Gulf of Mottama Project

Social Potential Assessment for Fishery Management in the Sittaung River and Major Tributaries

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EXECUTIVE SUMMARY

The Gulf of Mottama (GoM) with its unique intertidal ecosystem with diverse fish species is no exceptional in supporting important Small-Scaled Fishery (SSF) for local people residing in its coastal region and the river systems. In the GoM, the Sittaung River and its tributaries are one of the crucial river systems which supporting one of the migratory routes of several diadromous fish species as it supports crucial habitats for breeding and feeding migratory fish species. Due to co-founding conservation threats in the river and the gulf, conservation actions are required for the sustainability of the fishery.

In order to take effective conservation actions for the important fish species, the understanding on social context of local fishers in relation to the targeted fishery is still limited. Therefore, the study will explore "social potential" from the communities to effectively participate and support on the fishery conservation activities. Therefore, the study conducted in two potential conservation zones to understand the interest of communities and assess social potential to implement community-based fishery conservation activities in Sittaung river and major tributaries.

The study captured the fishery as major source of income for the study sites and identified five important fish species for conservation: Pama croaker, Paradise Threadfin, Mullet, Hilsa Shad and Seabass. Similar to other studies in the regions, the communities reported that overfishing, illegal fishing, changes and degradation of river ecosystem, unregulated extractions of resources and climate change as major conservation threats. In order to accommodate these threats, the study recorded the over 90% of the respondents interested in fishery conservation. The requested approaches include consultation and awareness raising about conservation issues, combating illegal fishing, seasonal closure for selected fishing gears, no fishing seasons for important fish species and, to effectively enforce all these activities, establishment of locally managed fishery conservation zones are suggested. However, there are some respondents who were worried about adverse impacts from the conservation actions, and they are suggesting mitigation actions such as supports for alternative livelihoods, financial support during close seasons and change of fishing gears or fishing ground.

The study further explored the social potential of the community: leadership, trust, social cohesion, communication, and knowledge in each study site. The social potential scores suggested that with intensive supports from stakeholders, the communities will be able to implement fishery conservation activities in the community. Therefore, the study recommended to move forward in establishing fishery conservation zone with further assessment and engagement with the communities. To strengthen the social potential throughout the process of establishment of fishery conservation zones is also recommended in the study.

ACKNOWLEDGEMENT

The research project was supported by the Gulf of Mottama Project (GoMP) which is mainly supported by Swiss Development Corporation (SDC). Therefore, we would like to provide our sincere acknowledgement to SDC for supporting the research through the GoMP. Most importantly, we would like to appreciate the participants in the communities who involved in the interviews and discussions for their meaningful and valuable contributions. Then, we would like to thank Dr. Bo Sann from IUCN for continuous supports through the development of the project. In addition, we want to thank the Fishery Officer, the Township Clusters Coordinators (TCCs) and the Community Facilitators and Monitors (CFMs) of the project for their supports in coordination for field activities. Finally, we would like to appreciate field researchers and research assistants from Myanmar Coastal Conservation Lab (MCCL) @ Point B Design + Training, who actively participated throughout the research process.

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1 INTRODUCTION

Regardless of variable definition of Small-Scaled fisheries (SSF) due to the context of the country or regions, the FAO Advisory Committee for Fisheries Research generally described SSF as *"as a dynamic and evolving subsector of fisheries employing labour-intensive harvesting, processing and distribution technologies to exploit marine and inland water fishery resources"* (FAO, 2020). Even though different institutions define differently, the importance of SSF is largely recognized across the globe. Globally, about 90% of the employment in capture fisheries fall into SSF throughout its diverse value chain. SSF value chains support livelihood for 113 million people and/or depending on its substances (Illuminating Hidden Harvest, 2021). The importance is more prominent along the coastlines (especially in rural coastal regions) of Southeast Asia where SSF remain as one of the major livelihood sources and food security for local communities (Tech and Pauly 2018, Cinco *et al.,* 2015, Béné *et al.,* 2010, Johnson, 2006).

The Gulf of Mottama (GoM) with its unique intertidal ecosystem with diverse fish species is no exception in supporting important SSF for local people residing in its coastal region and the river systems. There are extensive mudflats, and the complex estuarine and river systems of the gulf host about 40 economically fish species including Hilsa shad, Toli shad, Sea bass, Pama croaker, Paradise Threadfin, Indian Threadfin, Sea catfish, River catfish, Whiting, and Mullet (Thazin Htet, 2016, GoMP, 2018). Due to their economical values, the SSF in the gulf thrive millions of inhabitants along the coasts throughout the value chain from fishers to processors such as traders, taxi drivers, ice makers and fishing gears producers (GoMP, 2018). The small-scale or artisanal fishermen in the area compose the majority of fishers in the GoM region, but the fishery is mainly characterized by low technology and a lack of contemporary equipment. The main gears are trammel net, drift gill net, stake net, stake net, gill net, beach seine, bag net, crab trap and crab hook.

In the GoM, the Sittaung River and its tributaries are one of the crucial river systems which support one of the migratory routes of several diadromous fish species as it supports crucial habitats for breeding and feeding migratory fish species (Zau Lunn et al, 2021). However, the river is confiscated with unsustainable fishing practices such as electric fishing, poison fishing, stake net (Than Zakar Pike: very small mesh sized fishing gears) and other controversial gears including stow net (Damin). In addition, there are also the formation of sand bars in the downstream of the river that prohibit the migration of fish to upstream movements and gold mining, sand mining and pollution also occur in spawning area. Therefore, conservation interventions for migratory fish in this area is required for the sustainability of the fishery in the Sittaung River and its major tributaries.

1.1 Critical Knowledge Gaps

In October 2021, Fauna and Flora International (FFI) conducted "Rapid Assessment of Diadromous Migration of Economically Relevant Fish-Species with a focus on Hilsa shad

(*Tenualosa ilisha)* between the Gulf of Mottama and the Sittaung River Basin: Hilsa shad Conservation Planning in Sittaung and Major Tributaries". According to the assessment, the areas of Sittaung river and major tributaries starting from Thanlwin river mouth to Zay Ya Thein are important for migration and spawning of hilsa shad, an economically important fish species for small-scaled fishers. However, hilsa shad is tremendously declining due to major threats including fishing with tiny mesh-size nets (Than Za Kar Pike), set bag nets (Da-min), and the adverse impacts of construction of dams and saltwater intrusion barriers which limit the migration of the fish. In addition, other challenges such as sand mining, electro fishing, poison fishing, and discharge of untreated sewage and wastewater into the river have also led to depletion of several fish species including hilsa shad.

Therefore, the following measures are recommended by FFI`s assessment for effective management of hilsa fishery in Sittaung:

- Consultation and raising awareness of respective stakeholders.
- Legal enforcement on illegal fishing to decrease capture of juvenile fish.
- Seasonal closure of stow net fishing during spawning seasons.
- Establishment of community-based fishery conservation area (potentially locally managed freshwater areas (LMFA) or community managed fish conservation zone (FCZ) in collaboration with Department of Fishery and local communities) for spawning and nursery of fish species.
- Enforce hilsa shad close fishing seasons (recommended close season would be from January to April).

In addition, the study of FFI also recorded fish species in the upstream and downstream of the river. It recorded a total of 46 economically important fish species through market surveys. It is noted that hilsa shad was the most valuable fish species among them in terms of market value and high economic return. However, the hilsa shad fishery in the Sittaung is in decline and it is essential to focus on other economically fish species which support the well-being of small-scaled fishers along the river and its tributaries. Recognizing hilsa shad as an indicator for the fishery in Sittaung, it is expected that other important fish species are under similar or same fishing pressures and conservation threats. So, in addition to hilsa shad, it is also necessary to conserve these fish species for the sustainable benefits for the fishers.

In order to take effective conservation actions for the important fish species, the understanding on social context of local fishers in relation to the targeted fishery is still limited. Therefore, the study will explore "social potential" from the communities to effectively participate and support in the fishery conservation activities.

In the rapid assessment, FFI proposed six areas to focus on fishery conservation. Among them, Area 5 (Ta Naw Kyun) showed highest suitability and feasibility to initiate conservation actions for Sittaung. Moreover, the Area 6 (Zoke Ka Li and surrounding

areas) is in the range of GoMP, and the project has developed extensive knowledge on ecological context of the local fishery as well as supporting fishery development activities in the area during the project phases. Therefore, the present study collects social-ecological information on these two areas to further facilitate decision making for fishery conservation actions in Sittaung and tributaries.

1.2 Goals and Objectives

This study aimed to understand the interest of communities and assess social potential to implement community-based fishery conservation activities in Sittaung river and major tributaries. Therefore, the study is conducted with the following objectives:

1. To identify the important fish species which support the well-being of local communities in the study area.
2. To distinguish locally relevant community-based conservation approaches for fishery management in the area.
3. To assess social potential (interest, leadership, capacity, knowledge, social organization, collaboration, and participation) to implement community-based fishery conservation actions.

2 METHODS

2.1 Study Area

The research was conducted in 8 fishing villages in two proposed fishery conservation zones from rapid assessment conducted by FFI in 2021. The location of potential fishery conservation areas and the study sites were shown in Figure 2.1. Among 8 villages, Ta Naw Kyun in Waw Township is outside the project area of Gulf of Motta Project (GoMP).

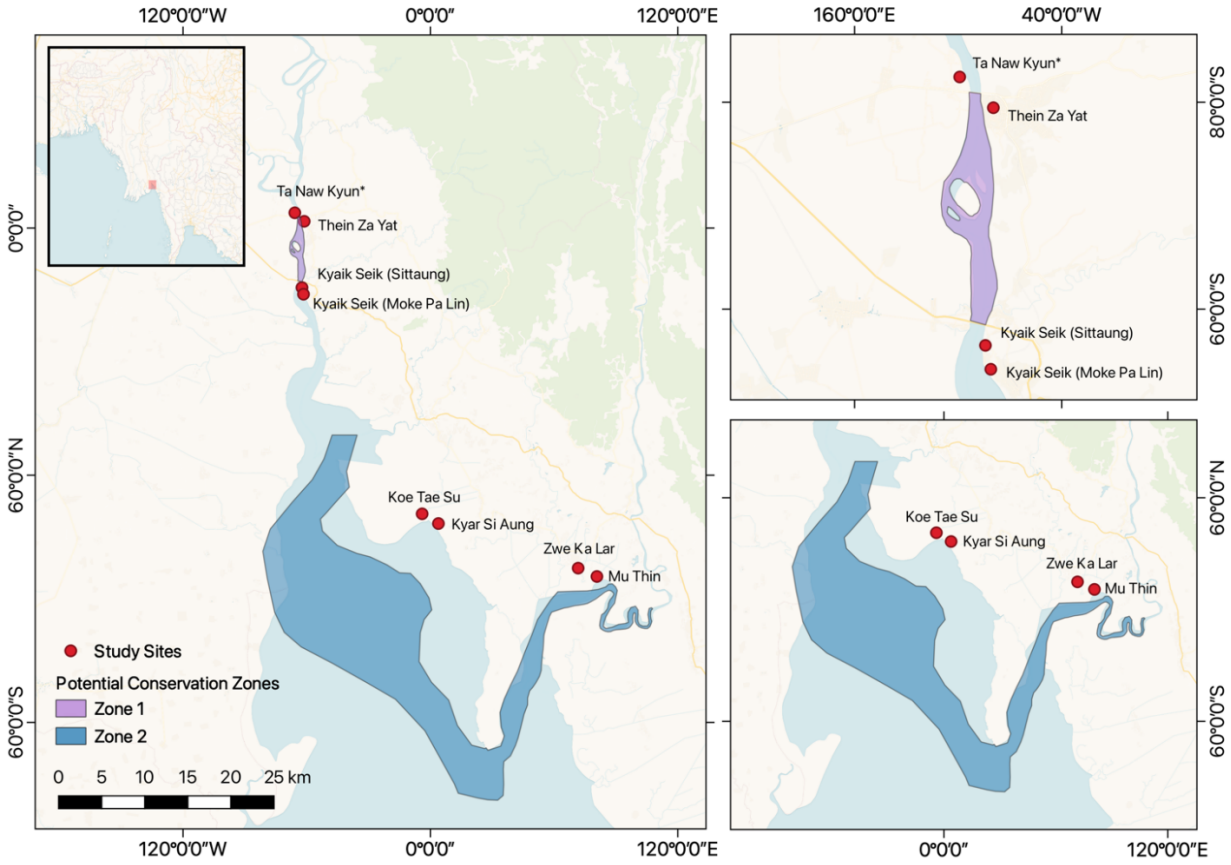

Figure 2.1. Map showing the location of potential fishery conservation zones in the Sittaung River and the village where the study was conducted.

