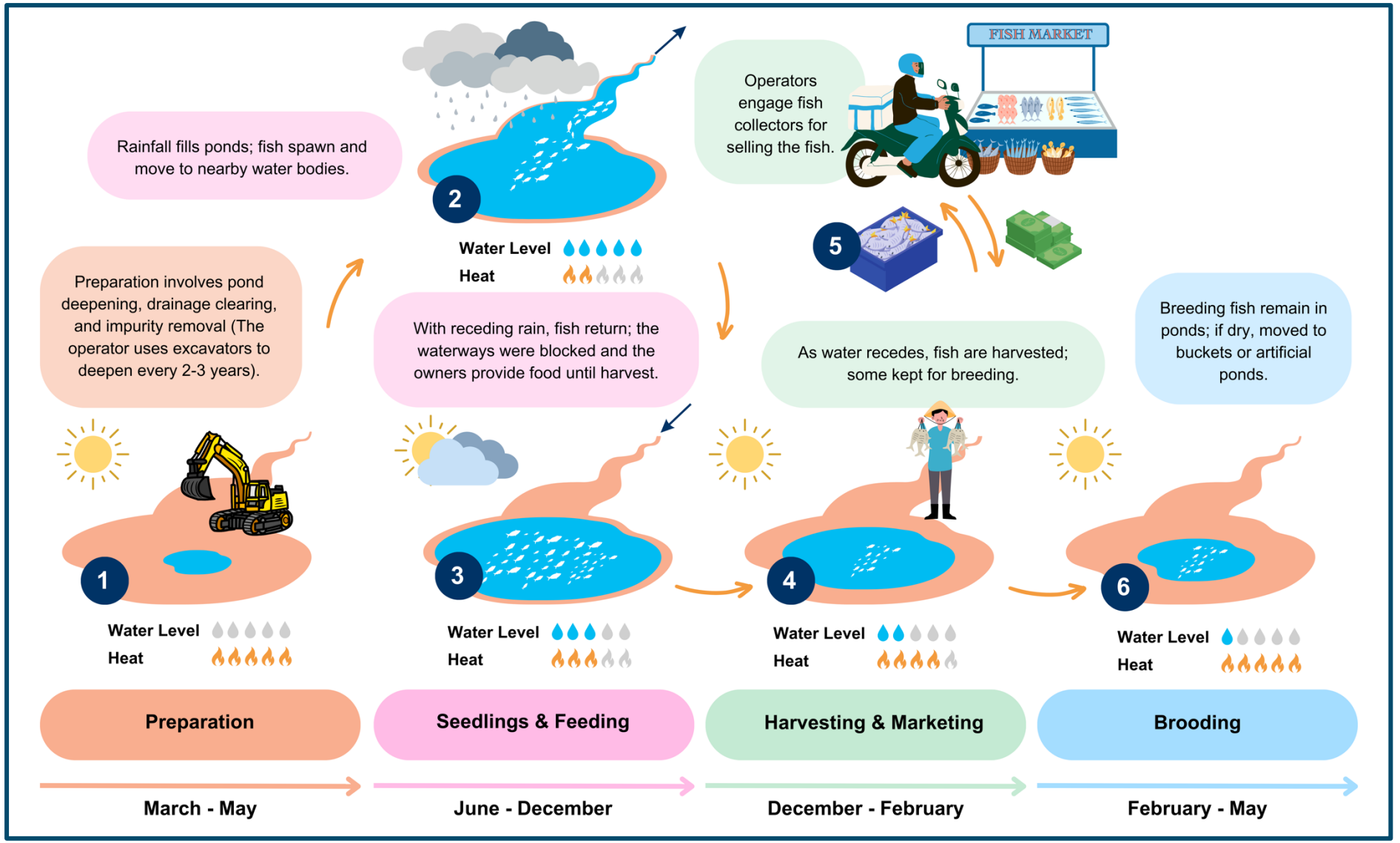

Figure 3.6. Schematic diagram mapping the journey of operating wild fish aquaculture pond throughout the year.

