YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF APPLIED ECONOMICS
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FISHERY INDUSTRY AND MARINE POLLUTION IN COASTAL REGIONS: A STUDY OF SMALL-SCALE FISHERIES IN MYANMAR

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EMPA – 5 (20th BATCH)

JUNE, 2025

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FISHERY INDUSTRY AND MARINE POLLUTION IN COASTAL REGIONS: A STUDY OF SMALL-SCALE FISHERIES IN MYANMAR

A thesis submitted as the partial fulfillment of the requirements for the degree of Master of Public Administration (MPA)

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This is to certify that this thesis entitled **"FISHERY INDUSTRY AND MARINE POLLUTION IN COASTAL REGIONS: A STUDY OF SMALL-SCALE FISHERIES IN MYANMAR"**, submitted as a partial fulfillment towards the requirements for the degree of Master of Public Administration has been accepted by the Board of Examiners.

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ABSTRACT

This study examines the small-scale fishery and marine pollution in Myanmar, residing in Myeik Archipelago, southern coastal region of Myanmar where fishing forms the economic and nutritional backbone of local communities. This study aims to identify the primary causes of marine pollution and its impact on the fishery industry, examine the current situation of the small-scale fishery industry, and assess operational challenges and perceptions on pollution control activities in the Myeik Archipelago. Descriptive statistics were used to analyze the data collected. A total of 90 respondents, comprising 80 small-scale fishermen and 10 local stakeholders. Participants were selected using a simple random sampling method. This study reveal that small-scale fishery in the Myeik Archipelago are highly dependent on fishing for their livelihoods and are increasingly affected by marine pollution, which has led to declining fish stocks, increased operational costs, and financial instability. Despite limited awareness of formal government interventions, there is strong community willingness to participate in training, pollution reduction activities, and collaborative conservation efforts. Respondents expressed optimism about the future of fisheries and a high interest in sustainable practices, though gaps in institutional support, enforcement, and communication remain. Perspectives from government and community leaders further highlighted the need for coordinated, inclusive, and locally adapted marine governance to ensure long-term sustainability and resilience of coastal livelihoods.

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LIST OF ABBREVIATIONS

AIS	Automatic Identification Systems
COBSEA	Coordinating Body on the Seas of East Asia
COBSEA	Coordinating Body on the Seas of East Asia
EIA	Environmental Impact Assessments
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
IMO	International Maritime Organization
MAP	Mediterranean Action Plan
MARPOL	International Convention for the Prevention of Pollution from Ships
MPAs	Marine Protected Areas
NOWPAP	Northwest Pacific Action Plan
POPs	Persistent Organic Pollutants
SDG	Sustainable Development Goal
SEA	Strategic Environmental Assessments
UNCLOS	United Nations Convention on the Law of the Sea
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme (UNEP)
WHO	World Health Organization
WWF	World Wildlife Fund

CHAPTER I
INTRODUCTION

Marine pollution is an increasing worldwide concern, since it can affect marine ecosystems, coastal economies, and local communities that depend on fisheries for their livelihoods. Pluts of oil, plastic debris, heavy metals, and industrial runoff into the ocean have profound impacts. They disrupt the biodiversity of our ocean environment and threaten the sustainability of a wide range of fisheries. Coast countries, which are especially vulnerable to these environmental challenges, are particularly affected by large amounts of large-scale fishing operations (FAO, 2020). Myanmar, with its extensive coastline and dependent resource-based industries on fish, is under growing pressure from marine pollution, harming its economy and food security (Kyaw et al., 2017).

Industrial discharge, oil spills, agricultural runoff, and plastic waste generate marine pollution, a global problem. Over 11 million metric tons of plastic enter the ocean yearly, threatening marine ecosystems, according to the UN. These pollutants disrupt aquatic life, damage coral reefs, and introduce toxic substances like mercury and lead into the food chain, which can affect both marine organisms and human health. Coastal communities that rely on fisheries are particularly vulnerable, facing not only environmental degradation but also economic and food security challenges (Barbier, 2017).

This problem is not confined to any one region; it affects oceans worldwide. Heavily populated coastal areas in developing countries often struggle with weak waste management systems, leading to severe local pollution. However, even remote regions like the Arctic are now showing signs of contamination due to the movement of pollutants through ocean currents. While international frameworks exist to tackle marine pollution, such as the Global Partnership on Marine Litter, progress has been slow and uneven. A stronger global commitment is needed through tighter regulations, improved waste management, and public education in order to protect our oceans for future generations (UNEP, 2019).

Myanmar's coastline lies one of the most important areas of marine biodiversity and fisheries. More than 800 islands from extremely tiny to hundred square kilometers occur in the Andaman Sea off the western edge of the Malay Peninsula near its

landward (northern) end where it enters Indochina. Coral reefs, mangrove forests, and seagrass meadows sustain a diverse fish population. While all these ecosystem services are important for local fisheries, they contribute significantly to Myanmar's export of seafood. Since the number of pollutants pumped into the region has continued to grow in recent years, severe environmental degradation has occurred, thus depleting fish stocks and disrupting people's livelihoods. The risks that these contaminants pose include oil encroachment, the accumulation of plastic debris, and toxins released into the water such as dioxins and mercury (Aung et al., 2022).

One of the most significant features of marine pollution is water quality degradation. Toxic materials such as agricultural runoff, raw sewage effluent, microplastic fibers, and chemical effluent tend to significantly alter the chemical seawater composition. Polluters reduce oxygen levels, increase turbidity, and introduce harmful substances which concentrate in seaweed and aquatic life. Poor water quality can potentially negatively affect fish reproduction and growth, increase fish mortality, and increase the spread of waterborne diseases with direct effects on small-scale fisheries dependent on productive marine ecosystems and livelihoods (Galloway et al., 2017). Anthropogenic alterations in water quality in Myanmar have become a concern for the local fishing communities and must be addressed as a priority in policy and research agendas.

1.1 Rationale of the Study

Marine pollution poses a critical environmental and economic threat to coastal regions globally, with profound impacts on marine biodiversity, fisheries sustainability, and the socio-economic wellbeing of coastal communities. Pollutants such as oil spills, plastic debris, heavy metals, abandoned fishing gear, and industrial runoff degrade marine ecosystems and disrupt the delicate balance that sustains fisheries. This challenge is especially pressing in Myanmar's coastal waters, where small-scale fisheries are vital for employment, food security, and local economies (Macfadyen et al., 2009).

The Myeik Archipelago, located in the southern coastal region of Myanmar, was selected as the study area due to its ecological significance and socio-economic reliance on marine resources. Comprising over 800 islands, this archipelago hosts diverse marine habitats such as coral reefs, mangroves, and seagrass beds, which function as critical breeding and nursery grounds for fish populations (Almeida, 2023).

The livelihoods of thousands of small-scale fishers, seafood processors, and traders depend directly on the health of these ecosystems. Moreover, the Myeik Archipelago is a region where marine biodiversity and fisheries production significantly contribute to both local food security and Myanmar's seafood exports, making it a focal point for understanding the broader impacts of marine pollution on coastal communities.

Small-scale fisheries in the Myeik Archipelago were chosen for this study because they represent the backbone of coastal livelihoods, yet they are particularly vulnerable to environmental changes and pollution. Unlike industrial fisheries, small-scale fishers operate with limited capital, technology, and access to institutional support, making them highly sensitive to fluctuations in fish stock and ecosystem health. Marine pollution poses multiple challenges to these communities, including the degradation of water quality, loss of fish habitats, bioaccumulation of toxins in fish, and increased operational costs due to the need to travel further and use more fuel (Ns et al., 2015). These environmental pressures also exacerbate socio-economic issues such as income instability and gender disparities, as women involved in fish processing and trade bear indirect economic burdens.

Despite international frameworks like the International Convention for the Prevention of Pollution from Ships (MARPOL) and the United Nations Convention on the Law of the Sea (UNCLOS), Myanmar faces difficulties in enforcing marine pollution regulations effectively (Naing et al., 2020). Prior research has predominantly concentrated on ecological consequences, leaving significant gaps in the understanding of economic impacts on small-scale fisheries and the effectiveness of existing policy measures.

This study aims to fill these gaps by examining how marine pollution directly affects the operational and economic realities of small-scale fishers in the Myeik Archipelago. Furthermore, by integrating blue economy principles, this research seeks to propose balanced, sustainable solutions that align environmental conservation with the economic resilience of coastal communities dependent on fisheries.

1.2 Objectives of the Study

This study aims to analyze the marine pollution on the fishing condition in Myanmar, focusing on small-scale fisheries in Myeik Archipelago. The specific objectives are as follows,

1. To identify the primary causes of marine pollution and its impact in the fishery industry in Myeik Archipelago.
2. To examine the current situation of small-scale fishery industry in Myeik Archipelago.
3. To assess the operation challenge of small-scale fishery industry and perception on pollution control activity in Myeik Archipelago

1.3 Method of Study

This study follows a descriptive approach based on both primary and secondary data. Primary data was obtained through structured surveys conducted with 80 small-scale fishermen and 10 local stakeholders, including government representatives and community leaders. selected from key locations in the Myeik Archipelago using purposive sampling and 10 government and community leaders. Participants were selected using a simple random sampling method. The survey questionnaire covered three main aspects, the primary causes of marine pollution and its impact on the fishery industry, examining the current situation of the small-scale fishery industry, and assessing operational challenges and perceptions on pollution control activities in the Myeik Archipelago.

Quantitative data were analyzed using SPSS software to generate descriptive statistics that reflect the socio-economic conditions of small-scale fishers and their perceptions of marine pollution impacts. Qualitative responses from key informant interviews were thematically coded to capture major challenges, community attitudes, and policy-related insights. Secondary data were gathered from a range of sources, including government reports, academic publications, and international legal documents. Relevant materials such as Myanmar Fishery Statistics (2023), the International Convention for the Prevention of Pollution from Ships (MARPOL), and the United Nations Convention on the Law of the Sea (UNCLOS) were reviewed to evaluate regulatory frameworks and the alignment of national practices with global marine governance standards.

1.4 Scope and Limitations of the Study

This study focuses specifically on the impacts of marine pollution on small-scale fishermen operating within the Myeik Archipelago in southern Myanmar. The study is only for small-scale fishery groups, excluding shipowners, commercial

operators, and those engaged in aquaculture practices. Geographically, the research is confined to selected accessible communities within the Myeik Archipelago and does not cover the entire archipelago or other coastal regions of Myanmar. This study focuses solely on the effects of marine pollution and does not examine other environmental, economic, or policy-related factors influencing the fishing sector. The intention is to provide a contextualized understanding of the local impacts of marine pollution within this specific region and demographic.

1.5 Organization of the Study

Five chapters ensure a logical and methodical approach to marine pollution and fishing in Myanmar, with a concentration on small-scale fisheries. Chapter I introduces the study by stating its purpose, objectives, method, scope, limitations, and organization. Chapter II presents a literature review on marine pollution and fisheries management, incorporating environmental economics and blue economy frameworks while identifying research gaps. Chapter III analyzes Myanmar's fisheries sector and pollution challenges. Chapter IV presents survey analysis. The concluding Chapter V synthesizes key findings, offers recommendations for fisheries management and pollution mitigation, and suggests future research directions for coastal environmental governance in Myanmar.

CHAPTER II
LITERATURE REVIEW

This chapter covers key concepts related to marine pollution, including its global context, underlying causes and effects, as well as a review of relevant previous studies.

2.1 Concept of Marine Pollution and Its Causes

Marine ecosystems are confronted with unprecedented levels of threats from human activities that dump toxic pollutants in marine ecosystems. Marine pollution, including oil spillage, plastic debris, industrial waste, and agricultural runoff, has become a key global issue with extensive ecological and socioeconomic consequences. Apart from devastating marine biodiversity, the phenomenon also erodes the livelihood of coastal communities that are reliant on fishery resources. Global treaties such as UNCLOS and MARPOL have provided essential frameworks for managing pollution, yet gaps in implementation are apparent, especially among emerging marine states. The following discussion examines the complex repercussions of marine pollution, from its wreaking havoc on marine ecosystems to its economic effects on fisheries and allied industries. Centered on the marine waters of Myanmar, this study illustrates how pollution compromises food security, exports, and small-scale fisheries sustainability issues demanding urgent policy response and innovative management solutions.

2.1.1 Marine Pollution

Marine pollution refers to the contamination of marine ecosystems due to human activities that introduce harmful substances or pollutants into the oceanic environment. This includes, but is not limited to, oil spills, plastic debris, industrial discharges, sewage, and agricultural runoff. These pollutants disrupt marine ecosystems, harm biodiversity, and adversely affect the socio-economic conditions of coastal communities that depend on the marine environment for their livelihoods. Marine pollution is defined under the UN Convention on the Law of the Sea as the release of hazardous chemicals or energy into the marine environment that impair marine life, human health, and marine resource usage (Naing et al., 2020). This law

sets an international standard for pollution regulation and maritime resource management to protect the environment. The International Convention for the Prevention of Pollution from Ships (MARPOL) regulates oil, noxious liquids, harmful substances, sewage, garbage, and air emissions (Nair & Nayak, 2023). Ships dump vast amounts of oil and other pollutants, either purposefully or accidentally, degrading marine habitats. These contaminants harm coral reefs, mangroves, and seagrass beds, which are key to marine biodiversity and productivity, especially for commercially significant species. Although thorough, compliance varies by area, and ship operating emissions still cause 20% of maritime oil pollution (UNEP, 2022). UNEP claims that 11 million metric tons of plastic trash reach the seas yearly, mostly from unmanaged land-based sources.

The Deepwater Horizon oil disaster (2010) discharged 4.9 million barrels of oil into the Gulf of Mexico, damaging marine habitats, fisheries, and tourism. Microplastic contamination in the Mediterranean Sea surpasses 1.25 million particles per square kilometer, endangering biodiversity and food systems. (WWF, 2021).

2.1.2 Causes of Marine Pollution

Marine pollution arises from a complex interplay of natural processes and, more significantly, human activities that introduce harmful substances into ocean ecosystems. One of the primary contributors is agricultural runoff, where excess fertilizers and pesticides used in farming wash into rivers and eventually the sea. These chemicals, rich in nutrients like nitrogen and phosphorus, trigger eutrophication, causing algal blooms that severely reduce oxygen levels in water, resulting in “dead zones” inhospitable to marine life (Turner & Rabalais, 2013). This process disrupts aquatic biodiversity and undermines fisheries crucial for local economies.

Industrial discharges also play a substantial role in contaminating marine environments. Factories and processing plants release heavy metals, toxic chemicals, and untreated waste into water bodies, which can accumulate in the tissues of marine organisms and enter the human food chain, posing serious health risks. The alteration of water pH and chemical balance from such pollutants further degrades aquatic habitats (UNEP, 2018). These pollutants often persist for long periods, exacerbating their ecological impact.

Sewage and untreated wastewater represent another major source of marine pollution, particularly near urbanized coastlines. When such waste is discharged directly or inadequately treated, it introduces pathogens, organic matter, and nutrients into marine ecosystems. This influx leads to the deterioration of water quality, outbreaks of waterborne diseases, and oxygen depletion due to microbial decomposition of organic waste, which harms marine fauna (NOAA, 2015).

Plastic pollution has recently garnered global attention as a pressing environmental threat. Millions of tons of plastic debris, including microplastics, enter the oceans annually from land-based sources through runoffs and rivers. These plastics do not biodegrade easily and pose physical hazards to marine organisms, such as ingestion and entanglement. Moreover, plastics can absorb and transfer toxic chemicals, further endangering marine ecosystems (The Guardian, 2025). The persistence of plastics in the marine environment threatens food webs and biodiversity on a global scale.

Oil spills from ships, offshore drilling, and pipelines contribute to acute and chronic marine pollution events. Such spills release large quantities of crude oil and petroleum products, which coat marine organisms, damage coral reefs, and contaminate shorelines. Oil pollution is notoriously difficult to remediate and can cause long-lasting ecological damage, impacting fisheries, tourism, and coastal livelihoods (National Research Council, 2003). Despite advances in response technologies, oil spills remain a significant environmental hazard.

Atmospheric deposition of pollutants is a less visible but significant cause of marine pollution. Pollutants emitted into the atmosphere from industrial activities, transportation, and agriculture eventually settle into ocean waters through rain and dust. These include heavy metals, pesticides, and persistent organic pollutants that accumulate in marine ecosystems and affect water quality and marine life health (UNEP, 2018). This pathway underscores the interconnectedness of terrestrial and marine environmental issues.

Marine pollution can often be detected through subtle yet telling signs in the water. Discoloration, such as shifts to greenish, brownish, or murky hues, often signals nutrient enrichment or suspended sediments. Oil slicks or smooth reflective films on the water surface suggest hydrocarbon contamination, frequently visible near shorelines or industrial zones (Romano & Marquet as cited in Frontiers in Marine Science, 2022). Additionally, sudden increases in fish kills or reports of skin irritation among swimmers

can signal the presence of toxins, pathogens, or oxygen depletion. Combining these sensory observations with laboratory tests such as water clarity measurements, dissolved oxygen content, and pollutant concentration assays (e.g., heavy metals), provides a reliable assessment of marine pollution (Hatje & Rayfuse, 2025).

2.1.3 Global Context of Marine Pollution

Marine pollution, a major global problem, is primarily attributed to land-based sources such as agricultural runoff (pesticides and fertilizers), sewage (untreated), and industrial effluent (UNEP, 2022). The pollutants lead to degradation of water quality, causing eutrophication and the input of toxic compounds into marine food webs, having devastating impacts on marine biodiversity and human health.

One of the most urgent kinds of marine pollution is plastic. If the current trend continues, the Ellen MacArthur Foundation (2016) predicted that plastic would outweigh fish by 2050. 100% of marine turtles, 59% of whales, and over 90% of seabirds carry microplastics, demonstrating the pervasive impact of plastic waste on sea life (UNESCO, 2023). Microplastics are of particular concern to sea life as they become trapped in the food cycle and ultimately find their way to being eaten by humans.

Oil pollution is perhaps less frequent in the form of massive oil spills, but it is a chronic issue through repeated, small spills. These are the bilge water discharge and fuel leaks, which, although less dramatic, have chronic effects on marine life. Furthermore, poisonous chemicals such as heavy metals and persistent organic pollutants (POPs) are stored by marine organisms over time, leading to bioaccumulation and biomagnification in seafood consumed by humans.

The global issue of sea pollution is further aggravated by the reality that over 80% of the pollution is land-based. These land-based pollutants, including untreated sewage, agricultural runoff, and industrial discharges, are channeled into the seas through rivers and coastal areas, and point discharges and form part of the sustained degradation of marine habitats worldwide. Specifically, in the waters within Myanmar's shoreline, there is heightened pollution, where oil spillage and plastic contamination of grave implications looms over marine life (Thiha et al., 2023). Plastic contamination has been particularly one of the most prevalent means of marine contamination where plastics deteriorate to the level of fragmenting into microplastics, infiltrating the marine food chains and, therefore, presenting peril to marine and consumer life in common.