2.2 Field Research

The pilot study was conducted in Kyauk Seik (Sittaung) and Thein Za Yat (Ywar Ma) in September 2022. Then, the research design was revised and finalized in accordance with suggestions from the GoMP and completed the surveys in other 6 villages in October 2022. The field activities included household surveys with fishers applying participatory visual tools and key informant interviews with village leaders or people with extensive knowledge about fishery management of the respective activities as identified in the household survey.

2.2.1 Household Survey

The research applies a human-centered approach, which is a qualitative study to explore the experiences, feelings of target users, small-scaled fishers in the study area to understand their dependency and record changes in fishery, identify their interests, and distinguish their motivation and constraints to participate in fishery management activities. The research further assessed the social potential of the communities. By "social potential", it means whether the communities appear to be interested in fishery management, and whether there seems to be a strong foundation in the communities for planning, organizing, implementing, and managing fishery conservation activities.

In each village, 30% of the total fishing households were selected through purposive sampling. The total household for each village is shown in Table 2.1. Each interview was conducted by 2-3 trained interviewers and took for 30 – 45 minutes to complete the questionnaire. The household survey tool can be seen as in **Appendix 1**.

The household survey comprised of two methods as follow:

- Semi-structure interviews, and
- Participatory visual tool.

Table 2.1. Total number of households, sample size and percentage of total household for questionnaires conducted in the study.

Village	Township	Total Household*	Fishing Household	Sample Size	% Fishing Household
Kyauk Seik (Sittaung)	Kyaik Hto	80	40	12	30
Thein Za Yat (Ywar Ma)	Kyaik Hto	400	125	37	30
Ta Naw Kyun	Waw	250	90	28	31
Kyauk Seik (Moke Pa Lin)	Kyaik Hto	96	35	10	29
Koe Tae Su	Bilin	108	70	20	29
Kyar Si Aung	Bilin	130	50	15	30
Mu Thin	Bilin	926	98	29	30
Zwe Ka Lar	Bilin	331	35	10	29

*Data from GoMP, 2019.

2.2.1.1 Semi-structured interviews

The questionnaire is structured to understand the following parameters:

Personal information: included basic demographic information about the respondent such as gender, age, years of fishing.

Dependency of household on small-scaled fishery: assessed the source of income for respondent's household and identify the importance of fishing to their income. Additionally, different target fish are important for the respondents, the fishing gears they use, and different months for different target fish are collected.

Perceptions on changes in fishery: identified the trend of the target fishing in the past 10 years with variables such as number of fish, size of fish, price of fish and number of

fishers. Based on the changes the respondents identified, the impacts on their household from the change were discussed.

Interest in fishery conservation: asked the respondents on their interest in fishery conservation and their previous activities on conservation activities were discussed.

Social potential in the community: opened the discussion on the leadership and trust in the community. It then asked how the respondents are participating or collaborating with different social and community groups, and how they are communicating with different people in the community.

2.2.1.2 Visual participatory tool: Sorting cards

In order to explore community interest in the fishery conservation, four sets of sorting cards were applied to identify the suitable approaches for conservation in the community and their roles to participate in different levels in the conservation activities. The parameters for each set of sorting cards are shown in Table 2.2. The conservation approaches are developed based on the recommendations from FFI`s assessment (2021). The ways to participate in different levels were identified from difference literature sources (References).

Table 2.2. The parameters of sorting cards applied as visual participatory tool in the study

Set	Sorting card	Description	Purpose
1	Conservation Approaches	Card 1: Consultation and raising awareness of respective stakeholders Card 2: Legal enforcement on illegal fishing to decrease capture of juvenile fish Card 3: Seasonal closure of some fishing gears during spawning seasons Card 4: Enforce close fishing season for commercially important fish species Card 5: Establishment of community-based fishery conservation area	To identify suitable conservation approach to implement in the community.
2	Participation Level 1: Household	Card 1: Attend awareness activities Card 2: Share information about fishery conservation to the household and friends Card 3: Participate in fishery research activities Card 4: Follow fishery rules and regulations Card 5: Report illegal fishing activities	To identify how the respondents are willing to participate in different levels in fishery conservation activities
3	Participation Level 2: Community	Card 1: Participate in community level fishery conservation activities Card 2: Collaboration and coordination in community awareness activities	To identify how the respondents are willing to participate in different levels in fishery conservation activities

		Card 3: Participate in community level discussion for identifying solutions for fishery related issues Card 4: Lead fishery conservation activities Card 5: Participate in patrolling for illegal fishing activities	
4	Participation Level 3: Outside Community	Card 1: Provide advice in designating fishery conservation zones Card 2: Participate in planning for community-based laws and regulations for fishery management Card 3: Advocate fishers from other villages to participate in hilsa conservation area Card 4: Attending stakeholder meetings for fishery conservation and management Card 5: Participate in creating funding for sustainable fishery conservation and management	To identify how the respondents are willing to participate in different levels in fishery conservation activities

2.2.2 Key Informant Interview

The collected data were validated in meetings with resource people mentioned in the household interviews. The key informant interviewees are village leaders, fishery related group leaders and/or elders in the community. The KII collected data on target fish for the respective communities, the trends on local fishery over the past 10 years, suitable conservation approaches for the communities and their recommendations on required actions to include all stakeholders in the community to the conservation activities.

2.3 Data Analysis

The field data were enumerated into Excel as soon as the data collection was completed. The quantitative data were analyzed in SPSS and Excel using descriptive statistics. To analyze qualitative data, the team mainly applied thematic analysis by coding the data using Excel. For each piece of qualitative information, different codes were assigned from standardized list of codes to identify the main theme covered by that piece of information. Then, they were quantified and evaluated the insights provided by the data.

2.3.1 Qualitative Analysis

To quantify the qualitative data from the study, social potential assessment was applied. For the assessment of the social potential of each study villages, a matrix was created based on the responses from the survey. The matrix has five factors affecting on the potential of the community to develop fishery conservation activities. Each factor for each village was scored from 1-5. The rubric can be seen in the Table 3.3.

3 RESULTS

The results session identified the dependency of study sites on fishery and their perception on changes in fishery over a period of 10 years, and explored the interests of community in fishery conservation. Finally, the social potential for each area is assessed to gain insights on further supports needed for each area to be able to establish fishery conservation initiatives.

3.1 Demographic Overview

The study conducted a total of 161 household interviews in 7 villages of 3 townships in Mon State and 1 village from Waw Township of Bago Region of the Gulf of Mottama. A total of 122 men and 39 women participated in household interviews and 7 village leaders and/or leaders in fishery sector were included in the key informant interviews. Fewer percentages of women were included as the household interview focused more on the experience of fishing in the Sittaung River and the Gulf of Mottama and only active fishers who were currently going out for fishing activities.

The age group of most respondents are 41 – 50 years (31%) and followed by 31 – 40 years (26%). Different age groups of respondents participated in the study are demonstrated in Figure 3.1. In the study, more than half of the respondents (66%) are original residents (born, raised, and currently residing in the community) and there are 34% of total respondents who are migrants from other communities (Figure 3.2). The fishers in the study village have strong experiences in fishing along Sittaung River and the Gulf of Mottama as almost 47% of the respondents have fishing experience more than 25 years (Figure 3.3). Most of the respondents who only have experience in fishing around 0 – 5 years are mostly migrants who were displaced from Bago. The resettlement of migrants is mostly common in Kyar Si Aung and Koe Tae Su.

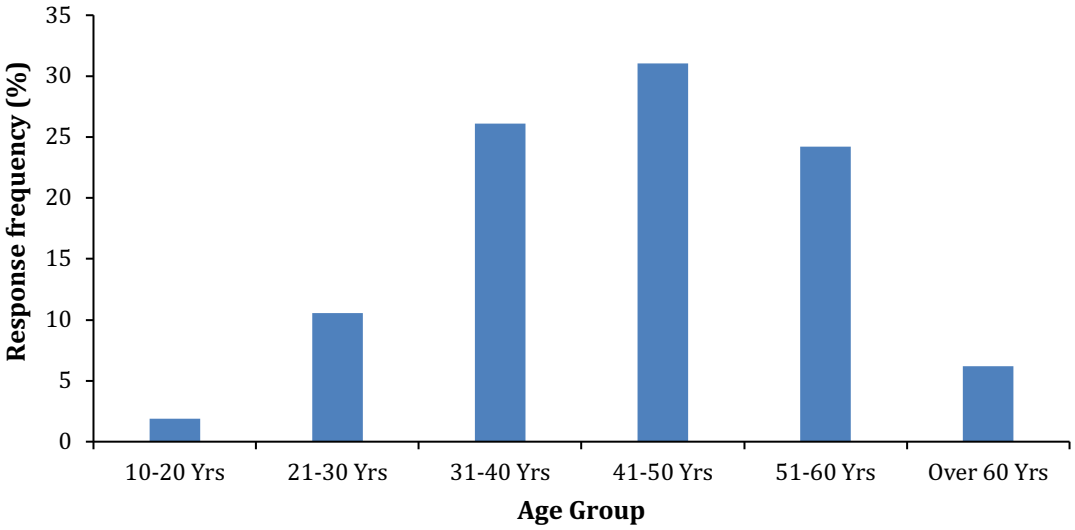

Figure 3.1. The percentage of respondents from different age groups participated in the study.

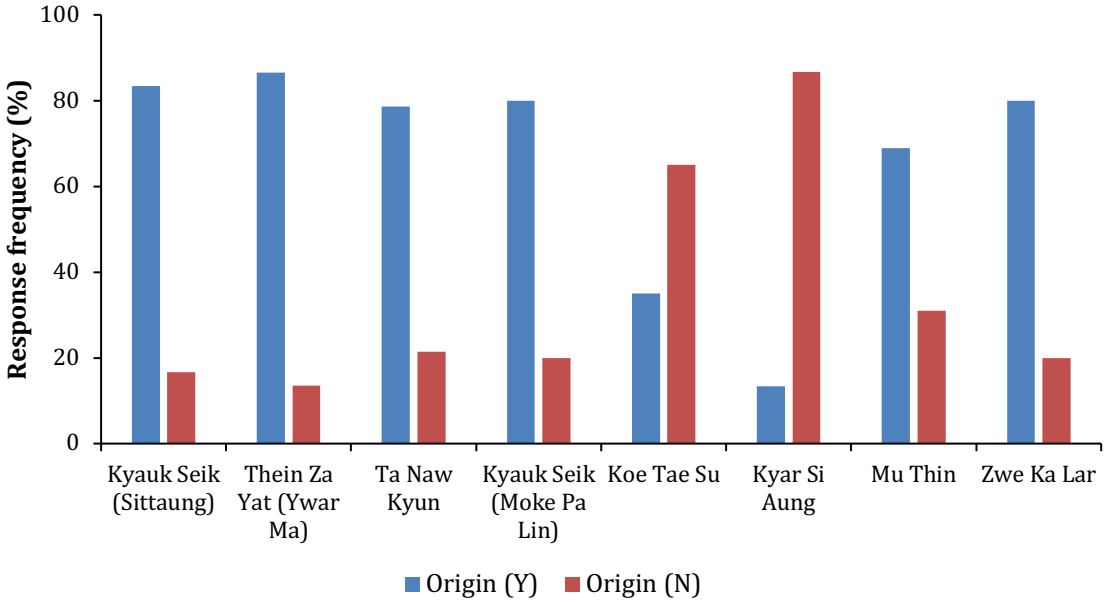

Figure 3.2. The residency of respondents in each village. The blue column represents the percentage of respondents who are original residents of the village, and the red column represents the percentage who migrated.