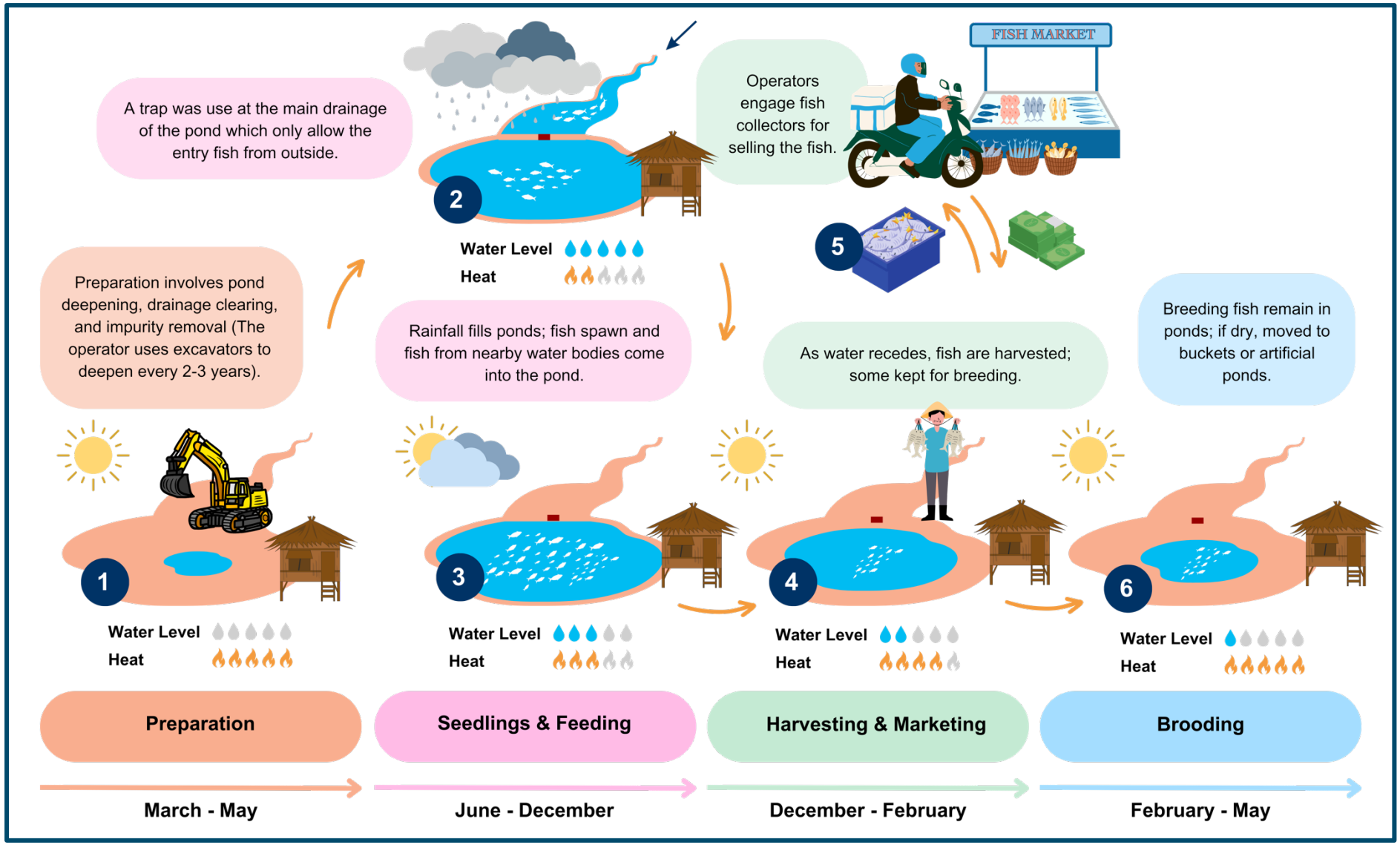

Figure 3.7. Schematic diagram mapping the journey of operating wild fish aquaculture pond by using sluice gate throughout the year.