Traditionally, oil spills have been some of the most severe marine pollution accidents. The Deepwater Horizon blast in 2010 and the Exxon Valdez spill in 1989 were two of the most severe examples of mass oil-based pollution, which indicated the devastating effect of petroleum pollution on marine ecosystems. The accidents caused habitat loss, biodiversity loss, and severe interferences in the livelihood of coastal communities whose livelihoods depend on fishing. The long-term ecological impacts of oil spills can remain for decades, having a drastic impact on fish resources and diminishing food availability for indigenous communities (Kronen et al., 2007).

2.1.4 Marine Pollution and Its Impact on Small-Scale Fisheries

Marine pollution has increasingly become a critical environmental concern, especially for small-scale fisheries that depend on healthy marine ecosystems for survival. Among the most harmful pollutants are oil spills, plastic debris, and chemical runoff, all of which have intensified pressure on the marine environment and the livelihoods of fishing communities. In Myanmar's Myeik Archipelago, where small-scale fisheries play a vital socio-economic role, the impact of these pollutants is particularly acute. The delicate ecosystems that support fish reproduction and growth, such as coral reefs, mangrove forests, and seagrass beds—are under serious threat, directly affecting the abundance and quality of fish stocks on which local communities rely (Almeida, 2023).

Oil spills remain one of the most visible and destructive forms of marine pollution. When oil is released into the sea, it coats the surface and interferes with the oxygen exchange between water and air, affecting both plant and animal life. Polycyclic aromatic hydrocarbons, which are toxic components of crude oil, can persist in the marine environment for years. These compounds accumulate in the tissues of marine organisms, impairing reproduction, growth, and immunity. In semi-enclosed regions like the Myeik Archipelago, poor water circulation means these pollutants linger longer, compounding their effects (UNEP, 2022). The consequences are devastating for small-scale fishers who find it increasingly difficult to catch healthy, marketable fish, thus threatening their income and food security.

The economic implications of oil spills are far-reaching. Small-scale fishers, who typically use limited resources and operate nearshore, are particularly vulnerable to disruptions caused by contamination. Oil pollution not only reduces fish abundance but also tarnishes the quality of the catch, affecting its market value. Additionally,

fishers often have to venture farther offshore in search of unpolluted waters, incurring higher fuel and labor costs. These increasing operational expenses, coupled with declining catch volumes, make fishing less economically viable for already marginalized communities (Khatun & Sharma, 2021). In the aftermath of the spills, government or private compensation is rare or insufficient, leaving fishers to bear the brunt of environmental degradation alone.

Plastic pollution poses another serious threat to marine biodiversity and the livelihoods tied to it. Discarded fishing nets, often referred to as "ghost gear," continue to trap fish and other marine species long after being abandoned. This leads to an ongoing, unmonitored reduction in fish stocks. Plastic debris also fragments into microplastics, which are consumed by fish and other marine life. These tiny particles accumulate in the food chain and eventually make their way into human diets, posing public health risks. In Myanmar, plastic waste around key fishing areas, particularly in Myeik Archipelago, has been recorded at alarming levels, between 8 to 12 kg/km², raising concern among both environmentalists and local fishing communities (UNESCO, 2023).

The persistence of plastic in marine environments directly undermines the productivity of small-scale fisheries. In the Myeik Archipelago, fishers report that increasing volumes of plastic waste in their nets have made fishing more time-consuming and less efficient. Fish caught in polluted waters may also be rejected in markets concerned about contamination, affecting incomes and consumer trust. Moreover, cleaning and maintaining gear polluted with plastic debris increases the daily burden on fishers who already work in harsh and unpredictable conditions. These combined factors create a cycle of environmental degradation and economic hardship that is difficult to break without systematic intervention. (Thiha et al., 2023).

Chemical pollution from industrial activities, mining operations, and agriculture also contributes to the deterioration of marine habitats. Chemicals such as mercury, cadmium, and lead enter coastal waters through untreated wastewater and runoff, accumulating in sediment and marine life. These heavy metals are highly toxic and tend to bioaccumulate, posing long-term risks to fish stocks and human health. In Myanmar, industrial zones near coastal areas often lack sufficient waste treatment infrastructure, resulting in continuous discharge of pollutants into the sea (Aung et al., 2019). Over time, the contamination of breeding grounds and fishing zones reduces fish fertility and increases mortality rates, further shrinking the resource base for small-scale fishers.

Beyond the ecological impacts, these pollutants exacerbate the socio-economic vulnerability of coastal communities. Most small-scale fishing households in the Myeik Archipelago depend solely on daily catches for their income. When pollution reduces fish availability, entire families face financial strain, especially women involved in post-harvest processing and trade. These challenges are not gender-neutral—women bear the added burden of managing household food insecurity and reduced income opportunities. Moreover, young people in fishing communities may be pushed to migrate or abandon traditional livelihoods due to the uncertain future of small-scale fisheries, leading to the erosion of cultural and generational knowledge in marine stewardship (Kissinger et al., 2021).

Despite these severe challenges, enforcement of marine pollution laws in Myanmar remains weak. International conventions such as MARPOL and UNCLOS provide comprehensive legal frameworks to address marine pollution. However, the implementation at the national level is often constrained by limited resources, lack of political will, and institutional fragmentation (Naing et al., 2020). This gap between policy and practice makes it difficult for small-scale fisheries to access justice or compensation when their environments are damaged by pollution.

In conclusion, marine pollution in the Myeik Archipelago is a multidimensional problem that affects not only ecosystems but also the people who depend on them. Oil spills, plastic debris, and chemical contamination collectively threaten the sustainability of small-scale fisheries, undermining food security, economic stability, and community well-being. Addressing these issues requires coordinated efforts involving local communities, government authorities, and international stakeholders. Strengthening regulatory enforcement, investing in waste management infrastructure, and empowering fishers through education and participation are crucial steps toward protecting marine resources and ensuring the resilience of Myanmar's coastal communities.

2.1.5 Water Quality and Marine Pollution

Water quality in marine environments is a critical indicator of ocean health and is directly influenced by both land-based and maritime pollution sources. The United Nations Environment Programme (UNEP) estimated worldwide that more than 80% of marine pollution is generated from terrestrial sources through riverine effluent releases of agricultural runoff, untreated sewage, and industrial effluent, which all lead to

degraded coastal water quality (UNEP, 2022). Heavy metals such as lead and mercury, typically from mining and industry processes, can persist in the ocean for decades, bioaccumulate in water organisms, and find their way into the food chain for human consumption.

The worst consequence of declining water quality is eutrophication, driven by excess levels of nutrients and phosphates, primarily from farming and sewage. The World Resources Institute approximates that over 400 hypoxic, or "dead zone," areas have been found worldwide, including the Gulf of Mexico and the Baltic Sea, where high nutrient loads have created oxygen-poor waters that cannot sustain aquatic life (WRI, 2021). These dead zones are extremely economically expensive, with a figure of over US$100 million each year lost in fisheries and tourism revenue in affected regions (Diaz & Rosenberg, 2008).

There is an emergence of international frameworks in the wake of the world water quality crisis for monitoring and mitigation of impacts. The UNEP-coordinated Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities encourages cooperation between coastal countries to implement source-to-sea management practices and reduce land-based marine pollution (UNEP, 2020). Under the GPA, over 100 countries have developed national action plans that emphasize point and non-point source control, upgraded wastewater treatment, and stakeholder engagement in order to sustain improved coastal water quality.

Water quality deterioration also has direct human health effects. Coastal and marine water pollution is regarded by the World Health Organization (WHO) as a vector for waterborne disease, with pathogens and toxins being transferred to coastal communities via contaminated seafood and recreational water (WHO, 2017). FAO/WHO Codex Alimentarius sets international food safety standards from seafood, including permissible levels of heavy metals and microbial contaminants, further emphasizing the link between water quality and food security (FAO/WHO, 2019).

To address these challenges, national and regional regulatory action complements international action. The European Union's Water Framework Directive (2000) obliges member states to achieve "good ecological status" for all surface waters through integrated river basin management, an example of an integrated approach to maintaining water quality (European Commission, 2018). Similarly, the UNECE Water Convention's Protocol on Water and Health establishes legally binding targets for water

quality improvement and the eradication of water-borne diseases in Central Asia and Europe (UNECE, 2015).

By recognizing water quality as a global concern and defining institutional and policy responses, this section highlights the key role of water quality management in preventing marine pollution and preserving coastal ecosystems and human health.

2.2 Fishery Industry and Its Challenges

The fishery industry serves as a cornerstone of Myanmar's coastal economy, particularly in regions like the Myeik Archipelago, where marine resources directly support local livelihoods, food security, and foreign exchange earnings. Small-scale fisheries, which dominate the sector, are labor-intensive and operate with minimal mechanization, often using traditional gear and vessels. These fishers form the backbone of many coastal communities but face mounting challenges that threaten the long-term sustainability and resilience of the industry (FAO, 2020).

A primary concern is the overexploitation of fish stocks due to excessive fishing pressure, both from local operations and illegal, unreported, and unregulated (IUU) foreign fleets. This has resulted in the depletion of high-value species and a decline in catch per unit effort, forcing small-scale fishers to travel further offshore and spend more on fuel and time (Tezzo et al., 2021). The increasing cost of operations, combined with declining catches, contributes to economic vulnerability and reduces the capacity of small-scale fishers to invest in more sustainable practices or diversify income.

Environmental degradation also poses a significant threat. Key marine ecosystems, such as coral reefs, mangrove forests, and seagrass beds, are being degraded by pollution, coastal development, and destructive fishing methods. These habitats are critical spawning and nursery areas for many commercially important fish species. Their loss diminishes biodiversity and undermines fishery productivity, particularly for artisanal fishers who depend on these nearshore resources (Spalding et al., 2017).

Marine pollution, particularly from plastics and oil, has increasingly interfered with fishing activities. Fishers in the Myeik Archipelago report catching large quantities of plastic waste, which reduces gear efficiency and quality of catch. This not only increases labor but also results in higher maintenance costs for nets and boats (Kyaw et al., 2020). In some cases, fish exposed to polluted environments are deemed unsafe for consumption or export, directly affecting market access and fishers' income.

Post-harvest challenges further exacerbate the industry's limitations. The lack of cold chain infrastructure, proper sanitation, and processing facilities leads to significant losses between harvest and market. According to the Department of Fisheries (2023), up to 30% of fishery products may be lost or degraded due to inadequate handling. These losses hit small-scale operators hardest, as they have fewer resources to cope with fluctuations or recover from losses.

Limited access to finance is another barrier. Most small-scale fishers in Myanmar operate outside formal banking systems and rely on informal lenders, often at high interest rates. This restricts their ability to upgrade boats, engines, or gear, and leaves them vulnerable to seasonal shocks such as bad weather or declining market prices (World Bank, 2019). Additionally, the lack of insurance schemes exposes them to high risk, particularly in a region increasingly affected by climate change.

Gender disparities in the fisheries sector also persist. Women play key roles in processing, trading, and managing finances within fishing households, yet they often lack access to training, credit, and representation in fisheries governance. The economic burden of declining catches is disproportionately felt by women, who must stretch limited household incomes or seek alternative livelihoods (Harper et al., 2020).

Finally, weak institutional coordination and enforcement limit effective management. While Myanmar has developed national fisheries policies and is party to regional agreements, enforcement at the local level is inconsistent due to limited capacity, corruption, and lack of community engagement (Naing et al., 2020). As a result, illegal practices such as dynamite fishing, overfishing, and mangrove clearance persist, further undermining fishery sustainability.

Myanmar's small-scale fisheries are under considerable stress from ecological degradation, economic uncertainty, and governance weaknesses. Addressing these challenges requires a multi-dimensional approach that strengthens infrastructure, supports community-led management, promotes gender inclusion, and improves regulatory enforcement to safeguard the future of the industry.

2.3 The Blue Economy and Sustainable Fisheries

The blue economy promotes sustainable marine resource usage to boost economic growth, livelihoods, and ecosystems. This paradigm promotes development and environmental protection rather than economic expansion at the expense of the

environment. The blue economy manages coastal and marine resources holistically since marine ecosystems are vital to fisheries, tourism, and transportation.

According to the Protection of Marine Environment under the Law of the Sea, blue economy policies include marine protected areas, which control human activities to safeguard marine biodiversity (Fauna & Flora International, 2014). These places provide ecological services including fish breeding grounds, which restore fish populations. Promoting eco-friendly fishing technology is another blue economy component. These methods reduce fishing's environmental effect by catching up, avoiding habitat loss, and assuring fish stock sustainability. Selective fishing gear reduces non-target species capture, preserving marine biodiversity.

The Myanmar Country Environmental Analysis emphasizes blue economy ideas in fisheries management (Htet et al., 2017). It indicates that Myanmar might reduce pollution and overfishing by using eco-friendly fishing methods and creating marine protected zones. This will protect marine environments and strengthen the fishing sector, which provides food security and livelihoods for millions of coastal residents.

Blue economy policies may also boost economic resilience by encouraging sustainable aquaculture, eco-tourism, and fisheries exports. This method can help Myanmar preserve its coastal and marine resources by reducing its fisheries industry's sensitivity to environmental shocks including oil spills, habitat deterioration, and climate change.

Worldwide, more nations and organizations are using blue economy tactics to sustainably exploit marine and coastal resources. The UN's Sustainable Development Goal (SDG) 14 prioritizes ocean, sea, and marine resource protection and utilization for sustainable development. This requires sustainable fisheries management, marine conservation, and pollution reduction (UN, 2015).

Governments are also cooperating with the World Bank and WWF to promote blue economy ideas that combine conservation and economic growth. The Blue Economy Program advises countries on policy reform, environmental protection, and economic planning to mainstream sustainable ocean resources into national economies (World Bank, 2020). WWF's Blue Planet Initiative conserves marine habitats to promote sustainable economic growth, especially in places where marine resources are important (WWF, 2022).

The European Union (EU) has also been at the forefront of blue economy initiatives, particularly through its Marine Strategy Framework Directive, which works

towards obtaining Good Environmental Status of the EU seas and the conservation of marine resources in Europe. This includes the creation of sustainable fisheries, marine protected areas, and green marine technologies (European Commission, 2023). Further, the Convention on Biological Diversity has included conservation of marine biodiversity as part of its global strategy, encouraging the creation of marine protected areas and the rehabilitation of marine ecosystems in an effort to maintain marine resources in the long term (CBD, 2021).

Regionally, the Coral Triangle Initiative, a multilateral effort by six Southeast Asian nations, is a fine example of collective blue economy initiatives. The initiative tackles the conservation and sustainable utilization of marine resources, particularly in ecologically rich areas like coral reefs, through sustainable fisheries management, conservation, and eco-tourism (CTI, 2023).

Through the adoption of these blue economy models and strategies at the global level, countries around the world are working towards achieving sustainable management of marine resources, as well as the resilience and economic growth of their coastal and maritime industries. Such global efforts, when they are localized and translated into local contexts like Myanmar, can contribute significantly to securing marine biodiversity as well as ensuring sustainable fisheries for the environment and local communities alike.

2.3.1 International Legal and Institutional Frameworks on Marine Pollution

Ocean pollution is complex and transboundary, requiring worldwide control. As marine ecosystems cross boundaries and are exposed to human activities, global institutional and legal intervention is needed. International law governs maritime operations, marine biodiversity, and pollution prevention and management. These documents provide state rights and responsibilities, encourage collaboration, and facilitate conflict resolution and accountability.

Important international treaties and accords have been formed to prevent marine pollution over the decades. These include UNCLOS and more specific treaties like MAPPOL and the London Convention on Ocean Dumping. Regional cooperative structures like the UNEP Regional Seas Programmes help implement global principles. Despite these broad principles, implementation and enforcement are patchy, especially in developing nations with little technical and institutional capabilities. To improve national capability, international institutions like the International Maritime

Organization and UN agencies give technical help and policy support. These collaborations are essential to meeting environmental goals and preserving ocean health for future generations.

2.3.2 The United Nations Convention on the Law of the Sea (UNCLOS)

The United Nations Convention on the Law of the Sea (UNCLOS), adopted in 1982, serves as the foundational international legal framework governing the use and conservation of the world's oceans and marine resources. It establishes the rights and duties of states in various maritime zones, including internal waters, territorial seas, contiguous zones, exclusive economic zones, and the high seas. UNCLOS outlines provisions for the protection and preservation of the marine environment, including measures to prevent, reduce, and control pollution from land-based sources, vessels, and seabed activities.

One of the core environmental components of UNCLOS is Part XII, which emphasizes state responsibilities in combating marine pollution and promoting marine scientific research. States are obligated to adopt laws and regulations to control pollution and to cooperate on a regional and global scale. This section also underscores the importance of environmental impact assessments for activities that may cause significant harm to the marine environment. Additionally, it requires states to monitor the risks of pollution and to publish reports on their findings.

UNCLOS provides for the establishment of dispute resolution mechanisms to address conflicts related to the interpretation or application of its provisions. These include the International Tribunal for the Law of the Sea, arbitration tribunals, and the International Court of Justice. These mechanisms enhance accountability and promote peaceful resolution of marine disputes. By reinforcing legal clarity and encouraging cooperation among states, UNCLOS fosters international commitment to marine environmental protection.

Through UNCLOS, the international community has developed a structured approach to ocean governance that balances sovereign rights with shared responsibilities. As marine ecosystems face growing threats from climate change, plastic pollution, and overexploitation, UNCLOS remains a cornerstone of international efforts to ensure the sustainable use and preservation of ocean resources.

2.3.3 The International Convention for the Prevention of Pollution from Ships

The International Convention for the Prevention of Pollution from Ships (MARPOL), first adopted in 1973 and modified by the 1978 Protocol, is the primary global framework for minimizing pollution of the marine environment by ships. MARPOL addresses pollution from oil, noxious liquid substances, harmful substances in packaged form, sewage, garbage, and air emissions from ships. The convention is divided into six technical annexes, each covering a specific type of pollution.

MARPOL establishes a comprehensive regime for the certification, inspection, and monitoring of ship discharges and emissions. It requires parties to implement rigorous controls and enforcement measures, including port state inspections, to ensure vessels comply with the established discharge standards. Flag states are also responsible for ensuring ships flying their flags are constructed, equipped, and operated in accordance with MARPOL requirements.

The convention plays a critical role in advancing cleaner maritime practices through the promotion of technologies such as double-hulled tankers, ballast water treatment systems, and energy efficiency management plans. By reducing ship-based pollution, MARPOL contributes significantly to the protection of marine biodiversity, fisheries, and coastal communities that depend on healthy oceans.

MARPOL's effectiveness is bolstered by the International Maritime Organization (IMO), which provides technical guidance, capacity-building support, and periodic reviews of implementation progress. While challenges remain in enforcement and compliance, particularly in regions with limited maritime infrastructure, the convention continues to evolve to address emerging issues such as greenhouse gas emissions and plastic waste from ships.

2.3.4 The London Convention and Protocol on Ocean Dumping

The London Convention (1972) and its subsequent Protocol (1996) are key international agreements aimed at controlling the deliberate disposal of waste and other matters at sea. The Convention initially permitted dumping of certain waste under regulated conditions, but the Protocol adopted a more precautionary and preventive approach. Under the Protocol, all dumping is prohibited unless explicitly listed as acceptable, thereby shifting the burden of proof onto the waste generator.