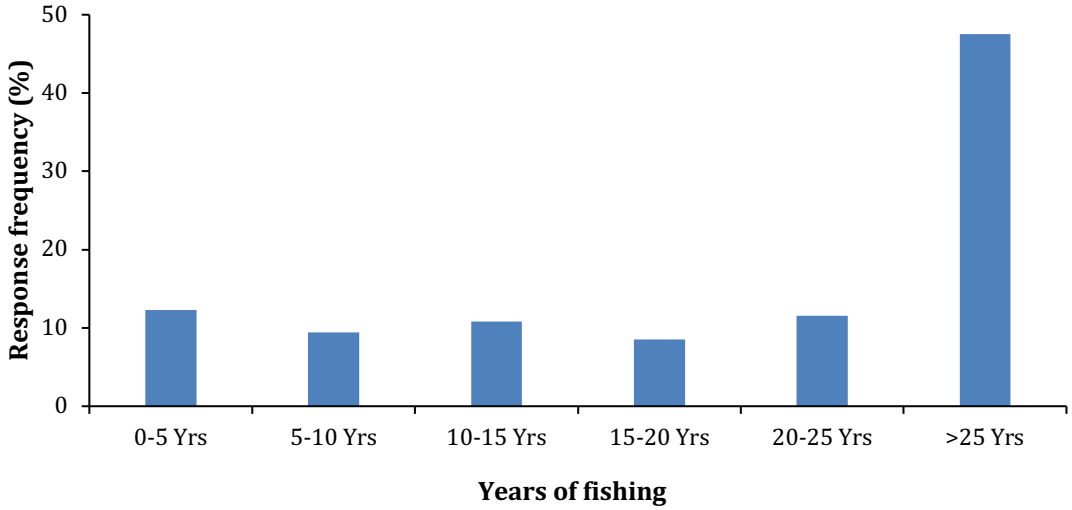

Figure 3.3. The experience in fishing of the respondents shows the mean years of respondents working as fisher.

3.2 Community Dependency on Fishery

The study captured varieties of livelihood activities which are conducting in the communities. Among them, the importance of fishing for household income is shown in Figure 3.4 where it shared information about the percentage of respondents in each study site where they ranked fishing as the most important source of income.

In this graph, most of the respondents (nearly 90%) in each village except Ta Naw Kyun and Kyar Si Aung scored fishing as their primary source of income. Kyar Si Aung was mainly composed of migrants from both Bago and other parts of Mon State and livelihood opportunities are scarce and community capital are limited. Therefore, the community focused on different activities which need less investment throughout the year to get income such as crab fishing, working as wage labor in farming. Therefore, regardless of their close vicinity to coastal resources, people were less dependent on fishing, but they were engaging opportunistically throughout the year. In terms of Ta Naw Kyun, it is relatively large village composed of 9 wards. Only 3 of them on the bank of the Sittaung River engaged in small-scale fisheries in the river. They havd lower dependency on fishing compared to other coastal villages as they could access different livelihood activities including farming.

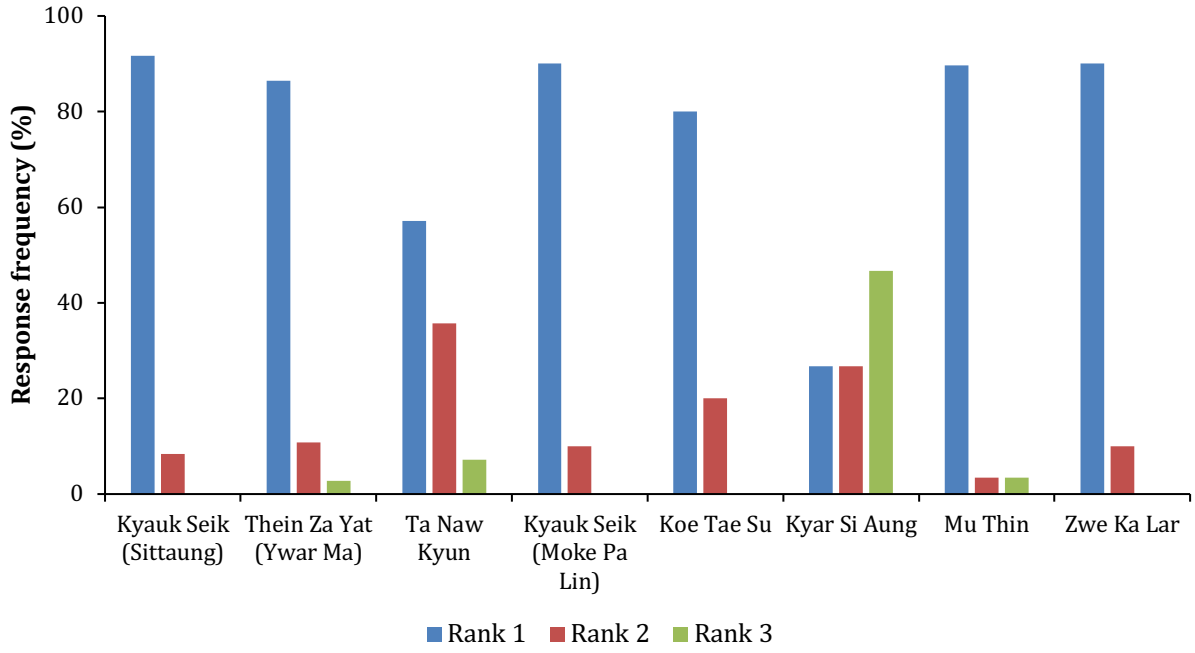

Figure 3.4. Percentage of respondent in each village who ranked fishing as top three sources of income.

3.3 Economically Important Fish Species

As the Gulf of Mottama supports very diverse fishery, the target fish differ based on the locations and the types of fishing gear they are using. The present study records 35 target fish species which are economically important for fishing communities, and the most important fish are shown in Figure 3.5. Among them, the top five fish species which are mostly targeted in the study area were Pama croaker (17.5 %), Paradise threadfin/ mango fish (15%), Hilsa shad (13%), Mullet (11%), and Seabass (7%). Hilsa shad is more common in Zone 1 as the fish migrate to these areas for spawning and nursery of juveniles. Some fishers from Zone 1 targeted Hilsa but they were not only fishing in Sittaung but also in the mouth of the Thanlwin River (near Mawlamyine). However, mullet were more targeted in Zone 2 due to the extensive mudflats in the area. The

responses from Zone 2 stated that the occurrence of Hilsa shad was very rare in the past 10 years. The identified fish had been validated with key informant interviews with leaders in fishery related associations in the community and Fishery Officer from the Gulf of Mottama project.

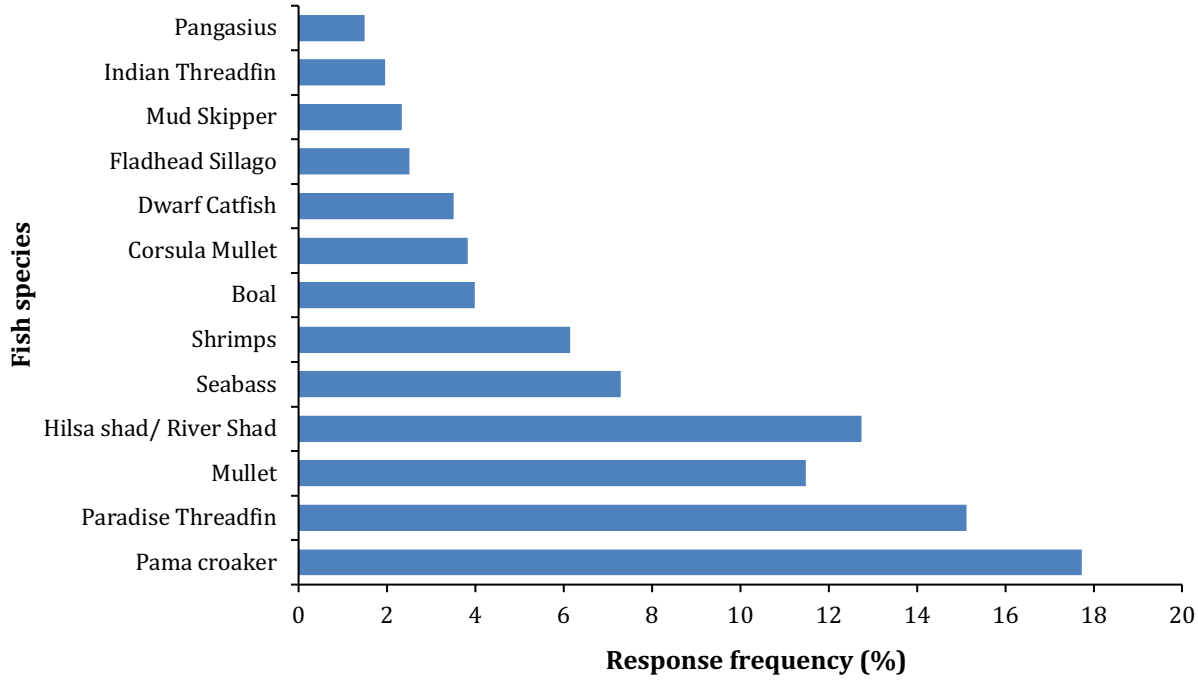

Figure 3.5. Different fish species targeted by the respondents.

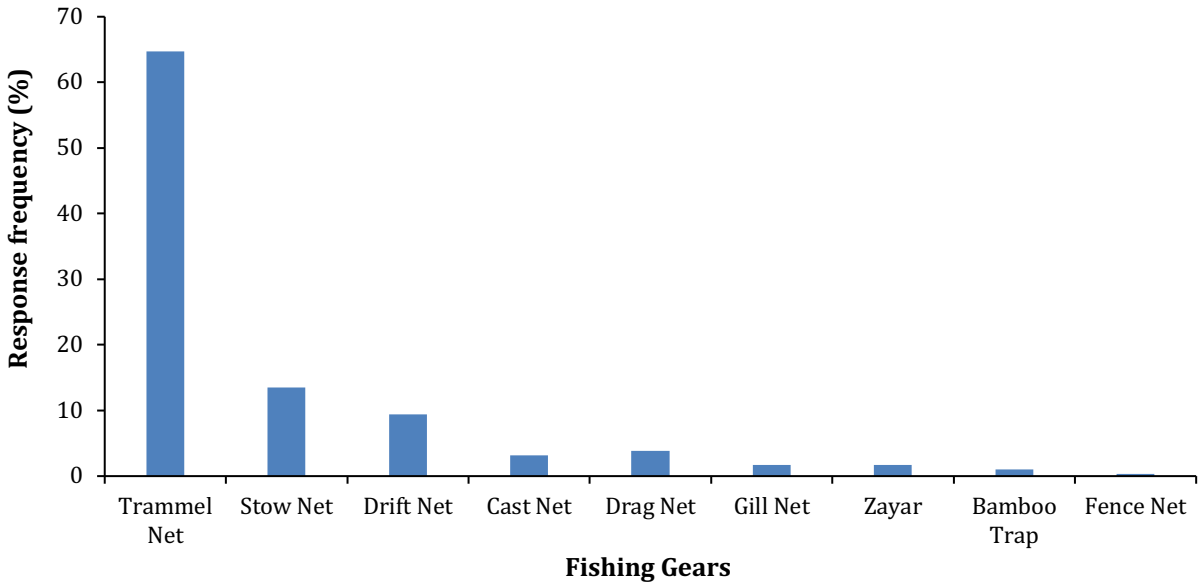

Figure 3.6. The gears used by the respondents in the study.

The target fish are being caught in more than 10 types of fishing gears and they are shown in Figure 3.6. Even though the use of gears is the same, the mesh sizes are varying based on the target fish species and location or fishing ground. The use of trammel net (Zone 1:

75.73%, Zone 2: 53.65%) and drift net (Zone 1: 11.79%, Zone 2: 5.20%) was common in both Zone 1 and 2. The drift net and drag net was mostly used in Zone 2 (Drift net: Zone 1 = 1.51%, Zone 2 = 17.24%, Drag net: Zone 1: 0.68%, Zone 2: 6.97%).

The gear types in which target fish are captured are shown in Figure 3.7. Trammel net was not only the most commonly used gear for small-scaled fishers (about 65% of respondents are using) but also captured all top five commercially important fish species. In addition, drift nets (about 9% are used) were also deployed for fishing of top five species. Although stow net was not important for fishing hilsa shad, the community claimed that stow nets capture fingerlings and juveniles and regard them as one of threatening fishing gears in the gulf.