3.2.3.5 Selling

The harvested fish were subsequently sold to collectors/ wholesalers from nearby village or township. The respondents in Bago sold fish in Thanatpin (10%), Bago (10%), Thakala (7%) and Yangon (2%), and operators in Mon sold in Thaton (12%), Taung Zune (3%), Zoke Tote (2%) and Zin Kyaik (2%). Some of the respondents (8%) mentioned that they sell fish around the village. And 32% of respondents contacted the merchants in advance and sold harvested fish at the merchants in village.

3.2.3.6 Marketing

The fish harvested are put in tarpaulin tank to clean the mud before selling. Fish is stored temporarily in glazed earthen pot prior to sale them alive. About 20% of the respondents rent motorbikes, cars, and tricycles to sell the fish to nearby collector/ wholesaler. Some of the respondents (3%) do not sell as they breed fish for meals and make dried fish for households. 13% of the respondents sell the whole pond so that they did not carry out anything and reduce waste.

3.2.3.7 Brooding

During the harvest, 67% of the farmers leave about 10% of the fish in the pond as brood stock. In such cases, the farmers need to feed them throughout the year. When the water in the lowest in the ponds, shades were built, or water hyacinth are grown to prevent heat. If the water is dried out, the brood stocks are transferred to glazed clay pots or small man-made pools.

3.2.4 Income and Profitability from Wild Fish Aquaculture

The mean annual net revenue from operation of wild fish aquaculture from each study village are shown in Table 3.1. The mean net revenue is slightly higher in Mon (~766,000 MMK) than in Bago (~600,000 MMK). This is mainly because most of the farmers in Mon do not invest in preparation and feeding. Overall, the mean value stated that all villages except Aung Kan Thar has profited in 2023. The variations in profit among villages depend on the size, location of the ponds, the entry of wild fish (it could be natural), the amount of stored fish seed, and due to the result of trailing new local practices. In Aung Kan Thar, one of the main reasons is due to intrusion of saltwater to the fish ponds.

Table 3.1. Comparison of mean annual cost and mean annual revenue, annual net revenue from operation of wild fish aquaculture in villages in Mon and Bago.

Village	Mean Annual Cost (MMK)	Mean Annual Revenue (MMK)	Annual Net Revenue (MMK)
Aung Kan Thar	892,700	740,000	(152,700)
Gwa Thaung	439,571	959,000	519,428
Htein Pin	343,100	665,500	322,400
Ngwe Thaung Yan	434,500	1,330,000	895,500
Thein Chaung	618,000	2,866,666	2,248,666
Mean (Mon)	**545,574**	**1,312,233**	**766,659**
War Taw	1,382,910	1,786,500	403,590
Kyune Tone	826,300	1,892,000	1,065,700
Mi Lauk	404,250	710,625	306,375
Mean (Bago)	**871,153**	**1,463,042**	**591,888**
Mean (Total Sample)	**667,666**	**1,368,786**	**701,120**

3.2.5 Changes in Wild Fish Aquaculture Systems

In the past 5 years, some major changes occurred in wild fish aquaculture systems of both Mon State and Bago Region.

Pond condition: About 22% of wild fish farmers reported fishponds became shallower because the ponds were not dug yearly, and siltation happened. However, 17% of wild fish farmers expanded their fishponds for more fish to enter.

Productivity: About 45% of wild fish operators said that they obtained more fish because of storing more fish seeds and taking care of fish. In contrast, 43% of wild fish farmers expressed that the amounts of fish entering the ponds has decreased due to increased numbers of wild fishers and ponds as well as application of molluscicide resulting in fish dying.

Fish species: A total 63% of wild fish farmers described that there was no significant change in breeding wild fish species because wild fish like snakehead murrel, catfish and perch were suitable to their place, and those species were tolerant to salt water. However, 12% of the wild fish farmers mentioned that there was entry of Tilapia, freshwater prawn, and featherback and they stated that they are spreading in nearby farm and water bodies.

Fish price: 90% of wild fish farmers strongly stated that fish prices greatly increased due to high commodity prices and another reason was fish stocks declined.

Profitability: 58% of wild fish farmers gained more profits due to higher fish prices and a lower cost in preparing old fishponds. Another 53% of wild fish farmers also mentioned that there were no changes in selling fish because they only sold raw fish and they continued to sell fish to wholesalers who they used to sell. Unlike them, 27% of wild fish farmers changed selling fish to new wholesalers who paid high prices while 15% sold the whole fishpond instead of harvesting fish because there was no waste and it was more profitable.