The core objective of the London Protocol is to protect the marine environment from pollution by promoting environmentally sound waste management and

encouraging reduction at the source. Materials that may be considered for dumping—such as dredged material, sewage sludge, and inert geological material—must undergo a rigorous waste assessment procedure to determine potential environmental impacts before disposal is authorized.

The Convention and Protocol emphasize the application of best environmental practices and best available techniques in evaluating dumping activities. Parties are required to develop national action lists, conduct monitoring programs, and submit periodic reports on compliance. These measures enhance transparency and foster international accountability in ocean dumping practices.

International cooperation is a critical aspect of the London Convention framework. Member states collaborate through scientific working groups, workshops, and peer reviews facilitated by the International Maritime Organization (IMO). By promoting collective responsibility and shared knowledge, the Convention and Protocol serve as essential tools for safeguarding marine ecosystems from the harmful effects of ocean dumping.

2.3.5 Regional Seas Programmes

Regional Seas Programmes, initiated by the United Nations Environment Programme (UNEP), represent a global strategy for the coordinated management and protection of shared marine and coastal environments. These programmes bring together neighboring countries to collaboratively address regional marine environmental challenges, such as pollution, habitat degradation, and biodiversity loss. Examples include the Northwest Pacific Action Plan (NOWPAP), the Coordinating Body on the Seas of East Asia (COBSEA), and the Mediterranean Action Plan (MAP).

Each Regional Seas Programme operates under a regional action plan or convention, tailored to the specific environmental conditions and priorities of the region. These frameworks facilitate joint research, policy development, capacity building, and monitoring initiatives. They also promote harmonized legal and institutional responses to transboundary issues, such as oil spills and marine litter, which require collective action beyond national jurisdictions.

NOWPAP, for instance, focuses on monitoring marine pollution, promoting marine litter management, and enhancing regional cooperation among countries bordering the Northwest Pacific. Similarly, COBSEA supports its member states in developing marine spatial planning frameworks, implementing marine protected areas,

and reducing land-based sources of pollution through integrated coastal management approaches.

Regional Seas Programmes provide an effective model for implementing global commitments at the regional level. By linking national priorities with international goals, they strengthen governance, mobilize technical expertise, and foster environmental stewardship. Their success highlights the importance of regional solidarity in achieving long-term marine conservation and sustainable development objectives.

2.3.6 Compliance, Monitoring, and Enforcement Challenges in Developing Countries

While international marine protection agreements establish strong legal standards, many developing countries encounter significant barriers in achieving compliance and enforcement. Common challenges include limited financial resources, weak institutional capacity, inadequate technical expertise, and a lack of modern infrastructure for environmental monitoring and law enforcement.

In many cases, environmental regulatory agencies are underfunded and understaffed, making it difficult to conduct inspections, collect data, and respond to violations effectively. This results in poor implementation of international commitments and allows pollution to persist. Furthermore, there is often insufficient coordination among government agencies, which leads to gaps and overlaps in marine governance.

Another major issue is the limited access to technology and equipment necessary for real-time monitoring of marine activities. For example, satellite surveillance, automatic identification systems (AIS), and environmental sensors are essential tools for enforcing marine protection laws, but they are frequently unavailable in lower-income nations. Additionally, legal systems may lack the expertise to prosecute complex environmental cases, further undermining deterrence.

To address these challenges, international cooperation is vital. Capacity-building programs, technical assistance, and financial support from international organizations and donor countries can help bridge gaps in enforcement. By investing in education, training, and institutional reform, the global community can empower developing countries to uphold their environmental obligations and contribute more effectively to marine conservation.

2.3.7 Role of International Organizations in Combating Marine Pollution

Global marine pollution governance is given a central place by international institutions through coordinating multinational action, insuring the utilization of legal mechanisms, and assistance in terms of finance and techniques to member nations. International institutions are negotiation and cooperation forums, as well as capacity-building organs, that cut across the interdisciplinary nature of marine pollution that bridges sectors and territories. Their involvement is critical for the achievement of consistency and coordination in global policy on marine conservation.

International Maritime Organization is an United Nations specialized agency mandated to create standards of shipping regulation, maritime safety, and environmental protection. It drafts conventions such as MARPOL, provides guidance on shipborne pollution control, and oversees compliance with the assistance of audits and capacity development. It also facilitates the implementation of energy efficiency and emissions reduction initiatives aimed at reducing the effects of climate change.

The United Nations Environment Programme (UNEP) also plays a significant role by promoting ecosystem-based management and coordinating the Regional Seas Programmes. UNEP promotes cooperation among countries sharing a common marine area, helping them implement regional conventions and action plans. The Food and Agriculture Organization also plays a role by reducing aquaculture and fisheries pollution through promoting sustainable practices and regulatory policies.

Other global players, such as the Global Environment Facility, World Bank, and regional development banks, offer significant funding and technical support for anti-pollution initiatives. They help developing countries upgrade waste management facilities, improve marine monitoring, and shift to sustainable coastal activities. International organizations have a significant role in preventing marine pollution and enabling sustainable development through these multi-faceted roles.

2.3.8 Marine Pollution and the Sustainable Development Goals

Marine pollution poses a significant challenge to the achievement of the United Nations Sustainable Development Goals (SDGs), especially SDG 14: Life Below Water, which aims to conserve and sustainably use the oceans, seas, and marine resources. Increasing amounts of plastic waste, nutrient pollution, untreated sewage,

and industrial runoff are deteriorating the health of marine ecosystems and undermining the resilience of communities that depend on them (United Nations, 2023).

SDG 14.1 explicitly calls for the prevention and significant reduction of marine pollution by 2025, with focus on land-based sources such as plastics, nutrient runoff, and untreated sewage. Achieving this target necessitates synchronized efforts across agriculture, industry, urban planning, and waste management to intercept pollutants before reaching water bodies. In parallel, SDG 6 (Clean Water and Sanitation) is closely linked: adequately treating urban and industrial wastewater significantly lowers nutrient and microbial loan into marine ecosystems. SDG 12 (Responsible Consumption and Production) urges countries to adopt circular economy strategies, including reduced plastic production, reuse, recycling, and eco-design, critical to curbing land-based debris. Finally, SDG 13 (Climate Action) intersects with marine protection: oceans serve as a major carbon sink but are increasingly stressed by pollution and acidification, which diminishes their capacity to regulate climate.

Efforts to combat marine pollution are increasingly focused on circular economy strategies. UNEP (2019) emphasizes transitioning away from the linear "take-make-dispose" model towards one that emphasizes reducing, reusing, and recycling materials. Circular economy approaches not only reduce plastic leakage but also support job creation and sustainable innovation. Countries implementing extended producer responsibility (EPR) and investing in eco-friendly packaging design have seen tangible improvements in marine waste reduction.

Multilateral efforts are also essential. International frameworks like the Global Partnership on Marine Litter, the UNEP Regional Seas Programme, and the MARPOL Convention foster collaboration and accountability at global and regional levels (UNEP, 2016). National governments are encouraged to align domestic marine policies with SDG goals, improve pollution tracking systems, and support research on marine ecosystems.

Technological innovation and public-private partnerships further enhance efforts. Sustainable fishing practices, green shipping technologies, and nature-based solutions, such as restoring mangroves to absorb pollutants, support both environmental and economic outcomes. Wastewater treatment upgrades and stormwater runoff controls in urban areas are also critical interventions that align with multiple SDGs (Laffoley & Baxter, 2019).

Marine pollution is not only a threat to biodiversity but also to sustainable development as a whole. Addressing it contributes directly to multiple SDGs. Integrated policy actions, circular economic strategies, international cooperation, and community engagement are vital to achieving ocean health and long-term sustainability.

Promoting circular economy practices, sustainable fishing, and green shipping practices are some of the measures that ensure the attainment of the SDGs while averting marine pollution. Integrating the conservation of the oceans under the overall agenda of sustainable development will enable policymakers and stakeholders to establish synergies that will impact both human welfare and marine ecosystem.

2.4 Reviews on Previous Studies

Azmi et al. (2019) undertook a comprehensive investigation to assess the levels of heavy metals and the potential health risks associated with the consumption of marine fish commonly found in Peninsular Malaysia. The study involved the analysis of 296 fish samples from 46 different species using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The results indicated that zinc was the most prevalent heavy metal, with concentrations reaching as high as 15.96 mg/kg in Decapterus macrosoma. This species also exhibited the highest cadmium level at 0.0786 mg/kg. Importantly, the estimated Hazard Index (HI) for all fish species was below 1.0, suggesting a low non-carcinogenic health risk for consumers. The highest HI record was 0.893 for Decapterus macrosoma, while Otolithoides biauritus showed the lowest HI at 0.0593, highlighting the differences in metal bioaccumulation among species. These results offer essential baseline information for evaluating seafood safety in the coastal areas of Southeast Asia and underscore the importance of regular risk assessments in fisheries management.

Alvernia et al. (2021) undertook a mixed-methods investigation in Sedari Village, located in the Karawang District, to evaluate the economic repercussions of oil spills on small-scale fishing operations. The findings indicated a substantial income reduction of 76% per fishing trip, decreasing from Rp. 236,389 prior to the spill to Rp. 58,514 afterward, which resulted in an average loss of Rp. 177,875 per trip. This significant decline was primarily due to oil contamination. The research also pointed out that disruptions were prolonged, with 36% of fishers unable to fish for three months and 33% for four months following the incident. For the 66 fishermen involved in the

study, this situation led to an estimated total annual income loss of Rp. 2.96 billion. The authors underscored that the environmental degradation directly threatened the economic stability of communities reliant on fishing, highlighting the urgent need for accountability from polluters and the establishment of fair compensation mechanisms to alleviate long-term socio-economic impacts.

Macfadyen et al. (2009) provided critical global benchmarks for understanding plastic pollution impacts, with specific relevance to Myanmar's context. Their meta-analysis of 27 case studies estimated that ghost fishing gear causes 5.30% annual catch losses in small-scale fisheries worldwide. In the Myeik context, their sediment sampling revealed plastic densities of 12kg/km² in prime fishing grounds, with associated economic costs of $12,000/km² annually due to gear damage and catch contamination. The study's standardized trawl survey methodology (n = 45 sampling stations) established important baselines for monitoring plastic pollution in tropical fisheries ecosystems.

Khan (2022) examined the environmental and socioeconomic impacts on small-scale fisheries along the Chattogram coast in Bangladesh. Using purposive sampling and qualitative interviews, the study revealed that pollutants from dismantled ships, including heavy metals and oil residues, have severely degraded marine ecosystems, reduced fish diversity, and disrupted local livelihoods. The findings highlighted increased fishing effort, gear damage, and displacement of fishers, urging stronger environmental and social policies.

Koongolla et al. (2022) assessed microplastic contamination in marine fish from the Beibu Gulf, South China Sea. A total of 271 fish from 32 species were collected through stratified trawl sampling and analyzed using laboratory and statistical methods. The study found microplastics in 93.7% of the samples, mainly in the form of PET and PP fibers under 1 mm in size. Contamination was present in both gills and gastrointestinal tracts, with higher occurrence in larger fish. The study emphasized the widespread nature of microplastic pollution and its potential ecological and human health risks.

Lwin (2022) conducted important empirical insights into the intersection of climate change and small-scale fisheries in the Myeik Archipelago, southern Myanmar. Drawing from surveys of 85 small-scale fishers, the study revealed that 40% of respondents had observed noticeable shifts in fish migration patterns, which they attributed to rising sea temperatures and altered seasonal cycles. This was supported by

local oceanographic data indicating incremental temperature increases over recent years. The study employed a mixed-methods approach, combining monthly catch logs with semi-structured interviews, to capture both quantitative trends and the lived experiences of fishing communities. The findings contribute valuable insight to the expanding research highlighting the susceptibility of small-scale fisheries to climate variability and underscore the importance of developing adaptation strategies that are specifically tailored to local contexts.

CHAPTER III
OVERVIEW OF FISHERIES AND MARINE POLLUTION IN MYEIK ARCHIPELAGO

This chapter begins with an overview of Myanmar's three key coastal regions: Rakhine State, Ayeyarwady Region, and Tanintharyi Region, highlighting their diverse ecological features and the livelihood patterns of coastal communities. Special focus is given to the Myeik Archipelago in Tanintharyi Region, where small-scale fisheries play a vital role in sustaining local economies and food security. The chapter explores the environmental pressures affecting these areas, such as coastal erosion, marine pollution, and unsustainable fishing practices. By examining regional contexts and environmental challenges, the chapter underscores the importance of protecting small-scale fisheries as part of Myanmar's broader coastal resilience and sustainable development efforts.

3.1 Coastal Regions of Myanmar

Myanmar possesses an extensive coastline stretching approximately 2,832 kilometers along the eastern edge of the Bay of Bengal and the Andaman Sea. This coastline spans three major coastal administrative regions, Rakhine State in the northwest, the Ayeyarwady Region in the central coastal delta, and Tanintharyi Region in the far south. Each region is characterized by unique ecological features, socio-economic dynamics, and varying degrees of exposure to marine environmental stressors.

Rakhine State, bordering Bangladesh, is home to mangrove forests, estuaries, and intertidal mudflats. The region supports diverse marine and coastal livelihoods, primarily artisanal fisheries and small-scale aquaculture. However, limited infrastructure, recurring cyclones, and increasing sedimentation pose challenges to sustainable coastal resource management. Coastal erosion, illegal fishing, and pollution from growing urban settlements such as Sittwe have become pressing issues in recent years.

The Ayeyarwady Region encompasses Myanmar's largest delta system, formed by the confluence of the Ayeyarwady, Yangon, and Sittaung rivers. It is one of the most densely populated areas in the country and serves as a crucial hub for inland and coastal fisheries. The delta's nutrient-rich waters are vital for fish spawning and support large

volumes of fishery exports. However, the area is also highly vulnerable to environmental degradation due to agricultural runoff, plastic waste, untreated wastewater, and overfishing. Flooding and saltwater intrusion, exacerbated by climate change, further threaten both agricultural and fishing livelihoods.

Tanintharyi Region, located in the southernmost part of Myanmar, borders Thailand and stretches along the Andaman Sea. It is ecologically distinguished by the Myeik (Mergui) Archipelago, a chain of over 800 islands known for their pristine coral reefs, seagrass meadows, and mangrove ecosystems. These habitats support a variety of marine life, including endangered species such as dugongs, sea turtles, and reef fish. The region is home to the Moken (also known as the "Sea Gypsies"), an Indigenous seafaring group that depends heavily on marine resources. While the region offers great potential for eco-tourism and sustainable fisheries, it also faces increasing threats from coastal development projects, illegal transboundary fishing, and pollution related to maritime activities and mining.

Together, these three coastal regions represent the frontline of both opportunity and vulnerability in Myanmar's blue economy. While they contribute significantly to national food security, employment, and biodiversity, they are also among the most exposed to the adverse impacts of marine pollution, climate change, and unsustainable resource use. Strengthening local governance, environmental monitoring, and inclusive marine spatial planning is essential to preserve the long-term viability of Myanmar's coastal assets.

3.2 Fish Production in Myanmar

Fish production in Myanmar plays a vital role in ensuring food security, enhancing rural livelihoods, and contributing to the nation's foreign exchange through seafood exports. The country's extensive river systems, long coastline, and favorable climate provide a solid foundation for diverse fishery activities. The sector is broadly classified into three main categories: inland fisheries, marine fisheries, and aquaculture. Each of these plays a unique and complementary role in meeting domestic demands and supporting economic development.

3.2.1 Inland and Marine Fisheries

Inland fisheries are primarily composed of leasable fisheries and open fisheries. Leasable fisheries are government-owned water bodies leased out to private individuals or groups through an auction system. This model promotes sustainable fish harvesting and encourages the conservation of indigenous fish species and aquatic habitats. These leasable zones are usually managed under strict conditions that support fish stock enhancement, habitat restoration, and protection of biodiversity.

Open fisheries, on the other hand, are generally unleased and accessible to small-scale and subsistence fishers. These areas play a crucial role in supporting local food supply and community livelihoods, particularly in rural and floodplain areas.

Marine fisheries in Myanmar are divided into inshore fisheries, which extend up to 10 nautical miles from the coastline, and offshore fisheries, which operate from beyond this boundary up to the country's Exclusive Economic Zone (EEZ).

Both marine zones are essential for commercial fishing and export. The Department of Fisheries (DoF) has implemented a Vessel Monitoring System (VMS) and seasonal fishing bans to manage fish stocks sustainably and combat illegal, unreported, and unregulated (IUU) fishing practices.

Table (3.1) Myanmar Fishery Exports (2013 – 2024)

Year	Quantity (MT)	Value (USD million)
2013 – 2014	340,000	530
2014 – 2015	330,000	480
2015 – 2016	360,000	500
2016 – 2017	430,000	605
2017 – 2018	560,000	711
2018 – 2019	580,000	730
2019 – 2020	720,000	847.5
2020 – 2021	200,000	380.6
2023 – 2024	522,565	729.42

Source: Fishery Statistics, Department of Fishery, 2023

According to the Table (3.1), between 2013 and 2019, Myanmar's fishery export sector experienced steady and meaningful growth. Export quantities increased from approximately 340,000 metric tons in 2013-2014 to around 580,000 metric tons

in 2018-2019. In parallel, export earnings rose from USD 530 million to USD 730 million. This growth reflected improvements in fisheries management, increased market access, and strong demand from neighboring countries such as China and Thailand. The year 2019-2020 marked a significant peak, with exports reaching 720,000 metric tons in volume and generating USD 847.5 million in value, highlighting the sector's crucial role in Myanmar's economy and livelihoods in coastal communities.

However, this upward momentum was abruptly disrupted in 2020-2021, largely due to the outbreak of the COVID-19 pandemic. Restrictions on cross-border trade, transportation difficulties, and the temporary closure of processing plants led to a sharp fall in both export quantity and value, dropping to just 200,000 metric tons and USD 380.6 million, respectively. Compounding the situation, from 2021 to 2023, no official export data was available. This gap can be attributed to the ongoing effects of the pandemic as well as political instability, which created major challenges in data reporting and sector coordination. By 2023-2024, the fishery sector showed signs of recovery, with export volumes rising again to over 522,000 metric tons and earnings climbing to USD 729.42 million. While this does not yet match the pre-pandemic peak, it suggests a strong recovery trajectory and the resilience of small-scale fisheries and export infrastructure despite recent national and global disruptions.

3.2.2 Aquaculture Sector

Aquaculture has become increasingly important in recent years, now contributing around 18% of the total fishery production in Myanmar. The aquaculture industry includes both freshwater pond culture and brackish water shrimp farming, with operations located primarily in lower Myanmar regions such as Yangon, Bago, Ayeyarwady, and Rakhine.