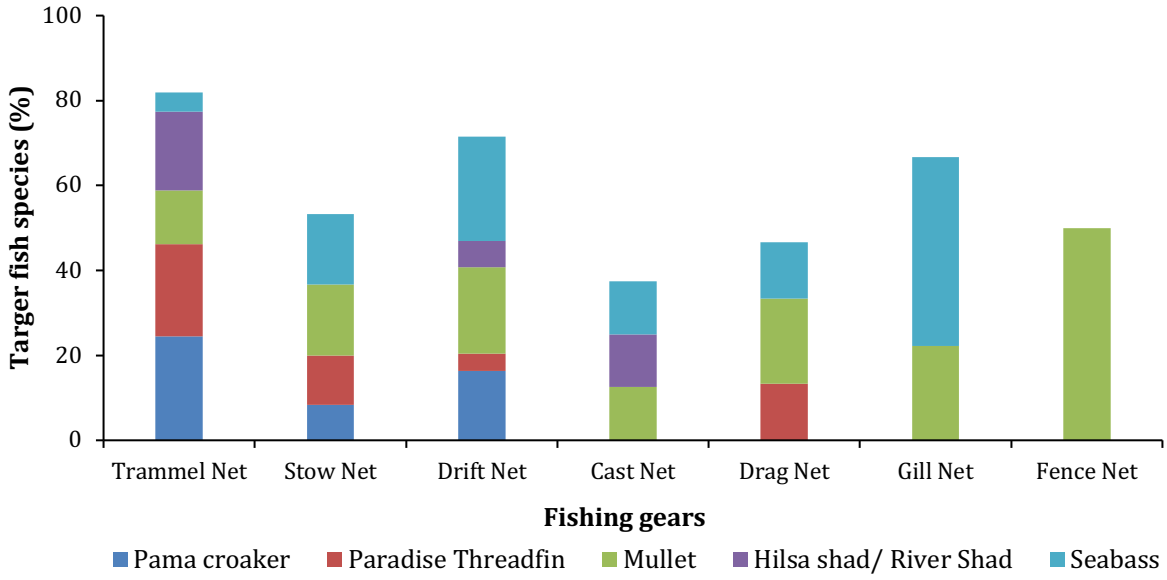

Figure 3.7. Fishing gears deployed by the respondents and the percentage of top five species being caught in these gears.

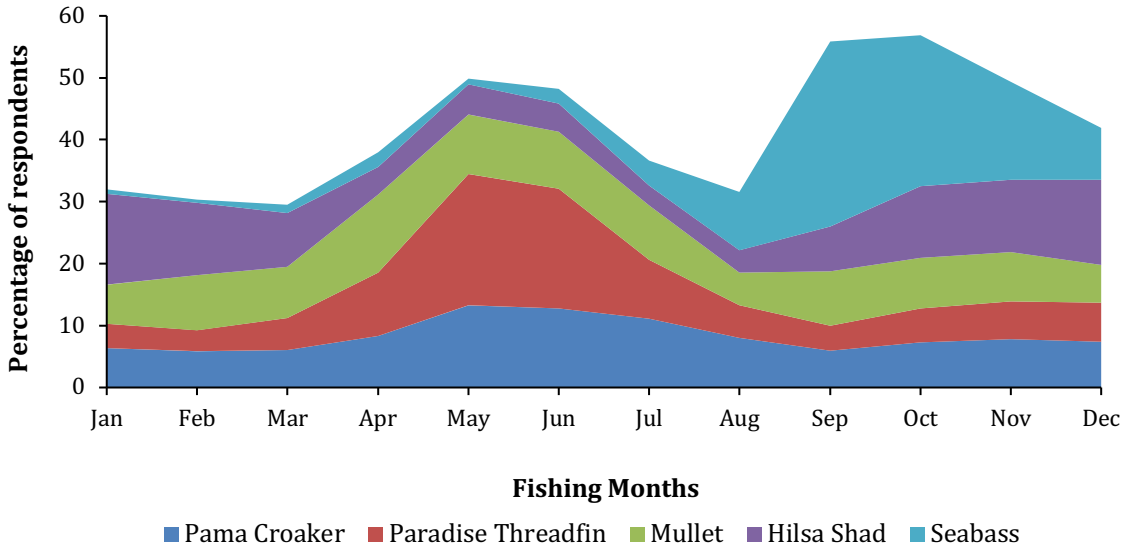

Figure 3.8. The months when respondents are fishing for top five important fish species in the study area.

The fishing seasons for important fish species are presented in Figure 3.8. Most of the fish were targeted all year round in the study area and it is mostly prominently for fishing of mullets (minimum 5.2% of respondents caught them in August and maximum of 13% in April). The peak season for Pama croaker and paradise threadfin were the same from April to July (about 11% of fisher caught Pama croaker and about 15% for Paradise threadfin). For hilsa shad, the fishers reported that the catches were higher from November to February with the peak in December and January (14-15% targeted by the respondents). The highest catch months for sea bass were from August to December with peak months in September and October (16-30% targeted by the respondents).

3.4 Status of Fishery

3.4.1 Changes and Drivers of Changes

The percentages of response frequency on the community perceptions on the changes in fishery in the past 10 years are shared in Figure 3.9. The changes were collected in the parameters such as number, size and price of fish and the number of fishers. The detail descriptions on the changes are as follow:

1. **Number of fish:** In the past 10 years, most of the respondents (86.88%) reported significantly decreasing in fish catch. The fishers suggested that the catch was reduced by more than 50%. The key drivers differ by location, but the common reason was due to intensified and widespread use of illegal fishing gears such as electrofishing, poison fishing and the use of illegal mesh sized gear.
2. **Size of fish:** About 30.59% of fishers reported that the size did not change over time as the fishers were using the same fishing gears with the same mesh size. However, 24.44% noticed the decrease in fish size and 39.31% recognized the significant decrease as well.
3. **Price of fish:** Majority of the respondents (81.73%) informed that the market price of fish increased in the past 10 years mainly because of the higher demand for scarce fishery products from both local and export markets. However, the current impacts of the political change resulted in rocketing commodity prices and disruption in exporting opportunities. Therefore, the market price remained unstable in the past two years regardless of overall increasement in market price in the last 10 years.
4. **Number of fishers:** According to the household interviews, the lower fish catch, higher investment in fishery inputs, and lower profitability from fishing caused decrease in the number of fishers. About 67.38% of the respondents stated this trend and these fishers quitted fishing and working as wage labor, farmers or mostly migrated to neighboring countries such as Thailand and Malaysia. However, 12.5% stated upward trend in the number of fish because they assumed

that as there were no job opportunities in the community, people just working as fishers for supporting household.

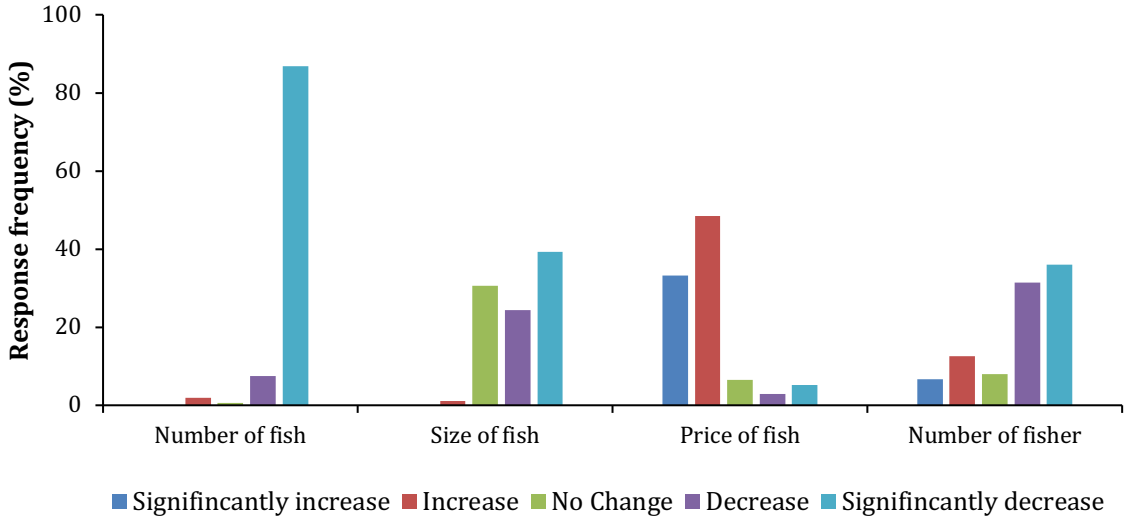

Figure 3.9. Percent of responses on the question "How the fishery status has changed in the past 10 years?". The variables are number of fish, size of fish, price of fish and number of fishers.

3.4.2 Conservation Threats

Based on the discussion with communities on the drivers of changes in fishery status over the past 10 years, the key conservation threats presume by the communities are as follow:

1. **Overfishing:** Among the respondents, about 5.74% informed that the fisher is getting rare due to increasing fishing pressures from more fisher and 4.3% stated that people modified gears or applied smaller mesh sized gears. About 13.4% reported that some of the fishers are fishing during spawning seasons and it causes the fish decline more prominent.
2. **Illegal fishing:** About 51.67% of respondents believe the driver of fish decline is illegal fishing. The mentioned illegal fishing is electric fishing, use of poisons or chemicals for fishing and use of stake net (Than Za Kar). The electric fishing and poison fishing are more widespread in the upper part or lower segments of Sittaung River near Kyaik Hto. They are more widespread after the political change due to weaker legal enforcement. The local anecdotal reports suggested that the electric fishers are modifying their gears with higher voltage batteries and can impact all types of aquatic lives in the 5-7 m radius. The fish being electrified cause them dead or paralyzed and then, easily captured by the fishers. Even if the fish survive, local people believe that they cannot reproduce anymore. For poison fishing, the types of chemicals and the intensity were not identified in the discussion as they are very difficult to detect.

   The most challenging problems about threatening the sustainability of fishery in the Gulf of Mottama is the use of Stake Net (Than Zakar Pike) in the upper part of

the gulf or the mouth of Sittaung River. They are 1.5-4 km long fishing nets deploy on the mudflats with fishing boats with 10-15 crews on board. The mesh size is as small as 6 mm and so locally called them mosquito nets as well. Therefore, these gears trap thousands of fish from different types and sizes including fingerlings and juveniles. These gears are operated by wealthy businesspeople from Kyaik Hto, and the respondents and KI interviews believe that they bribe the related government departments from confiscation. In 2019 and 2020, the GoMP facilitated the FDA and local authorities to patrol illegal fishing activities, confiscated fishing boats and gears. As a result, there were several reports on increase in fish catch in the same years. Since the pandemic and the political change, the patrolling activities have been postponed. One of the respondents quoted "*Now, the fish are as rare as gold and the reason is no other than Than Zakar. If you want to conserve for fish, deal with Than Zakar first*".

In the upper part of Kyaik Hto, one of the widespread applications is very fine net locally named "Zayar Pike" which capture larvae and juvenile fish and shrimps, and these were used to make specific fish paste known as Zayar.

3. **Habitat change and degradation:** The second most common threats that the respondents mentioned are changes and degradation of riverine systems in the gulf and the change in tidal flow in the Sittaung River. The suggested causes from the respondents can be natural and anthropogenic. The natural causes are erosion, sedimentation and such cumulative effects resulted in change in tidal flow and formation of mudflats on the mouth of Sittaung River and loss of deep-water area which are important hide-outs for fish. These impacts are also resulted from man-made activities such as construction of bridges and dams upstream of the river. Such changes create lower tidal influences from the gulf to the Sittaung River and obstacles for fish to migrate upstream. Some respondents also suggested deforestation in the catchment area are also the cause for degradation of the ecosystems.
4. **Sand mining:** Out of resource extraction activities in the river, sand mining is specifically identified as one of the causes for threatening fish species. The local ecological knowledge of respondents in the Zone 1 stated that there are some species of fish which lay eggs on the sand and if they are being extracted, it causes the eggs to destroy. In addition, the vibration from machinery of sand mining can also cause the fish to distress and it makes Sittaung River less favorable habitat for the migratory and residing fish.
5. **Pollution:** The pollution that respondents described are majorly due to lack of systematic waste management systems in the villages along the bank of the river and non-point sources from elsewhere. The major source the respondent mentioned was untreated discharge of sewages and industrial wastes from the nearby factories close to the river. The run-offs chemicals from pesticides and herbicides used in the farming are also contributing to the pollution of the river. In addition, many fishers reported that the river is now filled with plastic and sometimes they catch more plastic than fish.

6. **Climate change:** Some of the fishers in the interview stated the changing precipitation patterns and higher temperature in the past 10 years are causing shallower water level in the sea and limit the fish to further migrate to the upstream of the river.