3.3 Challenges, Opportunities, and Supports

3.3.1 Challenges in Operating Wild Fish Aquaculture

According to the responses as presented in Table 3.2, significant challenges in operating wild fish aquaculture were identified. Approximately 25% and 12% of respondents reported financial difficulties in renting backhoes and hiring labor for fishpond preparation respectively. They also had challenges in renting backhoes during the pond preparation month due to high demand and difficult transportation. Additionally, 15% of respondents were constrained in purchasing fish food as their funds were allocated to farming activities during that period, leaving no surplus funds. Moreover, 8% of respondents highlighted instances of theft, reporting incidents where fish and fish seeds were stolen from their ponds. Only 5% and 3% of respondents shared difficulties in renting water pumps during fish harvesting, along with insufficient containers to temporarily store harvested fish. About 10% of respondents expressed concerns about fish spoilage due to various reasons, including prolonged and inadequate transportation, vehicle breakdowns, and unavailability of motorcycle taxis during fish transportation and sale. Additionally, 8% of respondents mentioned unfair pricing by wholesalers, as they have received loans from them.

3.3.2 Opportunities for Improvement of Wild Fish Aquaculture

Despite the challenges, there are opportunities to upgrade wild fish aquaculture system. About 20% of respondents suggested that the pond should be dug deeper to prevent water from drying up fast, while another 20% of respondents stated that more fish will enter the pond if the pond is expanded. And 10% of respondents also said that it would be better if the pond is

prepared every year to produce high yield of fish. Additionally, 18% and 17% of respondents mentioned that breeding bloodstock fish such as Tilapia and Thai Perch are profitable because those fish grow significantly by feeding them with enough food. Storing many fish seeds might attract other fish to enter the pond and it will improve yield. Moreover, it is recommended to apply systematic feeding techniques to obtain good quality fish and feeding the fish with more food will make fish grow rapidly. The 20% of respondents strongly said that they need market access who pay higher prices while 17% of respondents discussed that selling dried fish is more profitable than selling raw fish due to higher demand and prices for dried fish.

3.3.3 Supports for Improvement of Wild Fish Aquaculture

In total, 53% of respondents firmly stated that financial support for preparation of fishpond is the most necessary for improvement of wild fish aquaculture system. In addition, 28% required financial aids to buy fish seeds and 15% require technical and financial support to practice systematic feeding to enhance the quality of fish. Furthermore, 15% of respondents required access to wholesalers or buyers who pay high prices. Then, 7% of respondents requested to provide skills and supports for production of dried fish.

Table 3.2. Challenges, opportunities and supports for improvement of wild fish aquaculture system in the Gulf of Mottama.

Activity	Challenge	Opportunity	Support
Preparation	- Financial difficulty to prepare fishpond (25%) - Difficult to rent backhoe (12%)	- Digging the fishpond deeper will prevent water drying up quickly (20%) - Expanding the fishpond to enter more fish (20%) - Preparing the fishpond 1 time in a year (10%)	- Financial support (53%)
Seedlings	- Fish are stolen (8%) - Unregulated fishing near the fishpond (7%)	- Breeding bloodstock fish is profitable (18%) - Storing many fish seeds to get more fish (17%)	- Financial support for buying fish seeds (28%) - Systematic technique for breeding fish (10%)
Management	- Financial difficulty to buy fish food (15%)	- Apply systematic feeding technique to get good quality fish (23%) - Fish will grow quickly by feeding more food (20%) - Feeding the fish with CP food can make fish bigger (10%)	- Financial support for buying fish food (30%) - Systematic feeding technique (17%)
Harvesting	- Difficult to rent water pump (5%) - Not enough containers to keep fish (3%)	- Rinsing the fish carefully to reduce mud smell (2%) - Harvesting fish in almost dried up pond is easy to handle (2%)	- Financial support to hire labors (8%) - Buckets support (3%)
Selling/ Marketing	- Transportation difficulty (10%) - Unfair fish price (due to prepayment practices) (8%)	- Contacting the wholesalers who pay high price (20%) - Selling dried fish is profitable (17%)	- Contacts of wholesalers who pay high price (15%) - Advanced technique to make dried fish (7%)

4 DISCUSSION

The study interviewed a total of 60 indigenous wild fish aquaculture operators in Mon and Bago and provided synthesis information about socio-economic importance of wild fish aquaculture to coastal communities in the Gulf of Mottama.