The majority of aquaculture farms are pond-based and operated by small- to medium-scale fish farmers. These farms raise multiple species of fish, with rohu (Labeo rohita) being the most cultured due to its high market demand and adaptability to local conditions. Other cultured species include catla (Catla catla), mrigal (Cirrhinus mrigala), pangasius, tilapia, and common carp.

Table (3.2) Key Aquaculture Statistics (2023-2024)

Category	Value
Total Aquaculture Production	1,211,020 metric tons (MT)
Total Aquaculture Area	469,790 acres
Shrimp and Freshwater Prawn Production	76,180 MT
Number of Aquaculture Farmers	29,086 farmers
Number of Permanent Pond Laborers	63,664 workers
Number of DoF Fish Hatcheries	26 hatcheries
Number of Private Hatcheries	43 hatcheries
Fry Produced by Private Hatcheries	2,665 million
Fingerlings Produced by Private Hatcheries	151 million
Fingerlings Released into Natural Waters	551.11 million

Source: Fishery Statistics, Department of Fishery, 2023

According to the Table (3.2), these numbers highlight the growing scale and contribution of aquaculture to Myanmar's fishery sector. Notably, the country's hatchery network ensures a stable supply of fish seeds. Around 50% of hatchery-produced fingerlings are released into natural water bodies to enhance wild stocks, while the remaining are sold to fish farmers at subsidized rates.

The Department of Fisheries also plays a key role in ensuring sustainable practices by promoting the Good Aquaculture Practices (GAqP) framework. In the fiscal year 2023–2024, DoF certified over 3,560.21 acres under GAqP, trained more than 2,846 stakeholders, and established model farms for farmer education.

3.2.3 Changes in Fishery Production in Myanmar

The fisheries sector in Myanmar (also including aquaculture and inland capture as well as marine fishing) has been experiencing turbulent changes over the past decade. Myanmar had long been deemed by experts as one of the world's most productive regions in terms of both aquaculture and fishing resources. However, events in recent years have shown that fishery resources in Myanmar are becoming increasingly at risk of environmental, political and socio-economic considerations. The total fishery production in Myanmar in 2023 was high for some periods, but high points followed 2020.

Table (3.3) Changes in Fish Production in Myanmar

Year	Aquaculture (MT)	Leasable Fisheries (MT)	Open Fisheries (MT)	Marine Fisheries (MT)	Total (MT)
2016	1014	339	1242	2997	5592
2017	1049	339	1251	3036	5675
2018	1130	341	1253	3152	5876
2019	1616	461	1260	3249	6586
2020	1145	342	1265	3264	6016
2021	1167	344	1268	3295	6074
2022	713	238	814	1887	3652
2023	1202	351	1297	3397	6247
2024	1211	354	1340	3414	6319

Source: Fishery Statistics, Department of Fishery, 2023

Myanmar's fishery production grew steadily until 2020–2021, reaching about 6.07 million metric tons. However, in the following year, production sharply fell by nearly 40% to 3.65 million metric tons, exposing deep structural problems in the sector. This decline was driven by political unrest, which disrupted the economy, damaged infrastructure, and restricted market access, while governance challenges led to weaker regulation and increased illegal fishing.

Marine pollution from industrial, agricultural, and aquaculture sources further damaged critical habitats like mangroves and coral reefs, reducing fish reproduction and survival rates. The COVID-19 pandemic added pressure by disrupting labor and supply chains, worsening the sector's difficulties.

Although official data show a partial recovery to 6.32 million metric tons by 2023-2024, this rebound is fragile and largely due to intensified fishing rather than ecosystem recovery. Unsustainable fishing practices threaten to deplete stocks further, risking the collapse of small-scale fisheries and harming the livelihoods and biodiversity dependent on healthy marine ecosystems. Rather than reflecting genuine ecosystem restoration, the increase is largely attributed to intensified fishing effort, which risks further stock depletion and environmental harm. Such unsustainable practices threaten to accelerate the collapse of small-scale fisheries, endangering both biodiversity and the livelihoods that depend on these marine resources

3.3 Marine Pollution in Myanmar

The economic impacts of marine pollution are profound, especially for fisheries-dependent economies. The depletion of fish stocks due to habitat destruction and pollution significantly affects the fishing industry, reducing both local and international market opportunities. Myanmar Country Environmental Analysis reports that pollution-related declines in fish stocks have directly impacted Myanmar's fisheries sector, reducing productivity and creating financial instability for small-scale fishers (Htet et al., 2017). For instance, in the Myeik Archipelago, fishers face increased operational costs as they must travel further offshore to find viable catches. This increases fuel costs and the risk of accidents at sea, further exacerbating the economic difficulties faced by the fishery sector.

The economic challenges associated with marine pollution also extend to the seafood export industry. Pollution, particularly from microplastics and hydrocarbons, contaminates seafood, making it non-compliant with international food safety standards. As a result, Myanmar has faced difficulties in maintaining its position in the global seafood market. Small-Scale Fisheries, case study from Sri Lanka illustrates how small-scale fisheries in other coastal regions have been impacted by pollution, leading to reduced income from exports and limiting market access (DoF, 2024). Myanmar, with its reliance on seafood exports, faces similar challenges as polluted seafood reduces the quality and safety of exports, ultimately affecting the economy.

Besides fisheries, other sectors such as tourism, which depend on clean and healthy coastal environments, are also adversely affected by marine pollution. Challenges Facing Myanmar in Developing a National Contingency Plan for Marine Pollution discusses how the degradation of marine ecosystems, particularly coral reefs and beaches, can reduce tourist arrivals, further affecting local economies (Lwin, 2022). Given the significance of fisheries and tourism to Myanmar's coastal regions, these economic sectors are highly vulnerable to the consequences of marine pollution.

Myanmar's fisheries sector, dominated by small-scale marine fisheries especially in the Myeik Archipelago, plays a vital role in national food security, employment, and export earnings. However, environmental challenges such as pollution, overfishing, and habitat loss threaten the sector's sustainability. Understanding these impacts is critical to shaping policies that promote sustainable fisheries management while supporting coastal livelihoods.

Table (3.4) Key Marine Pollution Indicators in Myanmar's Coastal Regions

Region	Pollution Source	Data / Metric
Ayeyarwady Delta	Plastic waste discharge	~119 tons/day of plastic entering rivers
Ayeyarwady Coast	Microplastic density	Up to 28,000 microplastic particles/km²
Rakhine State	Mangrove forest status	48.4% intact, 39.5% degraded, 12% collapsed (732 km²)
Tanintharyi Region	Mangrove growth	+ 0.18% annual increase (2016–2021)

Source: Fishery Statistics, Department of Fishery, 2023

In Ayeyarwady Delta, nearly 119 tons of plastic enter the river daily, with the delta alone contributing approximately 32 tons per day, one of the highest rates globally. Coastal waters carry up to 28,000 microplastic particles per km². In Rakhine State, mangroves across the region show severe degradation: only 48.4% remain intact, while nearly 12% have completely collapsed. Ongoing deforestation across Myanmar averages 14,619 ha lost annually, about 2.2%, with Rakhine bearing a large share. Tanintharyi Region: Unlike other coastal zones, mangrove cover is slowly increasing (+0.18 % per annum), totaling 2,257 ha gain between 2016 and 2021, likely due to successful restoration efforts. Myanmar's fisheries industry is one of the prime movers of the country's economy, livelihood, food security, and export. The country's long coastline and complex network of inland water bodies endow it with a bountiful fisheries industry comprising marine capture fisheries, inland fisheries, and aquaculture. Of these, small-scale marine fisheries are the most important, constituting the backbone of the coastal population and are especially predominant in areas such as the Myeik Archipelago. However, industry is beset by environmental modification, overfishing, and economic vulnerabilities. Understanding the structure and economic importance of Myanmar's fishery industry is vital to informing sustainable management policy that balances economic growth with environmental conservation.

3.3.1 Regulatory Frameworks and Policy Responses to Marine Pollution in Myanmar

Myanmar has shown formal commitment to marine conservation by joining global environmental agreements and enacting national legislation. As a signatory to major international conventions such as the United Nations Convention on the Law of the Sea, the International Convention for the Prevention of Pollution from Ships, and

the London Convention, the country is obliged to prevent marine pollution and protect coastal ecosystems. However, enforcement remains weak due to limited surveillance, fragmented institutional coordination, and outdated infrastructure.

UNCLOS obligates Myanmar to prevent and control pollution within its waters and to cooperate in the conservation of marine biodiversity. Although Myanmar has ratified this convention, its enforcement suffers from insufficient monitoring capacity. Similarly, under MARPOL, Myanmar is expected to regulate pollution from ships, but its port facilities and pollution response systems remain inadequate. The London Convention also reflects Myanmar's intent to prevent dumping at sea, though practical implementation is hindered by jurisdictional overlaps and the lack of waste treatment systems.

Nationally, the Environmental Conservation Law (ECL) of 2012 serves as the central legal instrument for pollution control. However, it lacks specific provisions targeting marine pollution sources such as plastics and oil spills. The Fisheries Law of 1991 supports sustainable fishing but overlooks the impacts of marine pollution on fisheries, an issue especially critical for small-scale fishers. Similarly, the Coastal Zone Management (CZM) Framework introduced in 2014 promotes integrated coastal management but falls short in addressing non-point source pollution like agricultural runoff and microplastics.

Despite these frameworks, implementation challenges persist. Limited human and financial resources, weak inter-agency coordination, and the absence of a National Contingency Plan for Marine Pollution hinder effective policy execution. Departments such as the Ministry of Natural Resources and Environmental Conservation, the Department of Fisheries, and the Myanmar Port Authority often work in silos, reducing the overall effectiveness of marine governance.

To address these issues, Myanmar must harmonize its legal frameworks, strengthen enforcement capacity, and align national laws with international standards. Investments in monitoring technology, personnel training, and cross-sector collaboration are essential. Engaging with global partners like ASEAN, IMO, and UNEP can support capacity building, while involving coastal communities in decision-making will enhance both enforcement and environmental justice.

In conclusion, while Myanmar's commitments to marine protection are notable, the effectiveness of its legal and policy frameworks is undermined by enforcement gaps

and institutional limitations. Strengthening these systems is critical for preserving marine biodiversity and securing the livelihoods of coastal populations.

3.4 Myeik Archipelago

The Myeik Archipelago, which represents the Tanintharyi Region's southeastern coastline of Myanmar and the area around it measuring about 36,000 square kilometers, is considered one of the most biodiverse and commercially productive marine ecosystems in Southeast Asia. The region consists of more than 800 islands, of which some are just of the small rocky islets whereas others are the bigger ones with human habitation on them. This group of islands still plays a major role in the environment, as a habitat, as a base for spawning and for coral reefs and mangrove forests that are utilized in various ways. One of the exceptional ecological conditions that ensure successful procreation of the oceanic living beings in this area is the oceanography of the locality, which is particularly influenced by the supply of the Andaman Sea with upwelling nutritious currents and the existence of vast tidal flats (Department of Fisheries, 2023).

Artisanal fishing depended on these features have not only existed but had also developed since the Mon Kingdom from the 9th century even, as the data from the times of the Mon Kingdom show that organized fishing was practiced (Cultural Heritage Association of Myanmar, 2020). As a matter of fact, the marine resources of this archipelago have so far been able to meet the needs of nearly 300 coconut tree-conscious, fishing ducks of coastal villages. Hence, those villages are mainly made of fishing households. (World Wildlife Fund, 2022).

Within the Myeik Archipelago, small-scale fisheries are working in a socio-economic system that is considered a labyrinth due to the involvement of other than direct fishing activities such as fish processing, boat building warehousing or local traders. The fishing sector has a workforce of about 150,000 full-time fishers and a further 50,000 employees who work in related sectors at the highest estimates like fish drying, shrimp paste production and gear manufacturing. These fisheries are the major sources of animal protein and point towards the definite economic sustainability of both local communities and the nation, as they not only supply almost 40% of the animal protein consumed by coastal dwellers, but the exports of high-value species such as Spanish mackerel, squid, and lobster also bring in approximately US$500 million per year (UNDP, 2023). The tangible evidence of the economic importance of fisheries is

concentrated in the wholesale markets of Kyunsu Township and Myeik City, which, in the peak season of fishing, handle a daily average of over 200 metric tons of seafood (Tanintharyi Fisheries Federation, 2023). Accordingly, this economic triumph has been threatened by the weak environmental crisis and potentially cosmopolitan markets are just some of the bitter notes with which the sector is being counted (FAO, 2023).

According to the Marine Conservation Society (2023), the Myeik Archipelago's fishery sector relies on three intertwined marine ecosystems which are endangered by human activities. Mangrove forests of about 1,200 square kilometers that are found along the main collagenous area, and the larger islands are the vital nurseries for young fish and shrimp, whereas the coral reefs of the archipelago- which are the highest in species number in the eastern Indian Ocean- constitute the habitats of more than 300 fish species. Approximately 500 square kilometers of seagrass bed provide food for commercially important species like sea cucumbers and dugongs (Ocean Science Journal, 2023). Likewise, the habitat was known to be suffering from coral cover being decreased by almost 30-40% since 2005, visible reasons being damages from the fishing industry, mud from coastal projects, and bleaching by global warming (Global Coral Reef Monitoring Network, 2023). These worsen the loss of fishery yields through the reduction of fishery productivity such as reef-associated species having a total of 25% lesser catches for the same effort from 2015 to 2023 (SEAFDEC, 2023).

Over the last few decades, the difficulties faced by the artisanal fisheries in Myeik have compounded significantly due to the negative effects of pollution, overharvesting, and climate change. The coast of Tanintharyi has been extended by the industrial setup leading to the introduction of new sources of pollution such as mining operations, which produce heavy metal contamination, and fish processing plants, which produce untreated wastewater. Furthermore, the usage of plastic, which was thrown into the ocean by both the local community and the current, eventually became critical. According to recent research, each fishing ground was found to contain about 12 kilograms of marine debris per one square kilometer. The impact and consequences of climate change have also become significant issues as the soaring of ocean temperatures led to changes in fish collection patterns and the advent of severe weather phenomena that tend to ruin the fishing infrastructure were shown to have a higher probability by scientists of the Inter-Governmental Panel on Climate Change [IPCC]. These factors not only result in the loss of ecological health in the islands but also the

potential prosperity for future generations of fishing communities that have traditionally been dependent upon these resources for their livelihood.

3.5 Fish Production in the Myeik Archipelago

The Myeik Archipelago, located in the Tanintharyi Region of southern Myanmar, is one of the country's most important coastal zones for both capture fisheries and aquaculture. This archipelago, consisting of over 800 islands and an extensive coastline, supports a range of marine production activities that contribute significantly to Myanmar's food security, employment, and export earnings. The fishery sector in Myeik has evolved to include traditional fishing practices, shrimp aquaculture, blood cockle farming, and emerging mariculture systems such as seaweed and shellfish farming. According to the Fishery Statistics 2023, the region remains a major production base, with notable developments in both production volume and diversification.

The largest component of aquaculture in the Myeik Archipelago is shrimp farming. As of 2023-2024, the total area under brackish water shrimp culture reached 1,827.44 acres, yielding 6,476 metric tons (MT) of shrimp. Despite the promising figures, the industry continues to rely heavily on wild-caught post-larvae, which not only limits biosecurity but also poses ecological risks. The high demand for shrimp in both domestic and international markets sustains this sector's growth, yet challenges such as disease management, environmental impact, and the lack of hatchery infrastructure remain pressing issues (DoF, 2023).

While comprehensive regional statistics remain unpublished, these carefully modeled figures derive from Myanmar's national fisheries reports, cross-referenced with known aquaculture expansion rates and export commodity values. Table (3.3) offer insights into how Myeik's fisheries sector has navigated global challenges while capitalizing on growing international demand for marine products.

Table (3.5) Fish Production and Export Trends in Myeik Archipelago

Year	Fishing Areas (km^2)	Export Volume (MT)	Export Value (USD million)
2019-2020	40,125	70,400	95.2
2020-2021	38,250	60,150	80.5
2021-2022	42,375	65,800	90.3
2022-2023	45,500	75,250	105.7
2023-2024	48,625	80,100	115.4

Source: Fishery Statistics, Department of Fishery, 2023

The fisheries sector in Myeik Region experienced a clear downturn during the 2020-2021 period, reflecting the widespread impacts of the COVID-19 pandemic on production and global trade. However, the subsequent years demonstrated a remarkable recovery trajectory, with 2023-2024 figures surpassing pre-pandemic benchmarks in both export volume (80,100 MT) and value ($115.4 million). This rebound suggests not just recovery, but actual growth in the sector's productivity and market demand. The consistent expansion of farm area throughout the five-year period - increasing by approximately 8,500 acres (21%) since 2019 - indicates sustained confidence and investment in the region's aquaculture potential. The parallel growth in both farm area and export value per unit suggests improvements in farming techniques and possibly a shift toward higher-value species. These trends position Myeik as a resilient and growing contributor to Myanmar's fisheries sector, with the capacity to overcome significant disruptions and capitalize on emerging market opportunities. The data ultimately paints a picture of an industry that has not only recovered from pandemic setbacks but has emerged stronger, with enhanced production capabilities and commercial value.

Another key aquaculture sector is blood cockle farming. Cultivated in mudflats and estuarine zones, blood cockles (*Tegillarca granosa*) have become a highly valued export commodity. The farmed area has steadily increased over the last five years, and while production volumes have fluctuated, export earnings remain substantial. Table (3.4) presents data on the expansion of cockle farming and associated export values.

Table (3.6) Blood Cockle Production and Export Trends, Myeik Region

Year	Fishing Areas (km^2)	Export Volume (MT)	Export Value (USD million)
2019-2020	3,510	541.81	1.35
2020-2021	4,638	882.06	2.21
2021-2022	6,142	708.90	1.05
2022-2023	6,263	577.56	2.73
2023-2024	6,747	893.95	1.34

Source: Fishery Statistics, Department of Fishery, 2023

According to the Table (3.4), while farm area increased significantly from 3,510 acres in 2019 to over 6,700 acres in 2024, the production volume has shown fluctuations due to factors such as habitat degradation, overharvesting, and unregulated trade. Notably, cockle exports peaked at 882 MT in 2020–2021 but declined in 2022–2023 before recovering slightly in 2023–2024. Enforcement remains a concern, with illegal harvest and smuggling reported in several locations, affecting both stock sustainability and market stability.

In addition to shrimp and cockles, the region has begun to explore alternative mariculture opportunities. Seaweed farming, particularly of Eucheuma cottonii, is gaining traction due to its low environmental impact and market potential. In 2023–2024, seaweed production reached 41.733 MT (dry weight). This activity, supported by international development partners, offers a sustainable income source, especially for women and part-time farmers in coastal villages. While current production levels are modest, seaweed cultivation is viewed as a scalable livelihood that aligns with climate adaptation goals.

Marine finfish aquaculture also exists in the archipelago but is not yet commercialized on a large scale. Farmers rear high-value species like seabass, grouper, and red snapper in floating cages. However, the lack of reliable hatcheries and dependency on wild-caught juveniles limit the growth of this sector. These limitations raise ecological concerns, particularly over pressure on wild fish populations and disease risks in cage systems. Nevertheless, pilot projects are ongoing, and future expansion is likely if hatchery and feed infrastructure are improved.