3.4.3 Impacts to Communities and Adaptation to Changes

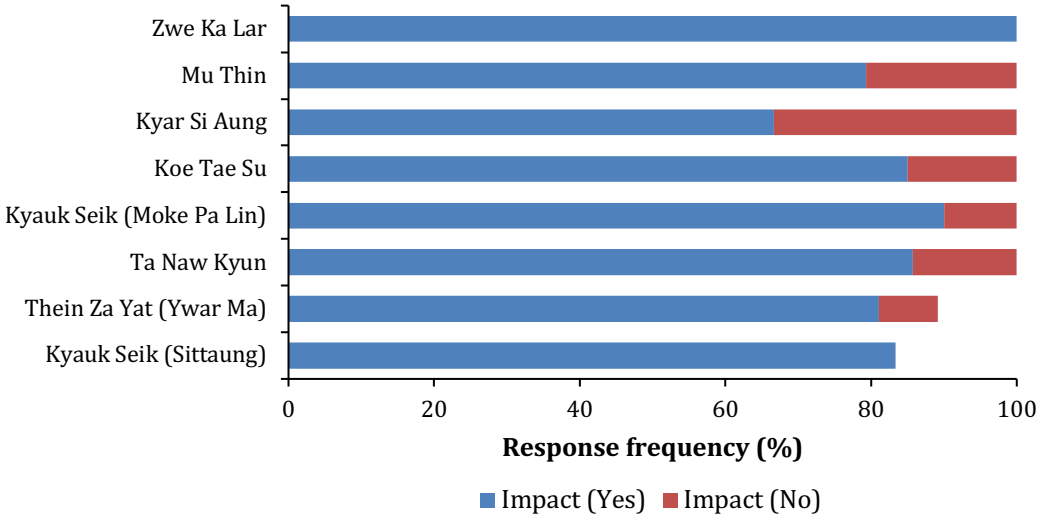

Figure 3.10. Percent of respondents who were impacted or not impacted by the changes in fishery.

A total of 12.67% of respondents argued that there are no impacts on their households due to changes in fishery in the past 10 years. Among them, 65.08% said that they do not mainly depend on fishing because they have small family (need less support) and have other livelihood options or alternative job opportunities in the village. However, about 16.67% have seen changes in fishery is normal for them, so they do not worry about the changes and need to adapt in fishing.

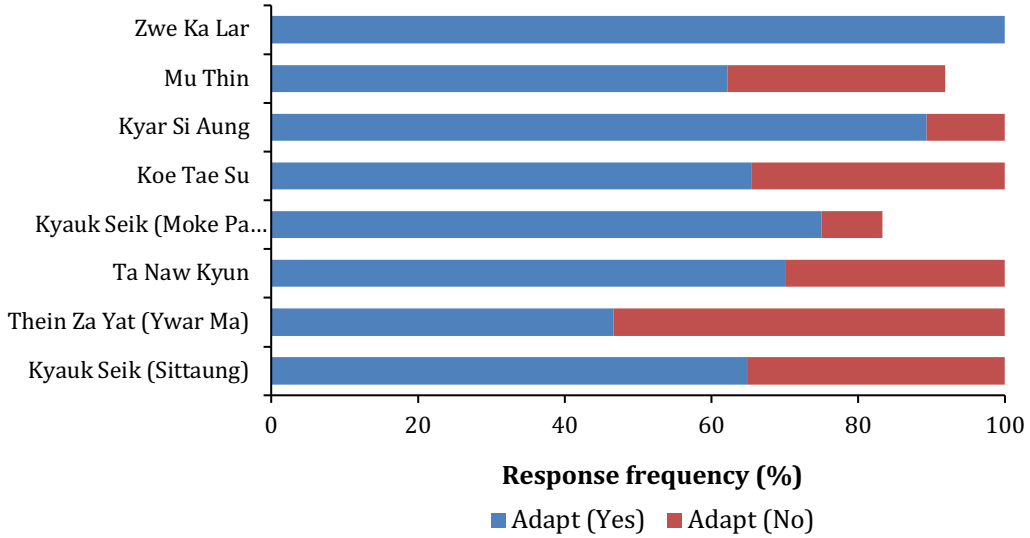

Figure 3.11. Percent of respondents who adapted or not adapted to mitigate adverse impacts from changes in fishery.

In total, 84% of the respondents stated that they were impacted from changes in fishery. The major impact is being difficult to get income from fishing (60.72%). As a result, about 14.13% reported they are losing profits from fishing. Therefore, 9.52% of respondents are engaged in debt. The study also explores how communities adapted to such changes. The common adaptation is changing livelihood activities such as crab fishing, wage labor, farming, and moving aboard (22.31%). Smaller proportion (13.24%) change other fishing gears or fishing methods by using small mesh-sized nets, about 9.35% move to other countries for their household incomes, and 8.2% take more time to get more fish. Some of the respondents believed that they would get financial support from their relatives, take loans from others, and reduce expenditures in households in closed fishing seasons. Moreover, others demonstrated that they change fishing grounds and target fish to get fish abundance and better catch when they catch fish in open seasons.

3.5 Opportunities for Fishery Conservation

3.5.1 Interest in Fishery Conservation

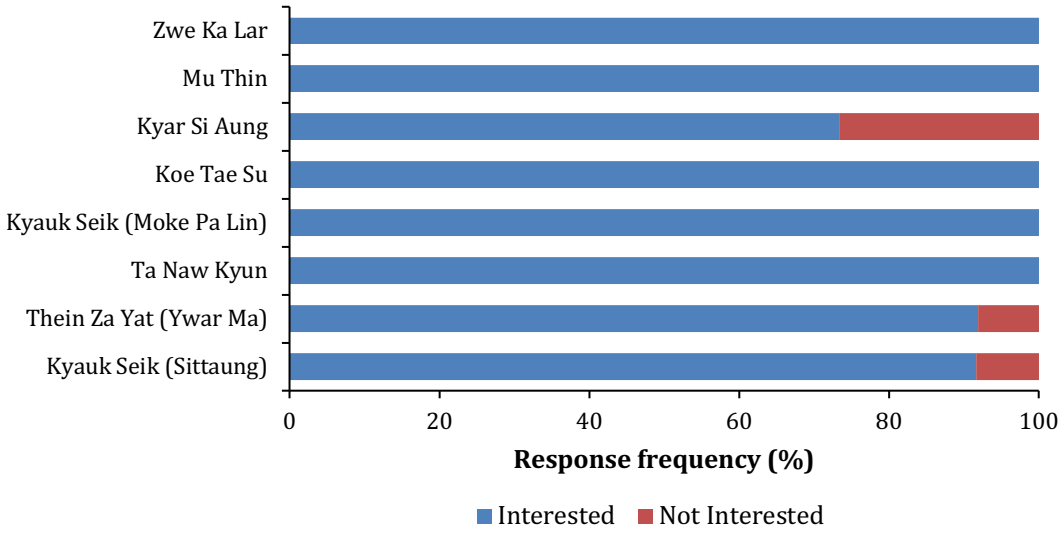

Figure 3.12. Percent of respondents on the interest in fishery conservation activities

All respondents from Ta Naw Kyun, Kyauk Seik (Moke Pa Lin), Koe Tae Su, Mu Thin, Zwe Ka Lar are interested to implement fishery conservation in the community (Figure 3.12). There are several reasons that motivate local community to be interested in fishery conservation along from the Sittaung River and major tributaries to the mouth of the Gulf of Mottama. Some of the prominent ones is that 35.62% of respondents from Zone 1 and 30.14% from Zone 2 are willing to increase fish stock and recover from depletion so that they will access larger fish and get sustainable fishing (Table 3.1). In addition, 19.88% respondents demonstrated that they want to improve well-being of community through getting more income especially for households who depend on fishing as major source of income. Furthermore, 16.77% respondents argued that fishers are threatened by intensity of the illegal fishing activities such as stake nets (Than Za Kar), electric fishing,

and poison fishing and other conservation threats. Therefore, they are eager to take actions on fishery conservation as a priority.

Table 3.1. Response frequency of the arguments from the respondents on their interest in fishery conservation

Interests	Arguments from the respondents	Response frequency (%)		
		Zone 1	Zone 2	Mean
Yes	To increase fish stocks and recover from depletion	35.62	30.14	32.88
	Improve well-being of the community	20.30	19.45	19.88
	Intensity of illegal fishing activities are threatening	12.82	20.73	16.77
	Fish stocks are declining (changes in river conditions, illegal fishing, etc.)	7.56	5.80	6.68
	Sustainability of fishery resources	7.60	3.78	5.69
	Dependent on fishing for livelihood (source of household income)	5.37	4.97	5.17
	To increase income	4.49	4.14	4.31
	Conservation is necessary	1.36	4.77	3.07
	Accessible to larger fish	0	2.92	1.46
	Require less efforts in fishing	0	1.57	0.79
	The fish catch is declining and negatively affecting on fishers	0.52	0.61	0.57
	Improve food security	1.19	0	0.60
	Target fish are economically important (conservation will increase income)	0.52	0	0.26
	Increasing threats in the river (pollution, chemicals, plastics, fishing during spawning seasons)	0.47	0	0.24
No	Challenging to take conservation actions	25	4.17	14.58
	Conservation will impact negatively to the fishers (fishing activities will be limited)	25	0	12.5
	It is impossible to conserve illegal fishing activities as fishing area is open access for everyone	0	8.33	4.17
	Do not depend on fishing	0	4.17	2.08

On the other hand, there are 27% of the respondents from Kyar Si Aung, 8% of the respondents from Thein Za Yat (Ywar Ma), and 8% of the respondents from Kyauk Seik (Sittaung) who are not interested in fishery conservation (Figure 3.12). One of the relevant arguments from Kyauk Seik (Sittaung) is that fishers are only dependent on the fishing, so fishing activities will be limited, and it can negatively impact on the livelihood of families, if fish are conserved. Moreover, 25% respondents from Zone 1 stated that they are challenging to take conservation actions because the migratory fish species are difficult to conserve as they migrate from river to sea conversely, and to restock due to the formation of sand banks. It is also described that fishers who is are not residents from the village have a challenge to participate in fishery conservation activities. About 8.33%

of respondents from Zone 2 stated that fish resources in the fishing area can access everyone and people are extremely fishing during spawning seasons by using small mesh-sized nets (e.g., stake nets) to catch more. Thus, they claimed that it is very essential to develop educational awareness about fishery conservation to be able to get better participation of community to prevent illegal fishing activities.

3.5.2 Preferred Conservation Approaches

In the study, 34.26% in Zone 1 and 28.20% in Zone 2 expressed that there are no existing conservation activities for protection of fish in the community. However, 18.07% in Zone 1 and 28.84% in Zone 2 the close season for fishing is currently regulating in the community. About 19.01% and 20.45% of the sample said that the respective stakeholders such as DoF and Gulf of Mottama Project are providing community awareness for fish conservation and leading patrolling activities against illegal fishing. Regardless of current actions, people stated that they are not effectively complying anymore due to synergic impacts of the pandemic and political instability in the country. Since then, there is no patrolling activities and relevant actions against illegal fishing from both government or other stakeholders. Therefore, people are fishing during close season (including spawning time) and the illegal fishing activities are more intensive and threatening to the fishing communities.

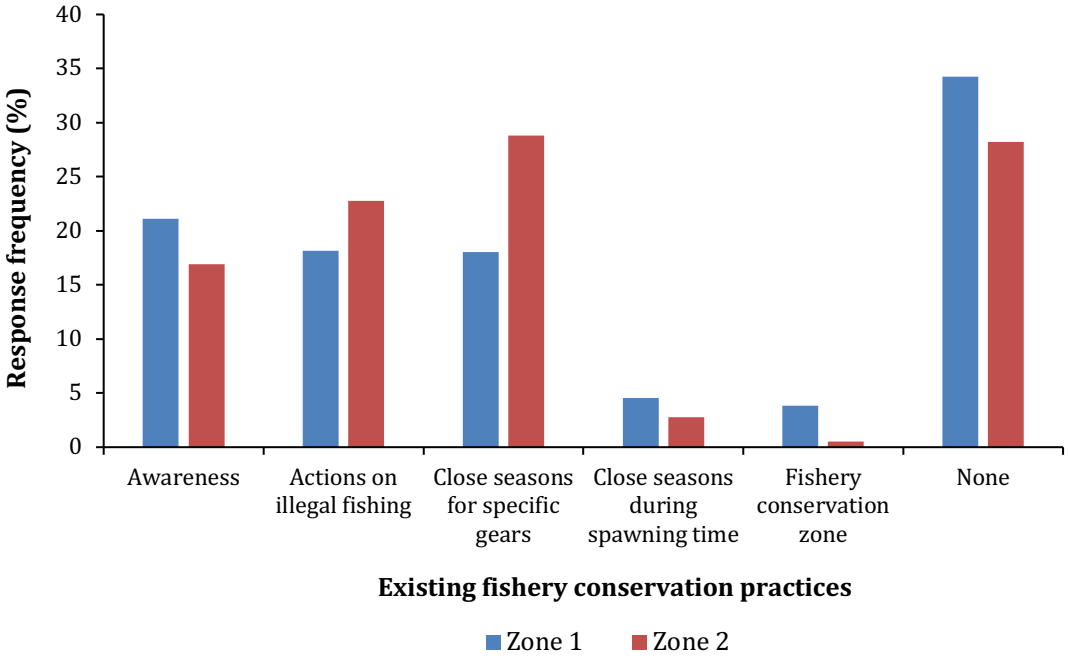

Figure 3.13. Percentage of respondents' answer on the question "What are the current fishery conservation practices in the community?"