4.1 Key Insights

The key insights from the study are discussed as follow:

Profitability and dependency for household income: Wild fish aquaculture in GoM is profitable venture with less efforts and financial investment compared to other fish farming methods. The system needs space and therefore, all the operators are farmers who had own farmland or rented ones. For some villages in Bago, the practice is extended in backyard of the houses. Therefore, the aquaculture practice is providing important additional source of income for farmers although they do not solely depend for their household income. For example, even if agricultural yield decrease, fish farming serves as support system to ensure the financial stability of the households.

Opportunities for improvement: As the aquaculture has very promising opportunities and potential to improve the household income, the people are much interest to further improved the aquaculture practices to gain more profits. The construction of the ponds influences the entry of wild fish. So, the ponds should be prepared with backhoe having enough depth and size. Some fishers provided small ditches in the pond as playground to attract more entry of fish. Moreover, increasing the brood stock has positive impact on larger fish catch and so, the brooding practices should be emphasized for further improvement.

In addition, more systematic baiting and feeding methods based on local knowledge hold potential for more fish entry. Local practices such as the use of horse oil, and a mixture of bran, raw bran broken peas are common. However, fish nutrition, and potential harms to the environment should be thoroughly considered. In addition, the operators are currently applying water hyacinth, alarmingly invasive species, as shelter for fish. So, such local practices should be evaluated for further improvement of the farming practices.

Motivation for improvement: The current wild fish aquaculture practices are based on traditional knowledge and most of the operators would like to get better techniques and support.

Access to finance: The operators expressed financial constraints as the major challenge. One significant reason that they refrain from keeping the brood stock is the need to sell all the harvested fish to generate higher income. As a result, financial supports are crucial in terms of preparation of the ponds, choosing fish feeds, and ensuring effective management.

4.2 Key Recommendations

Based on the key insights, the recommendations in response to Ecosystem Approach to Aquaculture (EAA) (FAO, 2010) are:

Financial support and access to finance: Initiatives providing financial support tailored to the needs of wild fish aquaculture operators should be encouraged. This assistance could encompass funding for pond preparation, investment in appropriate fish feeds, and support for effective management practices. Financial incentives that allow operators to maintain brood stock without compromising their income from fish sales should be explored. This can be vital in improving overall productivity.

Capacity building and technical support: To enhance construction methods for ponds, technical assistance for preparation of fishponds is essential. Promoting brooding practices and adequate feeding methods for farmers through training and education sessions could significantly improve the yield and quality of fish caught.

Environmental considerations and sustainable practices: Encouraging a shift towards more systematic and sustainable baiting and feeding methods based on local knowledge should be accompanied by comprehensive assessments of their ecological impact. Evaluating the use of invasive species, such as water hyacinth, for fish shelter is crucial to ensure farming practices remain environmentally sustainable. Other locally adapted methods for fish shelter should be identified and promoted.

Innovation and technology Adoption: Introducing innovative yet practical technologies that align with traditional knowledge can be beneficial. This can involve introducing more efficient methods for pond construction, better baiting techniques, or sustainable fish feed alternatives that improve both productivity and environmental sustainability.

Community engagement and knowledge sharing: Foster a collaborative environment that promotes the exchange of knowledge and experiences among operators. Encourage forums or workshops where traditional knowledge can merge with contemporary practices, promoting a shared learning experience for continuous improvement.

Improve Marketing Opportunities: Gaining good price from selling the fish is very important criteria for profitability of the fishers. Therefore, it is important to improve opportunities to access to markets in the region while ensuring the sustainable and environmental friendly productions from the farmers.

By addressing these recommendations, it will enhance the productivity, sustainability, and overall resilience of wild fish aquaculture in the Gulf of Mottama while supporting the livelihoods of the operators involved.

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