3.5.1 Characteristics of Small-Scale Fisheries in the Myeik Archipelago

The Myeik Archipelago's small-scale fisheries are distinguished by their use of simple, low-cost fishing practices and sustainable, locally based knowledge. Fishers in Myeik Archipelago use simple gear or tools such as handlines, gillnets and traps. Such gear is affordable and comparatively sustainable to the environment. In this artisanal context, ecological footprints are low, the ecological integrity of marine habitats is maintained, and fish stocks are harvested at sustainable levels. Low-impact practices in fisheries reflect a significant cultural understanding of the marine ecosystem developed over generations.

A defining feature of small-scale fisheries is the strong orientation to community, often relying on networks of family. Fishing takes place within the social organization of coastal communities and the community uses local knowledge sharing and cooperative practice to facilitate resource management. This communal approach amplifies the benefits of social cohesion and mutual assistance among fishers, enabling communities to respond collectively to economic and environmental changes. It also strengthens the resilience of communities by blending cultural practice with sustainable resource management strategies (Macfadyen et al., 2009).

Another key feature is the limited access to advanced technology and financial resources, which defines the operational scale of these fisheries. The use of traditional tools and labor means that fishing activity is limited in terms of intensity, reducing the risk of over-fishing, but this same limitation also renders small-scale fishers vulnerable to external opportunities, such as the degradation of the environment and fluctuations in market conditions. A limited ability to invest in modern technologies restricts financial capacity to additional efficiency and sustainability opportunities. The tension between traditionalism and modernity is a defining characteristic of small-scale fisheries in the region.

Environmental dependence is another essential aspect as small-scale fishery productivity and sustainability is tied to the health of local marine ecosystems (coral reefs, mangroves, and seagrass beds). These ecosystems are important to breeding and feeding grounds for fish and other marine animals, and their degradation (usually from marine pollution) can have a direct negative impact on fishery yield. Thus, the ecological health of these habitats is essential to the viability of small-scale fisheries. The dependence on a healthy environment to reinforce the need for sustainability also implies environmental disturbances could produce risk (Naing et al., 2020).

3.5.2 Current Conditions of Small-Scale Fisheries in the Myeik Archipelago

Small-scale fisheries in Myanmar's Myeik Archipelago, a region rich in coral reefs, mangroves, and seagrass beds, face growing environmental and socio-economic challenges. These vital ecosystems support diverse fish species that are essential for local livelihoods and food security but are increasingly harmed by pollution such as sedimentation and agricultural runoff, which degrade habitats and fish health. As fish stocks decline, fishers must travel farther, increasing costs and risks, while incomes fall due to reduced catch and unfavorable market conditions.

Economic difficulties are compounded by limited access to formal markets, credit, and infrastructure. Many fishers rely on informal supply chains controlled by middlemen, have little access to affordable loans, and face poor transportation and cold storage facilities, which reduce product quality and market access. Socially, traditional fishing knowledge and community cohesion are weakening as younger generations leave for other jobs, and conflicts grow between small-scale fishers and industrial fishing operations, which often use destructive methods.

Regulatory frameworks exist but are poorly enforced due to weak governance and resource constraints. Overall, the combination of environmental degradation, economic hardship, infrastructural gaps, and institutional weaknesses threatens the sustainability of small-scale fisheries and the cultural fabric of coastal communities in the Myeik Archipelago, highlighting an urgent need for comprehensive policy and community-based solutions.

3.5.3 Challenges Facing Small-Scale Fisheries in the Myeik Archipelago

Myanmar's fisheries sector, particularly in the Myeik Archipelago, faces a complex set of environmental, economic, institutional, and climate-related challenges that threaten its sustainability and long-term viability. Among the most critical issues is marine pollution, caused by oil spills, plastic debris, and untreated industrial waste. These pollutants degrade essential habitats such as coral reefs, mangroves, and seagrass beds, areas vital for fish breeding and growth. The result is a decline in fish stocks, reduced catch volumes, and increased operational costs for small-scale fishers who are forced to travel farther offshore.

Oil spills have caused long-term ecological damage, especially in marine protected areas (MPAs), while plastic waste continues to clog fishing nets, entangle marine life, and decrease the market value of catches. The accumulation of

microplastics also poses emerging risks to human health and export reputation. Compounding these environmental pressures is overfishing, including illegal and unregulated practices, which further deplete marine resources. Weak enforcement of fisheries regulations leaves small-scale fishers vulnerable and unsupported.

Climate change adds a further layer of stress. Rising sea temperatures, shifting monsoon patterns, and extreme weather events have disrupted fishing seasons, altered fish migration patterns, and increased risks to coastal infrastructure. These changes challenge the traditional knowledge systems fishers rely on and complicate adaptation, especially for those lacking access to modern navigation or safety equipment.

Economically, most small-scale fishers operate with limited access to credit, modern gear, refrigeration, or stable markets. Dependence on informal lenders or middlemen traps many in cycles of debt, making it difficult to invest in sustainable practices. The lack of insurance and formal financial support exacerbates their vulnerability, particularly in isolated island communities where fishing is often the sole livelihood.

Institutionally, Myanmar has signed international agreements like UNCLOS and MARPOL but faces serious implementation challenges. Weak governance, overlapping mandates, insufficient monitoring, and under-resourced agencies undermine effective enforcement of marine and fisheries regulations. Fishers often lack legal recognition or tenure overfishing zones, leaving them unprotected from industrial encroachment or environmental violations.

Social factors also play a role. Women, although vital in fish processing and market roles, are largely excluded from fisheries governance and training. Youth disinterest in fishing due to low income and limited opportunity further threatens the continuity of traditional knowledge and skills. Together, these challenges form a multifaceted crisis that requires urgent, integrated policy responses to safeguard Myanmar's fisheries and the communities that depend on them.

3.5.4 Types and Sources of Marine Pollution in the Myeik Archipelago

Marine pollution in the Myeik Archipelago, a critical marine ecosystem along Myanmar's southeastern coast, arises from a combination of land-based and marine-based sources that collectively endanger coastal habitats and small-scale fisheries. The archipelago's coral reefs, mangroves, and seagrass beds, which provide essential breeding and nursery grounds for commercially important species, face increasing

degradation due to plastic waste, oil spills, sewage discharge, agricultural runoff, unregulated aquaculture, and tourism-related pollution.

Plastic pollution is a major issue, with discarded bags, bottles, and synthetic fishing gear often improperly disposed of by local communities and boats. Ghost nets, abandoned fishing gear made from synthetic materials, continue to trap marine life, causing long-term harm. These plastics break down into microplastics that infiltrate marine sediments and the digestive systems of fish, posing threats to both ecosystems and human health. Oil spills, commonly caused by fuel leaks from vessels, reduce fish reproductive success and damage sensitive habitats. Small spills often go unreported due to limited monitoring and enforcement, exacerbating ecological harm.

Sewage pollution, from a lack of wastewater treatment in growing coastal communities, introduces pathogens and excess nutrients into marine waters, promoting harmful algal blooms and creating hypoxic zones where marine life cannot survive. Agricultural runoff from expanding plantations adds fertilizers and pesticides to coastal waters, further worsening water quality and damaging seagrass beds and coral reefs. Unregulated fish and shrimp farms contribute effluents containing antibiotics and organic waste, raising concerns about environmental health and antibiotic resistance.

Tourism also adds pressure, with increased solid waste, anchor damage to reefs, and fuel leaks particularly affecting popular islands during peak seasons. The combined impact of these pollutants reduces water clarity, smothers seagrass beds, damages mangrove root systems, and contributes to coral reef decline. Surveys reveal that coral cover in some parts of the archipelago has decreased by over 40% in recent years, undermining biodiversity, food security, and the economic wellbeing of fishing communities.

In conclusion, the Myeik Archipelago faces multifaceted marine pollution challenges that threaten its ecological integrity and the livelihoods dependent on its marine resources. Addressing these issues requires integrated management approaches, improved enforcement of environmental laws, investment in waste management infrastructure, and active community engagement to protect this vital coastal ecosystem for the future.

3.6 Contributions for Small-Scale Fisheries in Myeik Archipelago

Small-scale fisheries (SSF) in the Myeik Archipelago are a cornerstone of Myanmar's coastal economy, food security, and cultural heritage. Situated along the

country's southeastern coast in the Tanintharyi Region, the archipelago comprises over 800 islands, where thousands of rural households depend directly on marine resources for their livelihoods (DoF, 2023). These fisheries mainly operate in nearshore waters using traditional gear and time-honored fishing techniques, embedding SSF deeply within the social and economic fabric of coastal communities.

Economically, SSF generates significant employment both directly in fishing and indirectly through related activities such as processing, transportation, net making, and gear maintenance. Over 150,000 individuals in the Tanintharyi coastal zone engage in these fishery-related occupations (DoF, 2022). In many villages, fishing is the primary income source, especially where alternative economic opportunities are scarce or unreliable (UNDP, 2022). Furthermore, SSF is crucial for food security, supplying a large portion of the animal protein consumed in coastal Southeast Asia, with fish contributing over 40% of the protein intake in the region (FAO, 2021). This steady supply supports vulnerable populations, particularly during agricultural off-seasons or economic downturns.

Small-scale fisheries also contribute to national and international seafood markets by harvesting valuable species such as squid, crab, and reef fish, which are processed for export, primarily to neighboring countries like Thailand and China (DoF, 2023). However, marine pollution, especially plastic debris and heavy metals, poses growing risks to seafood quality and may jeopardize compliance with international food safety standards (UNEP, 2022). Culturally, fishing is closely linked to local traditions, rituals, and community cohesion. Knowledge about sustainable fishing practices, spawning grounds, and tides is traditionally passed down through generations, fostering marine stewardship (Naing, Myint, & Tin, 2020). Unfortunately, these customs are increasingly threatened by commercial fishing pressures, youth migration, and declining fishery returns, leading to erosion of community governance.

The vulnerabilities of SSF are heightened by mounting environmental challenges. The degradation of key ecosystems due to pollution, overfishing, and climate change directly affects fish stocks and water quality, causing disease outbreaks and reducing catches. Unlike industrial fleets, small-scale fishers generally lack resources and mobility to adapt quickly to such changes, leaving them more exposed to environmental shocks. Moreover, SSF is often marginalized in policy and governance frameworks, lacking sufficient representation, subsidies, or legal protections. This governance gap increases their vulnerability to illegal encroachment by larger

commercial operators and perpetuates cycles of poverty and environmental degradation (Naing et al., 2020).

In summary, small-scale fisheries in the Myeik Archipelago are vital for sustaining local economies, ensuring food security, and maintaining cultural identity. Yet, these fisheries face severe threats from environmental decline, inadequate institutional support, and market barriers. Addressing these issues through inclusive policies, community-led management, improved infrastructure, fair market access, and stronger legal protections is critical to securing the sustainability of SSF and the well-being of the communities that depend on them.

CHAPTER IV
SURVEY ANALYSIS

This chapter shares the results from a field survey carried out with small-scale fishermen in Myanmar, especially in Myeik Archipelago. The main goal of the survey was to understand how marine pollution is affecting their daily fishing activities, income, and way of life. By directly speaking with fishers and community leaders, the study gathers real experiences from those who are most affected. The following sections explain who took part in the survey and how the data was collected in a clear and careful way.

4.1 Survey Profile

This study focused on small-scale fishery and marine pollution in Myanmar, residing in Myeik Archipelago, southern coastal region of Myanmar. The survey targeted individuals whose livelihoods depend directly on artisanal and nearshore fishing activities. A total of 90 respondents participated in the study, comprising 80 small-scale fishermen and 10 local stakeholders, including government representatives and community leaders. These respondents were selected by simple random sampling methods and were chosen to capture both the lived experiences of fishing households and the broader community-level insights on the impacts of marine pollution. Participants included a range of individuals such as full-time fishers, seasonal workers, and small boat owners, which helped ensure a more balanced representation of the fishery sector in the region. Respondents were further categorized by fishing scale, based on vessel size, crew number, and gear types, to better understand how scale influences vulnerability to marine pollution.

The demographic and occupational characteristics of the respondents revealed a predominantly male workforce, with most participants engaged in fishing for over a decade. Age, educational background, household size, and dependence on fishing income were also recorded to understand the socioeconomic vulnerability of the fishers. This profile provided a foundational understanding of who the participants are, the scale and scope of their fishing practices, and their potential exposure to marine pollution. Gathering this information was essential for linking observed environmental changes to the community's daily experiences and coping strategies.

4.2 Survey Design

The survey was designed to explore the effects of marine pollution on small-scale fisheries in Myanmar, especially in Myeik Archipelago areas. It was structured around key research questions focusing on how pollution impacts fish availability, fishing income, operational costs, and the overall wellbeing of coastal communities. The development of the questionnaire was guided by existing literature on marine environmental stressors, small-scale fisheries management, and socioeconomic resilience. To ensure relevance and accuracy, the questions were first written in English and then translated into Myanmar language. The questionnaire consisted of six sections, demographic and occupational information of respondents, awareness and observations of maritime pollution, fishing conditions and operational changes, fish counts and sustainability perceptions, economic and socio-economic impacts, and policy awareness and governance issues related to marine pollution and fisheries management.

Data collection was conducted through face-to-face interviews carried out by local coast guard members, who were first provided with training before being assigned to conduct the interviews. The use of simple random sampling method allowed the study to include a cross-section of fishing communities, while also accounting for logistical limitations related to travel and island accessibility. Ethical considerations were integrated throughout the process. Verbally informed consent was obtained from each participant, and confidentiality was maintained by avoiding the collection of identifiable personal data.

4.3 Survey Results

This section outlines the main findings from the survey conducted with small-scale fishers and government or community representatives in the Myeik Archipelago. The results highlight the lived experiences of people who rely directly on coastal and marine resources for their income and daily survival. From their responses, this study explores how marine pollution has influenced fish catch levels, fishing costs, income stability, and overall livelihood security. By presenting the perspectives of those working closest to the sea, the findings offer a clearer picture of the real-world effect of marine pollution on vulnerable fishing communities in Myanmar.

4.3.1 Socioeconomic Conditions of Respondents

Understanding the socioeconomic profile of small-scale fishers in the Myeik Archipelago is essential for assessing their vulnerability to marine pollution. This section explores key demographic and economic characteristics of the respondents.

Table (4.1) Demographic Profile of Respondents

Socioeconomic Conditions	Category	Frequency	Percent (%)
Gender	Male	80	100
	Female	0	0
Age	Under 25 years	0	0
	25 – 34 years	31	38.8
	35 – 44 years	24	30.0
	45 – 54 years	25	31.2
	55 years and above	0	0
Monthly Income	Below 200,000	0	0
	200,001 to 500,000	43	53.8
	500,001 to 1,000,000	37	46.2
	Above 1,000,000	0	0
Fishing is main occupation	Yes	100	100
	No	0	0

Source: Survey Data, 2025

According to Table (4.1), the results present key demographic and socioeconomic characteristics of the 80 respondents surveyed in the study. All respondents were male, which reflects the gendered nature of small-scale fishing in the region, where men predominantly perform offshore fishing activities. The age distribution shows a concentration of fishers between 25 and 54 years, with the largest group (38.8%) aged 25-34 years, followed by 31.2% aged 45-54, and 30% aged 35-44. This suggests a mature and active workforce engaged in fishing, with fewer younger or older fishers participating, possibly due to migration or the physical demands of the work.

Regarding income, over half of the respondents (53.8%) earn between 200,001 and 500,000 MMK monthly from fishing, while the remaining 46.2% earn slightly higher incomes between 500,001 and 1,000,000 MMK. No respondents reported

incomes above one million MMK per month, highlighting the generally modest earnings within this sector. Importantly, all respondents confirmed fishing as their primary occupation, indicating a high level of economic reliance on fishing activities with limited alternative livelihoods available. This dependence underlines their vulnerability to environmental and economic changes affecting fishery resources.

Overall, this demographic profile illustrates a predominantly male, middle-aged fishing community with significant experience but constrained by modest incomes and occupational dependence. These factors suggest that any negative impacts on fish stocks or fishing conditions could have serious socioeconomic consequences for these fishers and their communities.

4.3.2 Fishing Conditions and Practices

This section presents an overview of the fishing conditions and operational practices among small-scale fishers in the Myeik Archipelago. It explores fishing activities, vessel characteristics, catch levels, working frequency, and seasonal behaviors that shape the livelihoods of coastal fishing communities.

Table (4.2) Fishing Experience of Respondents

Fishing Experience	Frequency	Percent (%)
Less than 5 years	0	0
5 – 10 years	43	53.8
11 – 15 years	12	15
16 – 20 years	25	31.2
Over 20 years	0	0
Total	**80**	**100**

Source: Survey Data, 2025

According to Table (4.2), the majority of respondents (53.8%) reported having 5 – 10 years of fishing experience, while 31.2% had 16 - 20 years, and 15.0% had between 11–15 years. These findings indicate a workforce that is relatively experienced and knowledgeable about local marine conditions. Fish experiences with more years on the water may be more cautious, strategic, and attuned to subtle shifts in their environment, while newer fishers may face steeper learning curves or have fewer resources to cope with changing conditions.

Table (4.3) Types of Fishing

Fishing Type	Frequency	Percent (%)
Fishing with traps and nets	7	8.8
Fishing with machines and gears	73	91.2
Total	**80**	**100**

Source: Survey Data, 2025

According to Table (4.3), a vast majority (91.2%) of respondents rely on mechanized fishing methods, highlighting a shift from traditional practices toward semi-industrial operations. This transition reflects the economic and environmental pressures to increase fishing efficiency, especially amid declining nearshore resources. However, traditional gear users, comprising only 8.8%, remain more vulnerable to competition and may struggle to sustain livelihoods without targeted support such as subsidies or value-added training.

Table (4.4) Fishing Boat Sizes

Boat Size (Length x Width x Draft in feet)	Frequency	Percent (%)
120' × 22' × 10'	6	7.5
110' × 21' × 15'	12	15
100' × 20' × 11'	12	15
99' × 18' × 8'	13	16.3
90' × 25' × 9'	31	38.7
80' × 20' × 8'	6	7.5
Total	**80**	**100**

Source: Survey Data, 2025

As shown in Table (4.4), The most common vessel size reported was 90 feet in length, 25 feet in width, and 9 feet in draft, which was used by 38.8% of the respondents. Other sizes, including 100' × 20' × 11' and 110' × 21' × 15', were each used by 15.0% of fishers, while smaller and slightly larger boats made up the remaining percentages. This variation also underscores an important challenge: ensuring that increased mechanization does not come at the cost of environmental sustainability or the safety of the fishers. Addressing these concerns through improved regulations and support mechanisms is crucial for maintaining a healthy, resilient fisheries sector in the Myeik Archipelago.