Regardless of the existing fishery conservation approaches, the study explores different conservation approach suitable for each community as in Figure 3.14 and identified their challenges and opportunities. The recommended approach resulted from sorting cards are as follow:

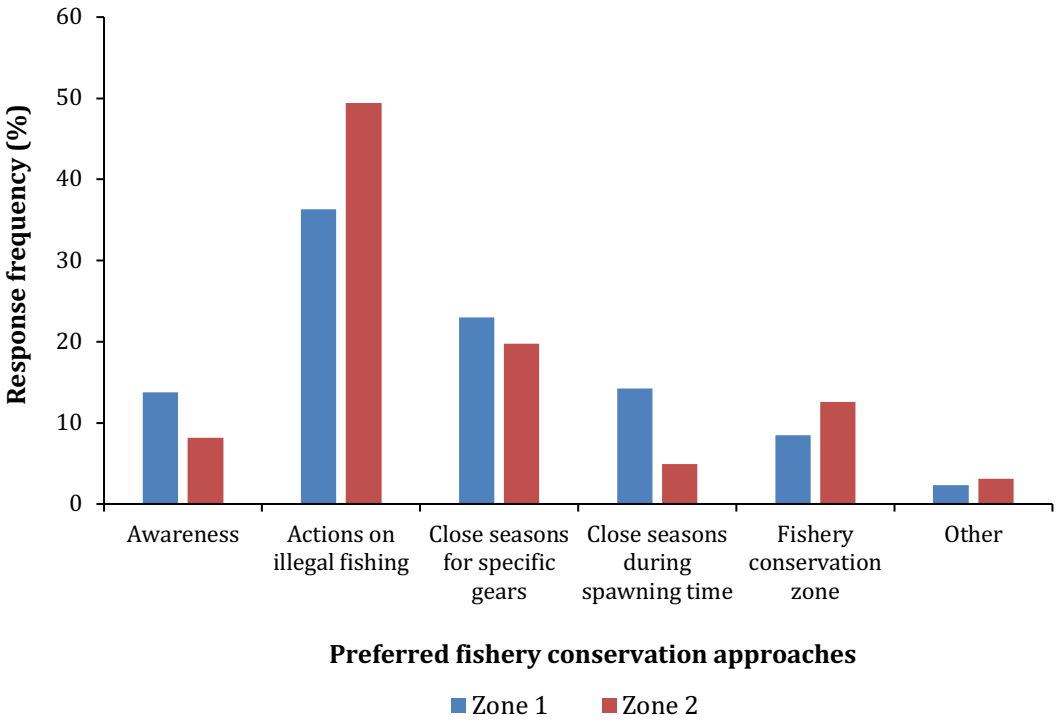

Figure 3.14. Percentage of respondents' answer on their preferred conservation approaches from the sorting cards.

3.5.2.1 Consultation and raising awareness of respective stakeholders

A total of 10.96% (13.78% in Zone 1, 8.15% in Zone 2) suggested to provide awareness about fishery and consult with communities to take actions on fishery conservation. It is because the respondents believe that community has very limited knowledge on conservation especially rules and regulations related to fishers. Some interviewees mentioned that the awareness should be more than setting up vinyl or boards in the community but need to effectively engage with communities. Such meetings and consultation create opportunities for fishers to talk with each other to share knowledge, take each other's perspectives and foster collaboration to solve fishery issues. However, the key challenge remains in how to make inclusive for all the fishers (including men and women) to participate in these education activities as fishers also need to focus on their livelihood activities.

3.5.2.2 Legal enforcement on illegal fishing to decrease capture of juvenile fish

Taking legal enforcement of illegal fishing is the most preferred solutions for fishery conservation as 36.31% from Zone 1 and 49.38% from Zone 2 prioritized such action. The critical illegal fishing activities are stake net (Than Za Kar Pike), electric fishing and poison fishing. As the destruction from widespread and intensive application of illegal fishing activities are obviously resulting in fish decline and consequently affecting negative impacts to the fishing households, majority of community have common interest to combat against to them. However, the obstacles expressed by the respondents is the need of collaborative actions from the whole community with effective participation from

local authorities, policy makers and stakeholders. The suggested actions include regular patrolling activities, effective law enforcement, and a system to effectively report illegal fishing activities which also protect the identity of the reporters so that they will not be harmed or victimized by the perpetrators. The underlying factors that might fuel the effectiveness of tackling illegal fishing expressed by the community include mistrust between social groups (mainly due to lack or miscommunication), corruptions/ bribery between illegal fishers and people in power, and liability of legal enforcement systems especially in the context of unstable political landscape.

3.5.2.3 Seasonal closure of some fishing gears during spawning seasons

People (about 21.34%) suggested to enforce seasonal closure of some fishing gears (mainly stow net (Da-min or Kyar Pa Sat) which is legally licensed under DoF) due to its adverse impacts on the fish stocks. Similar to illegal fishing, closure of stow nets especially during spawning season will improve fish stock as respondents believe that stow nets deploy small mesh-sized nets which caught fingerlings and juveniles to cause fish decline in the adjacent water. The major challenge is the gears are legally authorized by DoF and enforcing the closure of these gears might create conflicts among different fishers.

3.5.2.4 Enforce close fishing season for commercially important fish species

About 14.22% and 4.95% of the respondents respectively from Zone 1 and 2 recommended to enforce close fishing seasons for the important fish species. Most of the community believe that the effective enforcement for close season would significantly increase the fish catch within 1-2 years. The existing seasonal closure of fishing activities is enforced from May to July and the fishers expressed that it is not effective because the spawning time for important fish species in Sittaung are not within the enforced season. In addition, due to weak enforcement, some fishers expressed that they fish illegally during the close season as supporting the household is their priority. Regardless of the effectiveness of close season on the fish stock, the fishing communities who depend solely on fishing will impact negatively during the close seasons as they will have limited income to support the household. So, it is required to consult with local people on the needs and fulfil these will motivate them to follow the rules and regulation with close seasons.

3.5.2.5 Establishment of community-based fishery conservation area

With expectation to protect the spawning grounds and nursery habitats of fish from conservation threats, 8.5% and 12.51% expressed their preference on establishing fishery conservation areas managed by local community with supports from multi-stakeholders. The respondents understand that the fishery conservation zone would be effective to tackle illegal fishing activities, regulate fishing in the area and resulted in increased fish stocks. In order to do so, it is required participation from different social groups and collaborative actions among different communities including stakeholders.

3.5.2.6 Others

Other actions classified by some fishers include limitation of sand dredging in potential spawning areas and nursery habitats of the river, regulate mining activities and discharge of wastes into the river.

3.5.3 Potential Conservation Impacts on Community

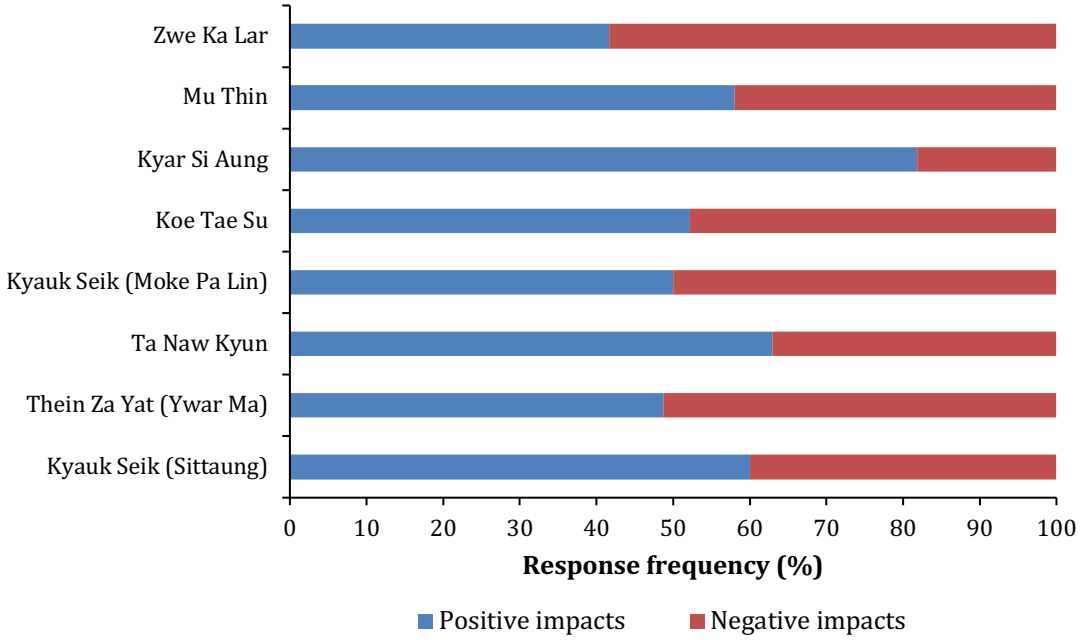

Figure 3.15. Percentage of responses on how household will be impacted from the conservation activities in community

In general, people believe that conservation will impact both positively (56.93%) and negatively (43.07%) to the fishing communities as shown in Figure 3.15. Most of the respondents mentioned negative impacts are short term but the positive impacts are more long term and lead to sustainability. The favorable results from conservation interventions would restock the fish, allow to grow larger and increase fish catch with little fishing efforts. Higher fish catch will raise the profits and eventually improved well-being of the community.

However, in a short term, people worry that there is no or less income due to limited livelihood activities during close season. The recommended and/or planned mitigations from negative impacts include:

1. Support alternative livelihood activities (27.07%)
2. Support loans to start SMEs in the communities (13.06%)
3. Change fishing gears or fishing ground (4.91%)
4. Saved money during fishing seasons and use them during close season (0.50%)
5. Fish illegally during close season (0.39%)

3.5.4 Willingness to Participate in Fishery Conservation

Very high percentages (75.62%) of the respondents are willing to participate in conservation activities in different levels in the community. The motivations are sustainable access to fishery resources not only for now but also for the next generations, to improve well-being of the community from increased income and improved livelihoods from higher fish catch through conservation actions and recognized that the illegal fishing needs to be complied by effective rules and regulations. The willingness to participate by each community is illustrated in Figure 3.16.

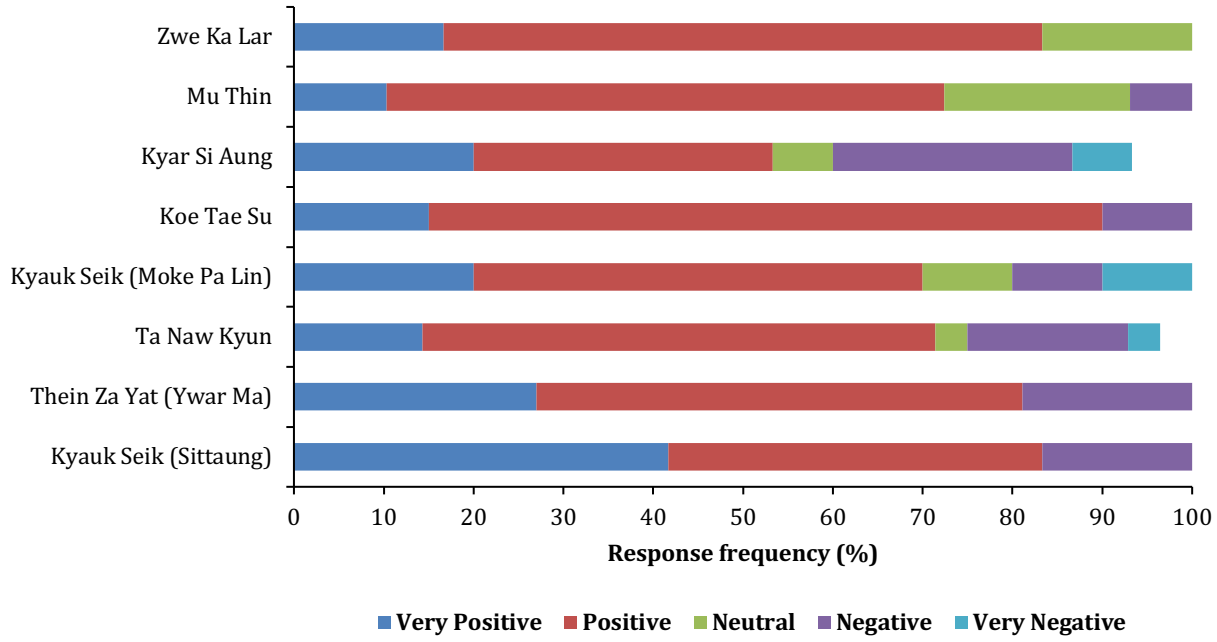

Figure 3.16. Community responses on the willingness to participate in fishery conservation activities.