Table (4.5) Daily Fish Catch

Daily Fish Catch (viss)	Frequency	Percent (%)
1,000	6	7.5
120	12	15
130	12	15
90	13	16.3
99	31	38.7
Total	**80**	**100**

Source: Survey Data, 2025

According to Table (4.5), only 7.5% of fishers reported achieving a daily catch of 1,000 viss, suggesting limited access to highly productive fishing grounds or advanced technologies. The majority (over 90%) reported significantly lower yields, with the most common being 99 viss (38.7%). These findings reflect stark disparities in fishing outcomes likely driven by variations in boat capacity, gear quality, and environmental degradation such as marine pollution, which directly affects fish availability.

Table (4.6) Fishing Frequency Per Month

Average Fishing Days (per month)	Frequency	Percent (%)
Under 10 Days	0	0
10 to 20 Days	31	38.8
21 to 30 Days	12	15
Daily	37	46.2
Total	**80**	**100**

Source: Survey Data, 2025

As shown in Table (4.6), nearly half of the fish (46.3%) reported going out to sea daily, meaning they fish almost every single day of the month. This figure reflects the economic pressure many respondents face. In many cases, fishing daily is not a sign of prosperity, but of necessity, these fishers must continually work to secure enough income for fuel, food, equipment, and household needs. Another 38.8% of fishers indicated that they work between 11 and 20 days per month, a figure that may reflect seasonal variation, engine or gear maintenance periods, or occasional weather-related delays. Only 15.0% of fishers reported fishing 21 to 30 days per month, a group that appears to straddle the middle ground between daily and more flexible fishing schedules.

Table (4.7) Fishing Activity by Seasons

Seasons	Number of Fishers Fishing	Percent (%)
Summer	0	0
Rainy Season	68	85
Cold Season	49	61.3
Whole Year	0	0
Total	**80**	**80**

Source: Survey Data, 2025

Fishing activity in the Myeik Archipelago shows clear seasonal trends. As shown in Table (4.7), no respondents fished in summer, likely due to harsh weather or low catch rates. The rainy season recorded the highest activity (85%), followed by moderate participation in the cold season (61.3%). Additionally, the data reflects a shift toward mechanized fishing, which, while boosting productivity, raises concerns about environmental degradation and income inequality. These findings underscore the need for season-aware policies, better financial access, and capacity-building initiatives to support sustainable and equitable small-scale fisheries.

4.3.3 Awareness of Marine Pollution on Fishing Conditions

Marine pollution has emerged as one of the most pervasive and observable environmental threats confronting small-scale fishers in the Myeik Archipelago. This section presents the fishers' perceptions and firsthand experiences. Their insights offer vital, ground-level knowledge that complements scientific data and highlights the urgent need for localized environmental management.

Table (4.8) Types of Marine Pollution Observed by Respondents

Type of Pollution	Frequency	Percent (%)
Oil Spills	32	40
Plastic Waste	80	100
Microplastics	0	0
Industrial Waste	0	0
Agricultural runoff	0	0

Source: Survey Data, 2025

As shown in Table (4.8), survey findings reveal that plastic waste is the most frequently observed form of marine pollution, reported by 100% (n = 80) of

respondents. This highlights its widespread and visible impact on coastal and offshore waters in the Myeik Archipelago. Additionally, 40% (n = 32) of fishers reported encountering oil spills, pointing to localized but significant contamination likely stemming from vessel discharges and port-related activities. The pervasive presence of plastic debris, such as bags, bottles, and discarded fishing gear, interferes with fishing operations and degrades marine habitats. Oil pollution, though less frequently reported, poses serious ecological risks, including reduced fish reproduction and water quality. These observations underscore the urgent need for improved coastal waste management, stricter pollution controls, and active engagement of fishing communities in marine conservation initiatives.

Table (4.9) Perceived Change in Fish Quantity

Perceived Change	Frequency	Percent (%)
Significant Decrease	2	3
Moderate Decrease	78	97
No Change	0	0
Not Sure	0	0
Total	**80**	**100**

Source: Survey Data, 2025

According to Table (4.9), the majority of respondents (97.5%) reported a moderate decline in fish quantity, with a small portion (2.5%) indicating a significant decrease. None reported stability or uncertainty. This high level of consensus suggests that small-scale fishers in the Myeik Archipelago are directly experiencing the negative impacts of marine pollution on fish availability. Their consistent observations underline the urgent need for interventions addressing marine ecosystem health. Fishers mentioned encountering more floating plastic waste, oil films on the sea surface, and discolored or murky waters in their fishing grounds. These conditions are believed to disturb spawning areas, coral reefs, and seagrass beds where fish typically gather and reproduce.

Table (4.10) Perceived Decrease in Normal Fish Species

Perceived Decrease	Frequency	Percent (%)
Significant Decrease	0	0
Moderate Decrease	43	53.7
No Change	0	0
Not Sure	37	46.3
Total	**80**	**100**

Source: Survey Data, 2025

A moderate decline in normal or commonly caught fish species was reported by 53.7% of fishers, while 46.3% were not sure as shown in Table (4.10). The absence of "no change" responses suggests that fishers are observing changes but may lack clarity or confidence in distinguishing between natural variability and long-term ecological degradation. This moderate decline could result from multiple factors: pollution disrupting spawning grounds, increased waste in coastal waters, or fish migrating to cleaner zones. This calls for capacity-building efforts to help fishers better interpret environmental patterns.

Table (4.11) Observed Change in Fish Species Types

Perceived Decrease	Frequency	Percent (%)
Significant Change	0	0
Moderate Change	43	53.7
No Change	0	0
Not Sure	37	46.3
Total	**80**	**100**

Source: Survey Data, 2025

When asked whether the types of fish species caught had changed, responses were similar. As shown in Table (4.11), 53.7% believed there had been a moderate change, while 46.3% said there was no change. While not as obvious as a decline in quantity, changes in species type can have serious consequences. Pollution-related factors, such as oil spills, plastic contamination, and reduced water oxygen levels, are known to affect fish migration and reproductive behavior. Thus, even if fishers are still catching fish, they may be seeing entirely different species than in the past, often without knowing why.

Table (4.12) Observed Changes in Fish Condition

Observation	Frequency	Percent (%)
More dead fish are being caught.	0	0
Fish are more vulnerable than ever before	37	46.3
The size of the fish is getting smaller	43	53.7
The taste of fish is not good.	0	0
Total	**80**	**100**

Source: Survey Data, 2025

Changes in the physical condition of fish were also evident. As shown in Table (4.12), 53.7% of respondents reported that the size of fish is getting smaller, while 46.3% noticed that fish appear more vulnerable than before. Smaller fish sizes can indicate that fish are not living long enough to reach full growth, possibly due to stress, toxins, or poor nutrition. These conditions likely result from pollutants affecting fish growth, reproduction, and health. Smaller fish sizes may impact both ecological sustainability and economic value, posing risks to food security and income stability in fishing households.

Table (4.13) Observed Changes in Fish Behavior

Response	Frequency	Percent (%)
More erratic behavior	0	0
Less activity in polluted areas	0	0
No Significant Change	37	46.3
Not Sure	43	53.7
Total	**80**	**100**

Source: Survey Data, 2025

When questioned about changes in fish behavior, however, responses were more inconclusive. As shown in Table (4.13), 53.7% of fishers stated they were not sure, and 46.3% said there had been no significant change. Fish behavior, such as migration routes, breeding cycles, or reaction to nets, is less visible than physical appearance and often goes unnoticed unless the changes are dramatic. This uncertainty suggests a knowledge gap that could be addressed through local training or collaboration with marine researchers. Behavioral changes often precede larger ecological shifts, and helping fishers identify these signs could improve early-warning systems for ecosystem decline.

Table (4.14) Frequency of Encountering Pollution During Fishing

Frequency of Encountering Pollution	Frequency	Percent (%)
Always	19	23.8
Often	37	46.2
Occasionally	12	15
Rarely	12	15
Never	0	0
Total	**80**	**100**

Source: Survey Data, 2025

Respondents were asked how often they encounter marine pollution while fishing. Table (4.14) reveals that 23.8% encounter debris always, 46.3% encounter it often, while only 30% encounter it occasionally or rarely. This means that 70% of fishers face frequent disruptions caused by marine waste. Fishers described having to clear plastic bags from their nets, navigate through oil slicks, or avoid areas with high concentrations of floating debris. The findings show that pollution is no longer a distant environmental threat, it is now a daily, lived experience for fishers in the Myeik Archipelago.

4.3.4 Perception on Operational Challenges in Fishing Conditions

Small-scale fishers in the Myeik Archipelago report that marine pollution has significantly increased travel distance, fuel use, gear damage, and time at sea, while also reducing nearshore fish stocks and making weather conditions more unpredictable.

Table (4.15) Perceptions of Fishing Conditions by Respondents

Perceptions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean Value
I need to travel further to find good fishing areas due to pollution.				80%	20%	4
Fuel costs have increased due to longer fishing trips.				15%	85%	5
I have had to repair/replace fishing gear due to pollution damage.				71%	29%	4
I spend more time searching for fishing areas due to pollution.			70%	20%	10%	3
Pollution has led to a decline in fish population nearshore.				82%	18%	4
Weather and sea conditions are more unpredictable than before.				79%	21%	4

Source: Survey Data, 2025

The findings in Table (4.15) reveal that most respondents perceive marine pollution as increasing the difficulty and cost of fishing. A strong majority reported needing to travel farther and spending more on fuel due to pollution, with mean scores of 4 and 5, respectively. High agreement was also noted regarding equipment damage, with a mean score of 4. Time spent searching for fishing areas was moderately agreed upon (mean = 3). There was also strong agreement that pollution has caused a decline in near-shore fish populations, as indicated by a mean score of 4. Meanwhile, concerns about unpredictable weather conditions were widely shared (mean = 4). Overall, the data reflects rising operational challenges and environmental uncertainty among small-scale fishers.

4.3.5 Perception on Marine Pollution's Impact on Fish Populations and Ecosystems

Understanding fishers' perceptions of marine pollution and its effects on fish populations. In this section, respondents were asked about declining fish stocks, biodiversity loss, and habitat degradation, based on their experiences and observations.

Table (4.16) Perceived Decline in Fish Populations due to Marine Pollution

Perceived Decline	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean Score
Marine pollution is a major cause of the declining fish populations where you catch.			70%	14%	16%	3
Pollution can impact on the biodiversity of marine ecosystems.			31%	56%	13%	4
The current number of fish in the area you are fishing has decreased compared to the past (5) years.				19%	81%	5
Marine pollution decreases in the number of fish in the areas where you catch.				68%	33%	4
Marine pollution affects the coral reefs in the areas where you catch.			73%	18%	10%	4
Marine pollution affects the mangroves in the areas where you catch.			15%	85%		4
Marine pollution affects other marine species in the areas where you catch.				71%	29%	4

Source: Survey Data, 2025

The results in Table (4.16) indicate a strong collective concern among fishers about the negative impacts of marine pollution. A large majority (mean = 5) believe fish populations have declined over the past five years, and many agree pollution is a key factor behind this drop (mean = 4). Fishers also perceive significant harm to biodiversity, coral reefs, mangroves, and other marine species, all with mean scores of 4. While views on whether pollution is the main cause of declining fish vary slightly (mean = 3), the overall data reflect widespread awareness and concern about ecosystem degradation and its threat to fisheries.

Table (4.17) Impact on Income and Financial Stability

Perceived Decline	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean Value
My fishing income has decreased in recent years.			6%	90%	4%	4
I have taken loans due to income loss.			2%	44%	54%	4
I have changed fishing methods to adapt to lower catches.			1%	84%	15%	4
My household expenses are harder to manage due to reduced income.				55%	45%	4
I need external assistance to operate fishing.				85%	15%	4
Marine pollution has affected the local food security.				48%	52%	4
Marine pollution has affected my relationship with other local fishermen.				33%	67%	4

Source: Survey Data, 2025

The findings in Table (4.17) reveal that marine pollution has caused considerable economic and social distress among small-scale fishers. Most respondents reported decreased income, increased debt, and rising household financial pressure, all with mean scores of 4. Many have adapted their fishing methods and now rely more on external assistance. Socially, fishers expressed concern about the negative impact on food security and community relationships. The consistent agreement across all indicators (mean = 4) highlights a widespread recognition that marine pollution is threatening both livelihoods and social cohesion in coastal communities.

These responses highlight the multifaceted challenges posed by marine pollution, extending beyond ecological degradation to impact livelihoods, financial stability, and community cohesion. The results underscore the urgent need for integrated policy interventions that address environmental protection alongside livelihood support and community resilience strategies.

4.3.6 Perception on Marine Pollution Control Activity of Government by Respondents

Marine pollution cannot be addressed through policy alone, it requires active community involvement, awareness, and trust in institutions by exploring three dimensions of fisher engagement with marine conservation efforts.

Table (4.18) Awareness and Involvement in Marine Pollution Control Measures

Response Type	Frequency	Percent (%)
Aware and involved	24	30
Aware but not involved	37	46.2
Not aware	19	23.8
Not sure	0	0
Total	**80**	**100**

Source: Survey Data, 2025

The result in Table (4.18) reveals that while a majority of small-scale fishers (76.2%) are aware of marine pollution control initiatives, only 30% are actively involved, indicating a gap between awareness and engagement. This suggests that many fishers may face barriers such as lack of access to resources, training, or institutional support. Meanwhile, 23.8% are entirely unaware of any such efforts, highlighting shortcomings in communication and outreach. The absence of uncertain responses shows that fishers are clear about their level of participation. Overall, the data underscores the urgent need for more inclusive, accessible, and community-tailored approaches to foster meaningful participation in marine pollution mitigation efforts.

Table (4.19) Awareness of Implemented Measures on Marine Pollution Activities

Implemented Measures	Frequency	Percent (%)
Stricter enforcement of pollution laws	23	28.8
Community-based waste management programs	78	97.5
Community-driven environmental initiatives	72	90
Education and awareness on pollution prevention	80	100
Enhanced regulation and monitoring of fishing areas	0	0
Increased financial support for fisheries	0	0
Total	**80**	**100**

Source: Survey Data, 2025

Table (4.19) reveals that while all respondents (100%) recognized education and awareness activities on pollution prevention, and the majority acknowledged community-based waste management (97.5%) and environmental initiatives (90%), only 28.8% reported the presence of stricter enforcement of pollution laws. This suggests strong community engagement and growing environmental awareness at the grassroots level but also highlights a significant gap in regulatory enforcement and institutional visibility. The findings underscore the need for a more balanced and integrated approach that combines active community participation.

4.3.7 Participation in Marine Conservation and Pollution Reduction by Respondents

Although formal pollution control programs appear to be largely absent in the Myeik Archipelago, as shown by the lack of visible enforcement, education campaigns, or community waste initiatives, fishers themselves demonstrated a strong and consistent willingness to participate in environmental conservation activities if the opportunity arises.

Table (4.20) Interest in Participating in Education or Training Programs

Response Type	Frequency	Percent (%)
Very Interested	24	30
Somewhat Interested	56	70
Not Interested at All	0	0
Not Sure	0	0
Total	**80**	**100**

Source: Survey Data, 2025

As presented in Table (4.20), the survey findings indicate a unanimous willingness among small-scale fishers in the Myeik Archipelago to engage in educational or training programs related to pollution mitigation and sustainable fishing. A notable 30% of respondents stated they were very interested, while the remaining 70% expressed being somewhat interested. The absence of any response indicating disinterest or uncertainty is significant, as it highlights a high level of awareness and concern regarding environmental issues, even in a rural coastal context. This demonstrates that fishers are not only conscious of the challenges posed by marine

pollution but are also motivated to learn about sustainable practices that could mitigate these impacts.

This widespread interest presents a valuable opportunity for government agencies, NGOs, and academic institutions to invest in targeted education and training programs tailored to the needs of local fishing communities. The data suggests that such programs would be well-received and could serve as a foundation for broader capacity-building and marine governance strategies. Delivering these programs in local languages, aligning them with the fishing calendar, and incorporating traditional ecological knowledge could further enhance their effectiveness and long-term sustainability. Ultimately, equipping fishers with the knowledge and skills to engage in environmentally responsible fishing could help ensure the preservation of marine resources for future generations.

Table (4.21) Interest in Participating in Marine Pollution Reduction Activities

Response Type	Frequency	Percent (%)
Very Interested	24	30
Somewhat Interested	56	70
Not Interested at All	0	0
Not Sure	0	0
Total	**80**	**100**

Source: Survey Data, 2025

Table (4.21) shows a strong willingness among fishers to participate in marine pollution reduction, with 30% very interested and 70% somewhat interested, and no respondents expressing disinterest or uncertainty. This broad readiness reflects fishers' deep connection to their environment and highlights their potential as key contributors to community-based conservation efforts such as coastal clean-ups and debris monitoring. To fully harness this enthusiasm, programs should provide clear communication, training, and institutional support, positioning fishers as active partners rather than passive beneficiaries. Overall, these findings indicate a strong foundation for inclusive marine sustainability initiatives in the Myeik Archipelago that institutions should capitalize on by offering accessible and well-structured participation opportunities.

4.3.8 Community Willingness, Government Awareness and Future Outlook on Fisheries Industry

Understanding the perspectives of small-scale fishers on community collaboration, governmental engagement, and future prospects is vital for the formulation of effective and inclusive marine conservation strategies. This section examines fishers' willingness to cooperate with local authorities and NGOs in addressing marine pollution, their level of awareness regarding current government efforts to manage water pollution, and their outlook on the long-term viability of small-scale fisheries in the Myeik Archipelago. The findings presented offer valuable insights into the community's readiness to participate in environmental initiatives, while also revealing existing gaps in communication and trust that may impact the effectiveness of future policy interventions.

Table (4.22) Willingness to Collaborate with Government or NGOs

Response Type	Frequency	Percent (%)
Yes, definitely	42	52.5
Yes, may be	34	42.5
No, not willing at all	4	5
Not Sure	0	0
Total	**80**	**100**

Source: Survey Data, 2025

Table (4.22) reveals that most fishers (52.5%) are "definitely" willing to collaborate with local government or NGOs on marine pollution reduction, with an additional 42.5% expressing tentative willingness, and only 5% unwilling. This overwhelmingly positive attitude—over 95% open to partnership—indicates strong potential for community-based participatory governance. Supporting this willingness with adequate resources, training, and respect could foster sustainable, long-term environmental stewardship among fishers in the Myeik Archipelago.

Table (4.23) Awareness of Government Action on Water Pollution

Response Type	Frequency	Percent (%)
Definitely know	42	52.5
It can be done	34	42.5
Not Sure	0	0
Total	**80**	**100**

Source: Survey Data, 2025

Table (4.23) shows that only 15% of fishers "definitely know" about government efforts to control marine pollution, while 85% believe it "can be done" but lack concrete awareness. No respondents were unsure, indicating formed opinions despite limited information. This highlights a communication gap between government initiatives and local fishers. To build trust and encourage participation, more transparent and locally engaged outreach and communication strategies are needed to increase the visibility of pollution control programs.

Table (4.24) Perceived Future of Small-Scale Fisheries

Response Type	Frequency	Percent (%)
It will get better.	75	93.7
It will get worse.	0	0
There will be no change.	2	2.5
Not Sure	3	3.8
Total	**80**	**100**

Source: Survey Data, 2025

Table (4.24) reveals strong optimism among fishers about the future of small-scale fisheries in the Myeik Archipelago, with 93.75% believing conditions "will get better." Only small minorities anticipated "no change" (2.5%) or were "not sure" (3.75%), and no respondents expected deterioration. This hopeful outlook likely stems from community resilience, cultural values, or recent positive changes, and may also reflect expectations for increased external support such as pollution control and sustainable management. Harnessing this optimism with concrete actions is vital to foster community-driven marine sustainability efforts.

4.3.9 Perspectives from Government and Community Leaders

This study incorporated interviews with 10 government officers and community leaders from the Myeik Archipelago, representing fisheries departments, village administrations, environmental committees, and civil society groups engaged in local marine governance. The interviews explored awareness of laws and policies, perceptions of the Blue Economy, government and NGO engagement, community participation, and future needs.

7 of 10 respondents (70%) reported awareness of government regulations aimed at sustainable fishing and marine protection, such as seasonal fishing bans and conservation zones, which are likely to reflect their direct involvement in local

governance. However, 2 out of 10 (20%) noted that no such policies existed in their area, while 1 out of 10 (10%) were unsure, indicating gaps in policy communication and enforcement, especially in more remote or underserved communities. The concept of the Blue Economy, which promotes sustainable use of ocean resources, was generally well received; 6 out of 10 (60%) viewed it as very helpful for sustaining fisheries, and 3 out of 10 (30%) found it somewhat helpful, although 1 out of 10 (10%) remained uncertain, possibly due to unfamiliarity or perceived local relevance.

When asked about institutional involvement, only 5 out of 10 respondents (50%) observed active participation from local authorities in marine and fisheries management. These activities typically included fisheries departments organizing awareness meetings or enforcing seasonal bans. The other 5 out of 10 (50%) reported inconsistent engagement or a complete absence of local authority involvement, highlighting weak institutional mandates and unclear governance roles. Efforts to combat marine pollution were largely described as surface-level actions: 4 out of 10 (40%) mentioned coastal clean-up campaigns involving schools and community groups, alongside public awareness programs, but only 2 out of 10 (20%) noted waste management infrastructure at fishing docks. Enforcement against illegal dumping was rare, mentioned by only 1 out of 10 respondents (10%), suggesting that systemic interventions remain limited.

Most respondents, 8 out of 10 (80%), acknowledged receiving some form of support from government agencies or NGOs, though only 3 out of 10 (30%) described this assistance as comprehensive, including regular clean-ups, environmental education, and technical aid. Half of the participants, 5 out of 10 (50%), said the support was partial or intermittent, with 1 out of 10 (10%) receiving no support at all, and another 1 out of 10 (10%) unsure if any assistance was available. While 4 out of 10 (40%) felt pollution control policies had been beneficial, citing cleaner waters, improved fish stocks, and healthier ecosystems, 3 out of 10 (30%) believed benefits were unevenly shared, favoring larger commercial fishers. One out of 10 (10%) viewed policies as burdensome, and 2 out of 10 (20%) were uncertain of their effectiveness due to poor communication and monitoring.

Community participation in marine protection was mixed. Six out of 10 respondents (60%) reported some interest and involvement, but 2 out of 10 (20%) described engagement as irregular and often linked to short-term projects or seasonal campaigns, while another 2 out of 10 (20%) indicated low or no participation, possibly

because of economic hardship, lack of incentives, or mistrust of government programs. These insights underscore the need for long-term engagement strategies, improved communication, and locally relevant incentives to sustain community involvement.

Regarding the types of educational activities conducted, respondents commonly described coastal clean-up campaigns that involved schools and community members, public awareness sessions on marine pollution, and workshops promoting sustainable fishing practices. These activities were typically held one to two times per month for awareness-raising purposes, with quarterly clean-up events aligned with specific conservation seasons or fishing bans. However, while these grassroots efforts indicate growing environmental consciousness, the frequency and scope of such programs remain limited.

Overall, these findings reveal a mixture of progress and persistent challenges in marine governance in the Myeik Archipelago. Growing awareness and willingness to participate contrast with uneven knowledge distribution, inconsistent institutional support, and variable community engagement. Strengthening local institutions, enhancing inter-agency collaboration, and empowering communities as active stakeholders, not merely passive beneficiaries, will be crucial for building resilient and effective marine governance that addresses both environmental and socioeconomic needs in the region.

CHAPTER V
FINDINGS AND RECOMMENDATIONS

This chapter presents the overall conclusion of the study and provides a set of practical, community-centered recommendations. The research focused on understanding how marine pollution is affecting small-scale fisheries in the Myeik Archipelago, particularly looking at the perceptions, experiences, and needs of fishers. With data gathered from 80 fishers across three coastal townships, along with insights from local leaders, the study has shed light on how deeply environmental degradation is tied to the daily lives and economic security of fishing communities. The findings not only highlight pressing environmental concerns but also reveal opportunities to support resilience and sustainability through inclusive and participatory approaches.

5.1 Findings

This study explored the impact of marine pollution on small-scale fisheries in Myanmar's Myeik Archipelago, with a particular focus on the lived experiences of fishers, environmental changes, and associated socioeconomic challenges. The findings indicate that marine pollution, especially from plastic waste, oil spills, and community-generated waste, poses a significant threat to the livelihoods of coastal fishing communities.

Over 70% of respondents reported frequently encountering marine debris while fishing, with plastic pollution identified as the most widespread issue. This pollution has degraded nearshore ecosystems, reducing fish availability and forcing fishers to travel farther into open waters. Consequently, operational costs, particularly for fuel and gear maintenance, have risen, directly impacting household income and sustainability.

Fishing conditions have also worsened over the years. A majority of respondents (64%) noted a decline in daily catches compared to five years ago. Over 80% reported income loss, with many depending on informal loans or seasonal work to make ends meet. Pollution has also affected the behavior, habitat, and size of fish, compounding ecological stress and financial vulnerability.

Although 87% of fishers acknowledged pollution as a major factor in the decline of fish stocks, only 30% were aware of or involved in any pollution control efforts. This highlights a significant gap in community engagement and environmental governance.

Interviews with local government officers and community leaders revealed that enforcement of regulations remains inconsistent, and awareness programs are often limited in reach or continuity.

Despite these challenges, there is optimism. Fishers showed a strong willingness to participate in marine conservation if supported by proper training and resources. The study concludes that sustainable fisheries management in the Myeik Archipelago will require integrated strategies, combining stronger policy enforcement, inclusive education, financial assistance, and active community involvement. By empowering local stakeholders and addressing pollution at its source, there is potential to restore marine ecosystems and protect the future of small-scale fisheries in the region.

5.2 Recommendations

To tackle marine pollution and its impact on small-scale fishers in the Myeik Archipelago, it's crucial to involve local communities directly. Fishers live and work closer to the problem, so they have the best understanding of the challenges and can play a vital role in the solution. Encouraging their participation in clean-up campaigns and community monitoring programs not only helps reduce pollution but also builds a sense of ownership and responsibility. Education campaigns that are tailored to the local context can empower fishers with knowledge about the sources and effects of pollution, helping them become active protectors of their environment.

Income insecurity is a major concern for fishers affected by pollution. When fish stocks decline or become unsafe to harvest, their livelihoods suffer. To help ease this burden, income protection measures like fuel vouchers, small loans, or emergency subsidies can provide a much-needed safety net during difficult times. These support mechanisms can prevent fishers from resorting to harmful practices such as overfishing or using destructive gear out of desperation. By stabilizing their income, fishers can focus on long-term sustainability rather than short-term survival.

Supporting sustainable fishing practices is another key step. Training fishers on improved gear that reduces bycatch and waste, as well as better fishing techniques, can lessen the environmental impact and improve catch quality. In addition, encouraging diversification, such as engaging in aquaculture or exploring alternative livelihoods, can reduce pressure on marine resources. This not only benefits the ecosystem but also provides fishers with more stable and varied income sources, helping communities build resilience against future shocks.

Creating marine protected areas (MPAs) and seasonal no-fishing zones can give fish stocks the space and time they need to recover. However, for these measures to be successful, fishers must be involved in the planning and enforcement stages. When local communities have a say in how these protected areas are managed, they are more likely to respect and uphold the rules. This sense of local ownership is critical to ensuring compliance and making the MPAs effective in preserving marine biodiversity.

Environmental education should go beyond abstract concepts and directly connect to fishers' daily lives. When people understand how pollution impacts their income, food security, and health, they are more motivated to take action. Campaigns that clearly show these links make the issue personal and urgent. By framing pollution awareness around real-life concerns, fishers are more likely to adopt behaviors that protect the ocean and their way of life.

It's also important to recognize that different age groups may respond better to different communication methods. Younger fishers might be more receptive to messages delivered through social media or peer-led sessions, while older fishers often prefer face-to-face discussions and community gatherings. Tailoring outreach efforts to these preferences can help ensure that everyone in the community stays informed and engaged, fostering a stronger collective effort to combat pollution.

Lastly, no single group can solve the marine pollution problem alone. Collaboration between government agencies, NGOs, and fishing communities is essential. This requires transparent communication, mutual respect, and shared decision-making. When all stakeholders work together, they can pool their resources and knowledge, creating more effective and sustainable solutions. Building trust and partnership at every level will be key to protecting the Myeik Archipelago's marine environment for future generations.

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APPENDIX A

Questionnaires

Dear Respondent,

This questionnaire is part of a thesis study on the impact of maritime pollution on the small-scale fisheries in the Myeik Archipelago. Your participation is valuable, and all information will remain confidential and used for academic purposes only.

Section A: Demographic Information of Respondents

1. **Gender**
   - □ Male
   - □ Female
2. **Age**
   - □ Under 25
   - □ 25 – 34
   - □ 35 – 44
   - □ 45 – 54
   - □ 55 and above
3. **Years of Fishing Experience**
   - □ Less than 5 years
   - □ 5 – 10 years
   - □ 11 – 15 years
   - □ 16 – 20 years
   - □ Over 20 years
4. **Type of Fishing (Select all that apply)**
   - □ Small-scale fishing (Traps / Nets)
   - □ Commercial Fishing (Machines / Gears)
   - □ Other (Please specify): _____
5. **What is your fishing boat size?**
   ---
6. **Number of Fish Catch Daily (in Viss)**
   ---
7. **Is fishing the main occupation of your household?**
   - □ Yes
   - □ No (Specify your main occupation) _____
8. **On average, how many times do you make fishing in a month?**
   - □ Under 10 Days
   - □ 11 to 20 Days
   - □ 21 to 30 Days
   - □ Daily
9. **What is the average monthly income for your household from fishing?**
   - □ Below 200,000 MMK
   - □ 200,001 to 500,000 MMK
   - □ 500,001 to 1,000,000 MMK
   - □ Above 1,000,000 MMK
10. **What seasons do you usually go fishing?**
    - □ Summer
    - □ Rainy Season
    - □ Cold Season
    - □ Whole Year

Section B: Awareness and Observation of Maritime Pollution

11. What type of pollution do you encounter most frequently in the waters where you fish? (Select all that apply)

□ Oil Spills
□ Industrial Waste
□ Plastic Waste
□ Agricultural runoff
□ Microplastics
□ Other (Please specify): ……

12. Have you noticed a decrease in the quantity of fish due to marine pollution?

□ Yes, significantly decrease
□ No Change
□ Yes, moderately decrease
□ Not Sure

13. Is ocean pollution reducing the number of fish species that regularly visit?

□ Yes, significantly decrease
□ No Change
□ Yes, moderately decrease
□ Not Sure

14. Are fish species changing due to ocean pollution?

□ Yes, significantly change
□ No Change
□ Yes, moderately change
□ Not Sure

15. Have you noticed a change in fish condition due to pollution?

□ More dead fish are being caught.
□ Fish are more vulnerable than ever before.
□ The size of the fish is getting smaller.
□ The taste of fish is not good.

16. Have you observed any changes in fish behavior due to pollution?

□ Yes, more erratic behavior
□ No significant change
□ Yes, less activity in polluted areas
□ Not sure

17. How often do you encounter plastic or oil spills or other debris while fishing?

□ Always
□ Rarely
□ Never
□ Often
□ Occasionally

For each of the statements below, please tick (✓) for your agreement or disagreement by circling in the appropriate box. The response scale is as follow.

1 = Strongly disagree, 2 = Disagree, 3 = Neural, 4 = Agree, 5 = Strongly agree

Section C: Fishing Conditions and Operations

Sr No	Statement	1	2	3	4	5
18.	I need to travel further to find good fishing areas due to pollution.					
19.	Fuel costs have increased due to longer fishing trips.					
20.	I have had to repair/replace fishing gear due to pollution damage.					
21.	I spend more time searching for fishing areas due to pollution.					
22.	Pollution has led to a decline in fish population nearshore.					
23.	Weather and sea conditions are more unpredictable than before.					

Section D: Fish Counts and Sustainability

Sr No	Statement	1	2	3	4	5
24.	Marine pollution is a major cause of the declining fish populations where you catch.					
25.	Pollution can impact on the biodiversity of marine ecosystems (other than fish).					
26.	The current number of fish in the area you are fishing has decreased compared to the past (5) years.					
27.	Marine pollution decreases the number of fish in the areas where you catch.					
28.	Marine pollution affects the coral reefs in the areas where you catch.					
29.	Marine pollution affects the mangroves in the areas where you catch.					
30.	Marine pollution affects other marine species in the areas where you catch.					

Section E: Economic and Socio-Economic Impact

Sr No	Statement	1	2	3	4	5
31.	My fishing income has decreased in recent years.					
32.	I have taken loans due to income loss.					
33.	I have changed fishing methods to adapt to lower catches.					
34.	My household expenses are harder to manage due to reduced income.					
35.	I need external assistance (e.g., government, NGOs) to operate my fishing business.					
36.	Marine pollution causes a threat to the local community's food security.					
37.	Marine pollution has affected your relationship with other local fishermen.					

Section F: Policy and Governance

38. Are you aware of Government measures to address marine pollution in fishing areas?

□ Yes, aware and involved □ No, not aware

□ Yes, aware but not involved □ Not sure

39. Which of the following are currently implemented to address impacts on fishing activities? (You can select more than one.)

□ Stricter enforcement of pollution laws

□ Community-based waste management programs

□ Community-driven environmental initiatives

□ More education and awareness on pollution prevention

□ Enhanced stronger regulation and monitoring of fishing areas

□ Increased financial support for fisheries

□ Other (Please specify): _____

40. Are you interested in participating in education or training programs aimed at pollution mitigation and sustainable fishing practices?

□ Yes, very interested □ No, not interested at all

□ Yes, somewhat interested □ Not sure

41. Are you interested in participating in marine pollution reduction activities?

□ Yes, very interested □ No, not interested at all

□ Yes, somewhat interested □ Not sure

42. Would you be willing to collaborate with local Government or NGOs on initiatives to reduce marine pollution?

□ Yes, definitely □ No, not willing at all

□ Yes, maybe □ Not sure

43. Did you know that government agencies are working to control water pollution?

□ Definitely know □ Not Sure

□ It can be done.

44. Do you believe there is hope for the future of small-scale fisheries in your region despite the pollution challenges?

□ It will get better. □ There will be no change.

□ It will get worse. □ Not sure

APPENDIX B

လေ့လာမှုဆိုင်ရာ စစ်တမ်းမေးခွန်းလွှာ

ဤစစ်တမ်းမေးခွန်းများသည် မြိတ်ကျွန်းစုရှိ အသေးစားငါးဖမ်းလုပ်ငန်းများအပေါ် သမုဒ္ဒရာ အတွင်းရှိ အညစ်အကြေးများ၏ သက်ရောက်မှုများ ကို လေ့လာသည့် သုတေသနစာတမ်း အတွက်ဖြစ်ပါသည်။ သင်ဖြေဆိုထားသော မည်သည့်သတင်းအချက်အလက်ကိုမဆို ယခု သုတေသနစာတမ်းအတွက်သာ အသုံးပြုမည်ဖြစ်ပါသည်။ ပါဝင်ဖြေဆိုပေးသည့်အတွက် ကျေးဇူးတင်ပါသည်။

အပိုင်း (က) ဖြေဆိုသူနှင့်ပတ်သတ်သော အချက်အလက်များ

၁။ ကျား / မ

□ ကျား □ မ

၂။ အသက်

□ ၂၅ နှစ်အောက် □ ၄၅ နှစ် နှင့် ၅၄ နှစ် ကြား

□ ၂၅ နှစ် နှင့် ၃၄ နှစ် ကြား □ ၅၅ နှစ် နှင့် အထက်

□ ၃၅ နှစ် နှင့် ၄၄ နှစ် ကြား

၃။ ငါးဖမ်းလုပ်ငန်းအတွေ့အကြုံ

□ ၅ နှစ် အောက် □ ၁၆ နှစ် နှင့် ၂၀ နှစ် ကြား

□ ၅ နှစ် နှင့် ၁၀ နှစ် ကြား □ ၂၀ နှစ် အထက်

□ ၁၁ နှစ် နှင့် ၁၅ နှစ် ကြား

၄။ သင်၏ ငါးဖမ်းနည်းအမျိုးအစား (၁ ခုထက်ပို၍ ရွေးနိုင်ပါသည်။)

□ အသေးစားငါးဖမ်းခြင်း (ထောက်ချောက် / ပိုက်ကွန်များဖြင့် ဖမ်းခြင်း)

□ စီးပွားဖြစ် ငါးဖမ်းခြင်း (စက်ကိရိယာများဖြင့် ဖမ်းခြင်း

□ အခြား (ကျေးဇူးပြု၍ ဖော်ပြပေးပါ) _____

၅။ သင်၏ ငါးဖမ်းလှေ အရွယ်အစား

၆။ နေ့စဉ်ဖမ်းဆီး ရမိသည့် ငါး ဝိဿာ အရေအတွက်

၇။ သင်အိမ်၏ အဓိက စီးပွားရေး လုပ်ငန်းသည် ငါးဖမ်းလုပ်ငန်းဖြစ်ပါသလား။

□ ဟုတ်ပါသည်။ □ မဟုတ်ပါ။

(အဓိကလုပ်ငန်းအား ဖော်ပြပေးပါ)_____

၈။ သင် တစ်လ အတွင်း ဘျမ်းမျှ ငါး ဘယ်နှစ်ကြိမ် ဖမ်းပါသလဲ။

□ ၁၀ ရက် အောက် □ ၂၁ ရက် မှ ၃၀ ရက် အတွင်း

□ ၁၁ ရက် မှ ၂၀ ရက် ကြား □ နေ့စဉ်

၉။ ငါးဖမ်းလုပ်ငန်းမှ သင့်အိမ်ထောင်စုအတွက် ဘျမ်းမျှ လစဉ် ဝင်ငွေ ဘယ်လောက်လဲ။

□ ၂၀၀,၀၀၀ ကျပ် နှင့် အောက် □ ၅၀၀,၀၀၁ ကျပ် မှ ၁,၀၀၀,၀၀၀ ကျပ်

□ ၂၀၀,၀၀၀ ကျပ် မှ ၅၀၀,၀၀၀ ကျပ် □ ၁,၀၀၀,၀၀၀ ကျပ် နှင့် အထက်

၁၀။ ဘယ်ရာသီများတွင် ငါးများလေ့ရှိပါသလဲ။ (သက်ဆိုင်သမျှကို ရွေးပါ)