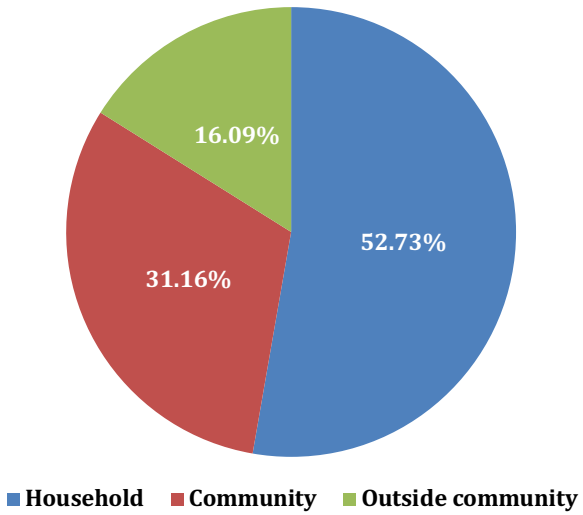

Figure 3.17. Community willingness to participate in each level (household, community, and outside community) for fishery conservation activities

Only about 15.91% reported not willing to participate in the conservation. The age and health of the respondents are major constraints to participate. However, some people expressed it is risky to involve in conservation specially to involve in combating illegal fishing activities. In addition, some people believe that GoMP will lead these conservation activities. So, if they do not like actions taken by GoMP, they will be discouraged to participate as well.

Among whom stated they are willing to participate, 52.73% want to involve in activities which are home-based or at the household level, and 31.16% are willing to participate in conservation actions at the village level. Only 16.09% are interested to participate in conservation activities outside the village (See Figure 3.17). The activities that the respondents interested to participate in each level differentiated by each potential conservation zone are tabulated in Table 3.2.

Table 3.2. Frequency of responses in percentage on their willingness to participate in different level in fishery conservation activities

Level	Participation	Response frequency (%)		
		Zone 1	Zone 2	Mean
Household	Attend awareness activities	26.94	23.87	25.41
	Share information about fishery conservation to the household and friends	17.76	9.78	13.77
	Participate in fishery research activities	18.12	16.20	17.16
	Follow fishery rules and regulations	16.97	17.08	17.02
	Report illegal fishing activities	19.86	31.75	25.80
Community	Participate in community level fishery conservation activities	21.53	18.22	19.88
	Collaboration and coordination in community awareness activities	17.23	12.23	14.73
	Participate in community level discussion for identifying solutions for fishery related issues	16.02	14.95	15.49
	Lead fishery conservation activities	21.31	22.67	21.99
	Participate in patrolling for illegal fishing activities	23.37	30.46	26.92
Outside Community	Provide advice in designating fishery conservation zones	8.75	22.07	15.41
	Participate in planning for community-based laws and regulations for fishery management	23.75	16.05	19.90
	Advocate fishers from other villages to participate in hilsa conservation area	27.92	18.81	23.36
	Attending stakeholder meetings for fishery conservation and management	7.08	17.18	12.13
	Participate in creating funding for sustainable fishery conservation and management	30.00	24.96	27.48

3.6 Social Potential for Fishery Conservation

3.6.1 Leadership in the Community

The important leadership position is mostly held by male village administrator in the community and followed by fishery group leaders for fishery related activities. About 31.77% of respondents support on leader if he/she (mostly man) can support community needs, development, and welfare and 14.38% supported the leaders' lead in solving community issues (including fishery related issues). Therefore, having a good leader who is considerate on fishery related issues is detrimental to establish conservation activities. The skills the community expect in good leaders include effective problem solving, coaching, resourcefulness, and honesty. Based on this information, the rubric for leadership is developed as in Table 3.2. Ta Naw Kyun and Zwe Ka Lar have strong leaders as they are selected and respected by the community. Kyauk Seik (Sittaung) scored lower in leadership as the community itself perceive they have no leaders in the community and only some elders are leading community affairs. For Koe Tae Su, people have different opinions on current leaders as one part of the village (especially original residents) preferred while another part (migrants) have strong belief that the leader is biased and unfair. The remaining villages scored intermediate for the leadership potential.

3.6.2 Trust in the Community

Most of the respondents (41.85%) trusted the village administrator followed by elders in the community (10.92%). Therefore, having strong leaders in the community build better trust among different social groups or communities. Having groups in the community also promote trust building in the community because existence of fishery groups organized by GoMP, or Mya Sein Yaung Project expressed they trust on the leaders and/ or members of these groups.

3.6.3 Social Cohesion in the Community

Social cohesion is identified by individuals or groups in the community are working collaboratively. Most of the fishers are not being a member formal groups such as fishery association but part of community groups (e.g., cooking group, youth groups, charity group). However, the fishers are collaborative with fellow fishers in solving fishery issues together in the sea and fishing together. When they are in the village, they collaborate with other villagers in their small community groups and participated in community activities such as funfairs, organizing wedding or funerals and charity.

Some of the respondents (11.73%) have strong relationship with fish collectors and they are selling fish to them as they took pre-payment from the fish collector. About 6.77% are in fishery association. The ones who engage in fishery associations benefited in financial supports such as loans but are required to join trainings and workshops and work together in specific activities such as patrolling for illegal fishing activities. Most of the villages have very similar score in terms of social cohesion except Mu Thin. The major factor resulting the social cohesion in Mu Thin is due to its large area and separation of

different sessions within the village. In addition, there is two major groups working in fishery such as FDA and Mya Sein Yaung Project and it differentiate community collaboration and resulted in lower social cohesion among the groups.

3.6.4 Communications in the Community

As fishers spend most of their time fishing out in the sea, the communication among fishers is very prominent as 46.33% of the respondents reported they communicate among fellow fishers in terms of sharing market information, better locations to catch fish, and knowledge about illegal fishing gears. Sometimes, the fishers need to communicate with village leader if there are any issues while fishing or if they want to report illegal fishing activities. The fishers have regular communication with fish collector to access information on updated market price of target fish.

3.6.5 Knowledge

The respondents are accessible to local ecological knowledge and/or formal knowledge in and/or outside the community. All the respondents have very deep local ecological knowledge on their target fishery except for migrants who have very little experiences. Even so, the fishers learn from each other. The formal knowledge was provided by institutions outside the communities mainly on ecology of fish, and fishery related rules and regulations. In the study villages, the formal awareness was raised by DoF or GoMP.

3.6.6 Social Potential Assessment

The social potential for each village is assessed by rubric scores developed based on findings from the study. The rubric score is presented in Table 3.3 and the social potential scores are in Table 3.4. According to the assessment, Ta Naw Kyun from Zone 1 and Zwe Ka Lar from Zone 2 showed high social potential or feasibility to start community-based conservation activities. The rest of the villages need supports in different sectors to strengthen to accommodate fishery conservation.

Table 3.3. Rubric scales for social potential for fishery conservation.

Criteria	Score 1: Very weak	Score 2: Weak	Score 3: Intermediate	Score 4: Strong	Score 5: Very strong
Leadership	No significant leader in the community or the community do not trust the leadership of current leader.	The leader was selected from institutions outside the community and therefore, the people do not want to follow the lead.	The leader was selected from institutions outside the community but have leadership skills and proportion of the community follow the lead.	The leader was selected from institutions outside the community but have good leadership skills and majority of the community follow the lead.	The leader was selected by the community and have strong faith on the leadership abilities.
Trust	There is no trusted person beside family.	Strong trust with only friends and colleagues.	Trust the neighbors.	Trust the leaders and elders in the community.	Strong trust with each other in the community.
Collaboration	There is no groups and collaborative activity in the community.	Collaborative in village social affairs and events not directly in fishery issues.	Proportion of the community are members in community groups but no significant participation in activities.	Proportion of the community are members in community groups and participate in some activities.	Most of the community are members in community groups and participate actively in community activities as well as fishery related activities.
Communication	No communication at all.	In community or fishery related activities, there is communication only with friends and partners.	In community or fishery related activities, there is communication only with groups or individuals in the community.	In community or fishery related activities, there is communication with other villages in addition to groups or individuals in the community.	In community or fishery related activities, there is communication with multi-stakeholders.
Knowledge	No or little knowledge on fishery issues.	Have some local ecological knowledge regarding fishery issues and are experienced fishers.	Knowledgeable on fishery issues and very strong experiences in fishing activities.	Highly knowledgeable on fishery issues and some already participated in fishery conservation activities.	Very highly knowledgeable on fishery issues including rules and regulations. Most of them are experience in participating in fishery management activities.

Table 3.4. Social potential scores for each village to establish fishery conservation activities.

Village	Leadership	Trust	Collaboration	Communication	Knowledge	Total Score
Sittaung (Kyauk Seik)	**2**	**3**	**3**	**4**	**3**	**15**
Thein Za Yat (Ywar Ma)	**3**	**2**	**3**	**3**	**4**	**15**
Ta Naw Kyun	**5**	**4**	**4**	**3**	**4**	**20**
Moke Pa Lin (Kyauk Seik)	**3**	**2**	**3**	**4**	**3**	**15**
Koe Tae Su	**2**	**2**	**3**	**3**	**4**	**14**
Kyar Si Aung	**3**	**3**	**4**	**3**	**3**	**16**
Mu Thin	**3**	**3**	**2**	**3**	**4**	**15**
Zwe Ka Lar	**4**	**4**	**3**	**4**	**3**	**18**

Social Potential Scores

Score: 21 - 25 Very high social potential to start a fishery conservation.

Score: 17 - 20 High social potential to start a fishery conservation.

Score: 13 - 16 Need supports to alleviate social potential.

Score: 09 - 12 Low social potential to start a fishery conservation.

Score: 05 - 08 Very low social potential to start a fishery conservation.

4 DISCUSSION AND CONCLUSION

The study identified five important fish species as well as they are under threats from both anthropogenic and natural drivers. Therefore, the study explored suitable fishery conservation approaches for conservation of these important fish in two zones in Sittaung River and its mouth. Based on the discussion, it is suggested that more integrated approach is necessary to sustainably manage fishery resources in the areas while ensuring the well-being of communities who depend on these resources. However, it is necessary to establish an approach that fosters and empowers communities to take responsibility for management of fishery resources they depend on and allow them to respond to threats at local level in coordination with different stakeholders.

4.1 Establishing Fishery Conservation Zone (FCZ)

In consideration with the recommendation from FFI (2021) and the further investigation of the study suggested to establish locally managed fishery conservation zones (FCZs) in the study areas. Following the Loury, 2020 on "Establishing and Managing Freshwater Fish Conservation Zones with Communities", the following suggested activities can be implemented with the communities.

1. **Identify legal framework and requirements**

The proceeding of the establishment of FCZ should start with reviewing legal frameworks and suitable approaches to support the community participation in the fishery management as it essentially needs to set and enforce regulations within and/or among communities. Especially in the case of Sittaung River where both administrative boundaries for Mon State and Bago Region intersect, establishing a co-management model with FCZ framework with shared responsibility between government institutions and communities, it is required to formulate an institutional road map to be formally approved and enforced.

2. **Evaluate fisheries situation**

Parallelly, the assessment on fisheries situation in the target areas should be conducted. The involvement of GoMP in the area provides intensive knowledge on trends in fishery, the conservation threats, and community suggested interventions on these threats have been identified. However, additional information such as impacts of stow nets on local fisheries, local ecological knowledge to identify spawning and nursery behaviors of economically important fish species (it will not only important to advice spatial planning for the conservation of target fish but also inform effective close seasons for fishing activities) should be expanded with the participation from the communities. These evaluations will support which management strategy (whether FCZ or not) is suitable for the community and support evidence-based decision making.

3. **Develop fisheries regulations**

This stage will develop management strategies selected in the previous phase into an inclusive management plan. The management plan can be formal (legally regulated document approved by the government) or an informal agreement among stakeholders. Considering the current situation, initiating with informal agreement at the community level would be preferable. Through series of consultations with different stakeholders, the management plan should identify goal and objectives of the fishery management, how different stakeholders will be participating and their roles and responsibilities, the strategies for fishery management, the geographic area for management, the rules and regulations and the compliances for not abiding the identified rules and regulations.

Specifically, for Sittaung River, specific plans and strategies for combating illegal fishing activities should be planned in this stage such as developing patrolling and enforcement protocols with communities and relevant institutions essential to take actions on illegal fishing activities. In addition, to enforce seasonal closures, social support system should also be planned. The challenges would be participation from different stakeholders, financing, and security to conduct these activities.

4. **Implement management strategies**

The stage ensures the designated area is actively protected and socially secure within the boundary of the fishery conservation area. To effectively implement, the regulations and management should disseminate widely with local community members through community engagement and outreach activities. In addition, the capacity of management team should be developed through trainings on management, specific skills required for conservation, and community engagement to effectively implement management plan such as patrolling or enforcement in the community. As this stage engages with different stakeholders including illegal activities, conflicts resolution strategies might need to be address as they arise.

5. **Monitoring and evaluation**

To assess the effectiveness of the management actions, monitoring and evaluation should be conducted periodically and shared the results among stakeholders.

6. **Adjustment of management strategies**

Analyzing the assessment, the management strategies should iterate and revise with consultation from different stakeholders.

4.2 Fishery Conservation as Social Process

Regardless of the framework on establishment of fishery conservation actions have been identified, the application of these framework to real-world, practicable actions requires further considerations. Conservation is not a linear process of recognizing the problems, develop plan, make decision, and take actions to achieve desired outcomes. However, conservation is often recognized as wicked problems due to its linkages and interactions with complex, multi-dimensional and dynamic social-ecological systems (Mason, 2018).

These problems can be complicated by diverse stakeholder values and conflict among stakeholders (Brechin, 2002, Mason, 2018, Madden, 2014). The process of developing and implementing conservation actions can exacerbate conflict; non-inclusive processes and negative social impacts might spark resentment and resistance against conservation (Madden, 2014). Where conservation planning, decision-making, and actions do not adopt a truly inclusive, holistic approach, opportunities for achieving the desired conservation outcome could be diminished.

Therefore, safeguarding the well-being of communities in taking conservation actions is required and need the considerations of more effective and ethical conservation by taking account into more holistic and humanistic approaches (Biggs, 2011, Brechin, 2001, Mason, 2018). The key attributes to transform into such conservation as in Figure 4.1 are:

- Considering conservation in the context of social-ecological systems (Ostrom, 2009).
- Incorporating interdisciplinary and transdisciplinary approaches and diverse forms of knowledge (Biggs, 2011, Crepsi, 1987, Reyers, 2010)
- Improving monitoring and evaluation to understand how actions link to outcomes (including negative social impacts) (Franks, 2014, Margoluis, 2009)
- The human elements of conservation must be incorporated throughout the planning and implementation process, including diverse values, recognition of human rights, respectful interactions, conflict transformation, and transparent, clear communication.

The key attributes are centered from "Design Thinking" process, which enables to solve complex problems and it can also be viewed as "the application of design methods by multidisciplinary teams to a broad range of innovation challenges" (Wint Hte and Whitty, 2018, Brown, 2010). Its core values of empathy, mindfulness, creativity, optimism, collaboration, and experimentation promote sharing of perceptions, values, and ideas across stakeholders. Other key attributes of Design Thinking include systems-thinking, "beginner's mind" (humility and curiosity), and practically testing out ideas through prototyping. Therefore, applying the attributes and process of Design Thinking to the fishery conservation process could help transform negative pathways (Scenario 1) into more positive pathways (Scenario 2) as shown in Figure 4.1. With the recognition of problems and perceptions of the communities identified in this study, we integrate this information by using human-centered Design Thinking process into the context of users in social-ecological systems of fishing communities and discuss the key insights and recommendations for improved participation of communities in the process of fishery conservation.

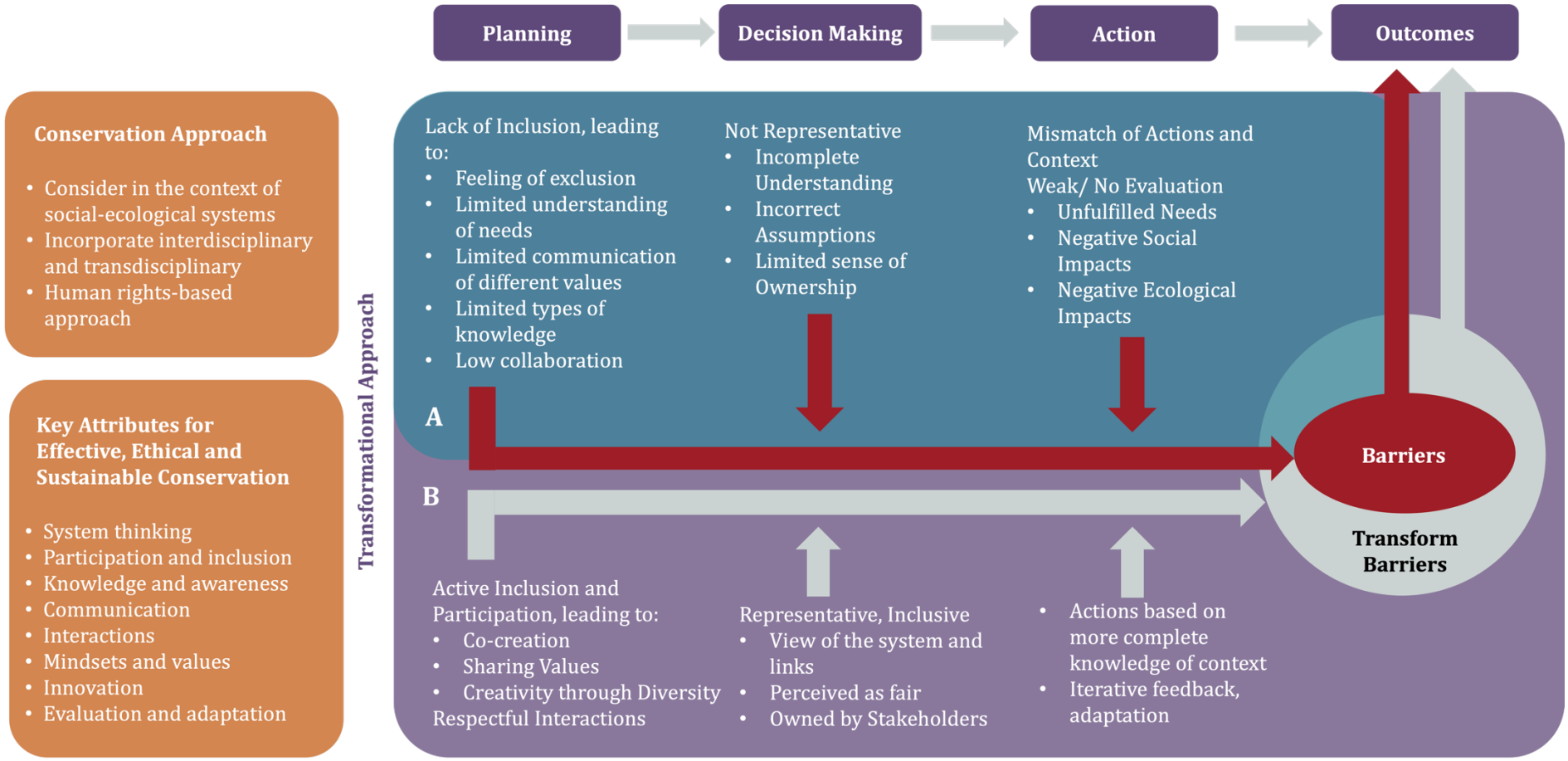

Figure 4.1. The proposed human-centered and design thinking approach which can transform or avoid common problems in the conservation process (planning, decision making, action, and outcomes). The scenario (A) shows the lack of considering these problems can contribute to barriers to effective conservation. The scenario (B) shows applying proposed approach and key attributes can promote a more positive and effective conservation process. (Adapted from Wint Hte and Whitty, 2018)

4.3 Key Insights

The key insights considering from challenges and opportunities are discussed as below:

Challenges

- Some villages expand wider fishing areas further down to Mawlamyine and Kawa (wide spatial distribution of fishing activities impose difficulties)
- Heavily dependent on fishery resources and high risk to the communities from conservation actions
- The fishing activities are so diverse and fishing season are different, it is difficult to gather all the fishers
- The current fishery conservation practices are not widespread and effective
- High migration rate (internal and external) limits the involvement of youths in the conservation actions
- Illegal fishing activities (mostly mentioned stake net (Than Za Kar Pike), electric fishing and poison fishing) are intensive and widespread
- The legally approved gears such as stow nets are identified as threats in the community
- Sand dredging is additional threats
- Significant knowledge gaps among members of fishery groups and non-members
- Trust issues among different villages regarding the use of illegal fishing gears
- Specifically in Moke Pa Lin (Kyauk Seik), the trust on GoMP is very low
- Ta Naw Kyun is outside GoMP area regardless of its strong potential to successfully implement fishery conservation activities

Opportunities

- There are diverse target fish species (more opportunities to select target fish for conservation)
- Very strong interests from the community in conservation
- Women play important role especially in accessing knowledge on fishery conservation
- Already have informal communication mechanisms within fishers
- Have common understandings and perceptions on threats toward fishery conservation
- There is more than one development project in the community
- Strategic location to initiate conservation activities
- Have experience in participating in fishery conservation activities

Key Insights

- It is important to consider the role of women in fishery conservation activities (it should be more than attending awareness activities and trainings)

- There is a need to identify underlying conflicts in the community to start conservation actions
- The villages are spatially or socially separated into different groups and each group have different belief systems and social dimensions. In the conservation process, participation from different social groups is necessary
- Should implement conservation activities in the communities to improve participation as villagers are reluctant to travel outside for conservation activities
- Community needs socially safeguarding systems for tackling illegal fishing activities
- It is important to have alternative livelihood support mechanism to successfully achieve conservation actions (especially for close seasons and gear restrictions)

4.4 Key Recommendations

"How might we strengthen capacity and create opportunities for stakeholders in GoM so that they are motivated to take sustainable actions to achieve wise-use of fishery resources in Sittaung River and major tributaries?"

To supports more effective, ethical, and sustainable fishery conservation, the study explored solutions to reinforce key attributes in Figure 4.1. to the social dimension for strengthening the social potential of community in context with the following question and recommend the interventions.

Leadership

- Leaders should be elected with the acknowledgement from different social groups in the community. The criteria for leadership positions should be recognized by the community and selection process should be transparent.
- Leaders should be capacitated with skills and knowledge in fishery management, leadership, and community facilitation to strengthen their local knowledge and effectively lead the activities.
- Women should also be in the executive positions for leading fishery conservation activities.

Trust

- The roles and responsibilities of members and leaders in the fishery conservation groups are shared widely across the community.
- The activities of the conservation are shared effectively in the community.
- Regular meetings to share problems and issues related to the fishery conservation.

Communication

- Create groups in the communities responsible for communicating information relevant to fishery conservation.

- Have small groups (10-15 fishers) among community for regular sharing of information in the community.
- Develop effective outreach programs to achieve all the fishers.

Collaboration

- Establish system to monitor and report illegal fishing activities in the fishing ground.
- Initiate community-based patrolling actions in collaboration with different stakeholders in the conservation areas.
- Participatory reporting systems for fishers to regularly monitor the status of fishery in the conservation area.
- Develop incentive programs for fishers (alternative livelihood supports, gear supports, financial supports) in discussion with the needs from the communities.

In addition to these recommended actions, other related community development issues accompanying with fishery conservation should be considered. These actions should be taken through co-creation workshops with stakeholder participations in the communities where they can express their challenges and identified community-based solutions in the community.

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