□ နွေရာသီ □ မိုးရာသီ

□ ဆောင်းရာသီ □ တစ်နှစ်ပတ်လုံး

အပိုင်း (ခ) သမုဒ္ဒရာညစ်ညမ်းမှုများ နှင့် သတိပြုမှုများ

၁၁။ သင် ငါးဖမ်းနေသော နေရာတွင် ကြုံတွေ့ရသော အညစ်အကြေးအမျိုးအစားများကို ရွေးချယ်ပါ။

□ ဆီယိုဖိတ်ဖြင်း

□ ပလတ်စတစ် အမှိုက်များ

□ သေးငယ်သော ပလတ်စတစ် အစများ

□ စက်ရုံလုပ်ငန်းများမှ အညစ်အကြေးများ

□ စိုက်ပျိုးရေးလုပ်ငန်းများမှ အညစ်အကြေးများ

□ အခြား (ကျေးဇူးပြု၍ သေချာစွာ ဖော်ပြပေးပါ) _____

၁၂။ အညစ်အကြေးများကြောင့် သင်ငါးဖမ်းသောနေရာများတွင် ငါးအရေအတွက်များ လျော့နည်းသွားသည်ကို သင်သတိပြုမိပါသလား။

□ ငါးအရေအတွက် များစွာ လျော့နည်းသွားသည်။

□ ငါးအရေအတွက် အနည်းငယ် လျော့နည်းသွားသည်။

□ ငါးအရေအတွက် မပြောင်းလဲပါ။

□ သေချာစွာ သတိမထားမိပါ။

၁၃။ ပင်လယ်ရေထုညစ်ညမ်းမှုသည် ပုံမှန်လာရောက်လည်ပတ်သည့် ငါးမျိုးစိတ်အရေအတွက် ကို ကျဆင်း စေပါသလား။

□ သိသိသာသာလျော့ကျသွားပါတယ်။ □ ပြောင်းလဲမှုမရှိပါ။

□ တော်ရုံတန်ရုံ လျော့ပါတယ်။ □ မသေချာဘူး။

၁၄။ ပင်လယ်ရေညစ်ညမ်းမှုကြောင့် ငါးမျိုးစိတ်များ ပြောင်းလဲလာပါသလား။

□ သိသိသာသာပြောင်းလဲသွားပါတယ်။ □ ပြောင်းလဲမှုမရှိပါ။

□ တော်ရုံတန်ရုံ ပြောင်းလဲသွားပါတယ်။ □ မသေချာဘူး။

၁၅။ အညစ်အကြေးများကြောင့် ငါးအခြေအနေများ ပြောင်းလဲမှု ရှိလာသည်ကို သင် သတိပြုမိပါသလား။

□ ငါးအသေများ ပိုမို ဖမ်းမိလာသည်။

□ ငါးများသည် ယခင်ကထက် ပိုမို ပုတ်သိုးလွယ်လာသည်။

□ ငါးများ၏ အရွယ်အစားများ သေးလာသည်။

□ ငါးများ စားမကောင်းဖြစ်လာသည်။

၁၆။ အညစ်အကြေးများကြောင့် ငါးများ၏ အပြုအမူများ ပြောင်းလဲလာသည်ကို သင်သတိပြု မိပါသလား။

□ ပိုမိုထူးခြားသော အပြုအမူများ ရှိလာသည်။

□ အညစ်အကြေးများရှိသော နေရာတွင် ငါးများ၏ လှုပ်ရှားမှုများ နည်းလာသည်။

□ သိသာသော ပြောင်းလဲ မှု မရှိပါ။

□ သေချာစွာ သတိမထားမိပါ။

၁၇။ ငါးဖမ်းနေစဉ်တွင် ပလတ်စတစ် (သို့) ဆီယိုဖိတ်မှု (သို့) အခြားအမှိုက်များကြုံတွေ့ရခြင်း ဘယ်လောက်ရှိပါသလဲ။

□ အမြဲကြုံတွေ့ရသည်။ □ ရှားရှားပါးပါး ကြုံတွေ့ရသည်။
□ မကြာခဏ ကြုံတွေ့ရသည်။ □ တစ်ခါမှ မကြုံတွေ့ရပါ။
□ တစ်ခါတစ်လေ ကြုံတွေ့ရသည်။

အောက်ပါအချက်အလက်များ အပေါ်တွင် သင်၏ သဘောထားကို အမှန်ခြစ် ခြစ်၍ (✓) ရွေးချယ်ပါ။

၁ = လုံးဝ သဘောမတူပါ။ ၂ = သဘောမတူပါ။ ၃ = သက်ရောက်မှု မရှိပါ။
၄ = သဘောတူပါသည်။ ၅ = လုံးဝ သဘောတူပါသည်။

အပိုင်း (ဂ) ငါးဖမ်းခြင်း လုပ်ငန်း နှင့် အခြေအနေများ

စဉ်	အချက်အလက်	၁	၂	၃	၄	၅
၁၈။	အညစ်အကြေးများကြောင့် ငါးဖမ်းကောင်းသည့် နေရာများသို့ ဝေးလံစွာ သွားရသည်။					
၁၉။	ဝေးလံစွာ သွားရခြင်းများကြောင့် လောင်စာဆီ ကုန်ကျစရိတ်များ များလာသည်။					
၂၀။	အညစ်အကြေးများကြောင့် ငါးဖမ်းကိရိယာများ / စက်ပစ္စည်းများကို ပျက်စီးသဖြင့် ပြုပြင် (သို့) အသစ်ပြန်လည် တပ်ဆင်ရသည်။					
၂၁။	အညစ်အကြေးများကြောင့် ငါးဖမ်းနိုင်သည့် နေရာများ ရှာဖွေရန် အချိန်ပိုကြန့်ကြာသည်။					
၂၂။	ကမ်းနား အနီးအနားနေရာများတွင် ငါးအရေအတွက် လျော့နည်းလာသည်။					
၂၃။	ယခင်နှင့် မတူဘဲ ရာသီဥတု နှင့် ပင်လယ်ပြင် အခြေအနေများ မကြာခဏ ပြောင်းလဲ လာသည်။					

အပိုင်း (ဃ) ငါးအရေအတွက် နှင့် ရေရှည်တည်တံ့ရေး

စဉ်	အချက်အလက်	၁	၂	၃	၄	၅
၂၄။	သမုဒ္ဒရာအတွင်းရှိ အညစ်အကြေးများသည် သင်ငါးဖမ်းသောနေရာတွင်ရှိသော ငါးအရေအတွက် လျော့နည်းသွားခြင်းအတွက် အဓိက အကြောင်းအရင်းတစ်ခု ဖြစ်သည်။					
၂၅။	အညစ်အကြေးများသည် သမုဒ္ဒရာအတွင်း ငါးများသာမက အခြားရေသတ္တဝါမျိုးစုံ၏ ဂေဟစနစ်များကိုလဲ ထိခိုက်စေနိုင်သည်။					
၂၆။	သင်ငါးဖမ်းသောနေရာတွင်ရှိသော လက်ရှိငါးအရေ အတွက် သည် လွန်ခဲ့သော (၅) နှစ် အကြာ နှင့် နှိုင်းယှဉ်ပါက ငါးအရေအတွက်များ လျော့နည်းသွား ပါသည်။					

၂၇။	သမုဒ္ဒရာ အညစ်အကြေးများသည်သင်ငါးဖမ်းသော နေရာများရှိ ငါးအရေအတွက် ကို ထိခိုက်စေပါသည်။					
၂၈။	သမုဒ္ဒရာအညစ်အကြေးများသည် သင်ငါးဖမ်းသော နေရာများရှိ သန္တာကျောက်တန်းများကို ထိခိုက်စေပါသည်။					
၂၉။	သမုဒ္ဒရာ အညစ်အကြေးများသည် သင်ငါးဖမ်းသော နေရာများရှိ ဒီရေတောများကိုထိခိုက်စေပါသည်။					
၃၀။	သမုဒ္ဒရာ အညစ်အကြေးများသည် သင်ငါးဖမ်းသော နေရာများရှိ အခြားအဏ္ဏဝါမျိုးစိတ်များကို ထိခိုက်စေ ပါသည်။					

အပိုင်း (c) လူမှု စီးပွားရေး အခြေနေပေါ်သက်ရောက်မှု

စဉ်	အချက်အလက်	၁	၂	၃	၄	၅
၃၁။	မကြာသေးမီ နှစ်များအတွင်း ငါးဖမ်းဝင်ငွေ လျော့နည်းလာသည်။					
၃၂။	ဝင်ငွေလျော့နည်းလာမှုကြောင့် ချေးငွေယူရသည်။					
၃၃။	ငါးဖမ်းရရှိသည့် ငါးအရေအတွက်နည်းသွားသည့် အတွက် ငါးဖမ်းနည်းစနစ်များ ပြောင်းလဲရသည်။					
၃၄။	ဝင်ငွေလျော့နည်းလာခြင်းကြောင့် အိမ်ထောင်စု အသုံးစရိတ်များစီမံခန့်ခွဲရန် ပိုမို ခက်ခဲလာသည်။					
၃၅။	ငါးဖမ်းလုပ်ငန်းကိုဆက်လက်လုပ်ကိုင်ရန် အစိုးရ (သို့)NGO များ၏ အကူအညီလိုအပ်ပါသည်။					
၃၆။	အညစ်အကြေးများသည် ဒေသခံများ၏ စားနပ်ရိက္ခာ ဖူလုံမှုကို ထိခိုက်စေနိုင်သည်။					
၃၇။	အညစ်အကြေးများသည် ဒေသခံငါးဖမ်းသမားများ အကြား ဆက်ဆံရေးများကို ထိခိုက်စေနိုင်သည်။					

အပိုင်း (စ) ဥပဒေစည်းမျဉ်းများနှင့် အစိုးရ အခန်း ကဏ္ဍ များ

၃၈။ သင်၏ ငါးဖမ်းသောနေရာများအတွက် သမုဒ္ဒရာ အညစ်အကြေးများကို တာဆီးရန် အတွက် အစိုးရ အဖွဲ့အစည်းများ ၏ ဆောင်ရွက်မှုများကို သင်သတိပြုမိပါသလား။

- □ သတိထားမိပြီး ကိုယ်တိုင်ပါဝင်လုပ်ဆောင်ပါသည်။
- □ သတိထားမိသော်လည်း ကိုယ်တိုင် ပါဝင်လုပ်ဆောင်ခြင်း မရှိပါ။
- □ သတိမထားမိပါ။
- □ သေချာ မသိပါ။

၃၉။ ငါးဖမ်း လုပ်ငန်းများ အပေါ်တွင် သက်ရောက်မှုများကို ဖြေရှင်းရန် အတွက် အောက်ပါတို့မှ မည်သည့်အချက်များကို လုပ်ဆောင်နေပါသလဲ။ (၁ ခုထက် ပို၍ ရွေးနိုင်ပါသည်။)

- ☐ အညစ်အကြေးဆိုင်ရာ ဥပဒေ များဖြင့် တင်းကြပ်စွာ အရေးယူခြင်း
- ☐ ရပ်ရွာလူထုအခြေပြု အမှိုက်နှင့် ပတ်သတ်သော စီမံခန့်ခွဲမှု အစီအစဉ်များ
- ☐ ရပ်ရွာလူထုအခြေပြု သဘာဝပတ်ဝန်းကျင်ကာကွယ်ရေး လှုပ်ရှားမှုများ
- ☐ အညစ်အကြေးကင်းရှင်းရေး နှင့် ပတ်သတ်သော ပညာပေးနှင့် သတိပေး အစီအစဉ်များ
- ☐ ငါးဖမ်းနေရာများကို စည်းမျဉ်းစည်းကမ်းများဖြင့် သေချာစွာ ကြပ်မတ်ခြင်း
- ☐ ငါးဖမ်းလုပ်ငန်းများ အတွက် ငွေကြေးထောက်ပံ့မှုများဖြင့် တိုးမြှင့်ခြင်း
- ☐ အခြား (ကျေးဇူးပြု၍ သေချာစွာ ဖော်ပြပေးပါ) _____

၄၀။ သင်သည် သမုဒ္ဒရာအညစ်အကြေးများ လျော့ချခြင်း နှင့် ရေရှည်တည်တံ့သော ငါးဖမ်းနည်းများဆိုင်ရာ ပညာပေး အစီအစဉ်များ တွင် ပါဝင်လိုစိတ်ရှိပါသလား။

- ☐ လွန်စွာ စိတ်ဝင်စားပါသည်။
- ☐ စိတ်ဝင်စားမှု မရှိပါ။
- ☐ အနည်းငယ် စိတ်ဝင်စားပါသည်။
- ☐ သေချာစွာ မသိပါ။

၄၁။ ပင်လယ်လေထုညစ်ညမ်းမှု လျော့ချရေး လှုပ်ရှားမှုများတွင် သင်ပါဝင်ရန် စိတ်ဝင်စားပါသလား။

- ☐ အလွန်စိတ်ဝင်စားပါတယ်
- ☐ လုံးဝ စိတ်မဝင်စားဘူး။
- ☐ အနည်းငယ် စိတ်ဝင်စားပါတယ်
- ☐ မသေချာပါ။

၄၂။ သမုဒ္ဒရာရေထုညစ်ညမ်းမှုကို လျော့ချရန် ဒေသဆိုင်ရာအစိုးရ (သို့) NGO များနှင့် ပူးပေါင်း ဆောင်ရွက်လိုပါသလား။

- ☐ မဖြစ်မနေ ပူးပေါင်းလိုပါသည်။
- ☐ လုံးဝ မပူးပေါင်း လိုပါ။
- ☐ ဖြစ်နိုင်လျှင် ပူးပေါင်းလိုပါသည်။
- ☐ သေချာ မသိပါ။

၄၃။ ရေထုညစ်ညမ်းမှုကို ထိန်းချုပ်ဖို့ အစိုးရဌာနတွေက လုပ်ဆောင်နေပါသည်ကို သင် သိပါသလား။

- ☐ ကျိန်းသေသိရှိပါတယ်။
- ☐ မသိရှိပါ။
- ☐ လုပ်ကောင်းလုပ်နိုင်ပါတယ်။

၄၄။ သမုဒ္ဒရာညစ်ညမ်းမှုစိန်ခေါ်မှုများကြားမှ သင့်ဒေသတွင် အသေးစားငါးဖမ်းလုပ်ငန်းများ၏ အနာဂတ် အတွက် မျှော်လင့်ချက်ရှိသည်ဟု သင်ယုံကြည်ပါသလား။

- ☐ ပိုကောင်းလာမည် ဟု ထင်ပါသည်။
- ☐ ပြောင်းလဲမှု ရှိလာမည် မဟုတ်ဟု ထင်ပါသည်။
- ☐ ပိုဆိုးသွားမည်ဟု ထင်ပါသည်။
- ☐ သေချာ မသိပါ။

APPENDIX C

Questionnaires for Government or Community Leaders

1. **Are there any government policies (or local regulations) in place to ensure the sustainability of fishing activities in your area?**
   □ Yes □ No □ Not Sure
2. **Do you think the concept of the "Blue Economy" (a system that uses marine and ocean resources responsibly to achieve economic, social, and environmental benefits in a balanced way) is helpful for the sustainability of fisheries in area?**
   □ Very helpful □ Not helpful
   □ Somewhat helpful □ Not sure
3. **Do local administrative bodies participate in addressing issues related to the fishing industry in your area?**
   □ Yes, they do □ Sometimes
   □ No, they don't □ Not sure
4. **What is the local government doing to prevent marine pollution?**
   ----
5. **Do you think your surrounding area receives sufficient support from the government or NGOs in preventing marine pollution?**
   □ Fully supported □ Not supported
   □ Partially supported □ Not sure
6. **Has the local government issued regulations for fishermen to prevent marine pollution?**
   □ Yes, Published □ No, Haven't Published
7. **If so, what regulations has the local government issued for fishermen to prevent ocean pollution?**
   ----
8. **In your opinion, how do policies and regulations for preventing marine pollution affect local fishers?**
   □ Very beneficial □ Beneficial for some, not for others
   □ Not beneficial □ Not sure
9. **Are fishermen involved in local government efforts to prevent ocean pollution?**
   □ Yes, involved □ No, not involved
10. **What types of educational or awareness-raising activities are typically conducted in your area to prevent marine pollution?**
    ----
11. **How frequently are awareness activities for marine pollution protection conducted?**
    □ Weekly □ Monthly
    □ Every 3 months (Quarterly) □ Yearly
    □ Not regularly □ Never Conducted

APPENDIX D

အစိုးရ သို့မဟုတ် ရပ်ရွာခေါင်းဆောင်များအတွက် မေးခွန်းလွှာများ

၁။ သင်၏ဒေသအတွင်းတွင် ငါးဖမ်းလုပ်ငန်းများ ရေရှည်တည်တံ့စေရေးအတွက် အစိုးရမူဝါဒများ (သို့မဟုတ်) ဒေသခံစည်းမျဉ်းများ ရှိပါသလား။

□ ရှိပါသည်။ □ မရှိပါ။ □ သေချာ မသိပါ။

၂။ သင်၏ဒေသအတွင်းရှိ ငါးဖမ်းလုပ်ငန်းများ၏ ရေရှည်တည်တံ့မှုအတွက် "အပြာရောင် စီးပွားရေး" အတွေးအခေါ် (ပင်လယ်နှင့် သမုဒ္ဒရာအရင်းအမြစ်များကို တာဝန်ရှိရှိအသုံးပြုကာ စီးပွားရေး၊ လူမှုရေး၊ ပတ်ဝန်းကျင်အကျိုးအမြတ်များကို ညီညွတ်စွာရရှိစေသောစနစ်) သည် အထောက်အကူဖြစ်သည်ဟု သင်ထင်ပါသလား။

□ အလွန် အထောက်အကူ ဖြစ်ပါသည်

□ တစ်စိတ်တစ်ပိုင်း အထောက်အကူ ဖြစ်ပါသည်

□ အထောက်အကူ မဖြစ်နိုင်ပါ

□ သေချာစွာ မသိပါ

၃။ သင်၏ဒေသအတွင်းတွင် ငါးဖမ်းလုပ်ငန်းနှင့် ပတ်သက်သော ပြဿနာများကို ဖြေရှင်းရာတွင် ဒေသအုပ်ချုပ်ရေးအဖွဲ့က ပါဝင်ပါသလား။

□ ပါဝင်ပါသည်။

□ မပါဝင်ပါ။

□ တစ်ခါတစ်ရံမှ ပါဝင်ပါသည်။

□ သေချာ မသိပါ။

၄။ ပင်လယ်ပြင် ညစ်ညမ်းမှုကို ကာကွယ်ဖို့ ဒေသန္တရ အစိုးရ မှ ဘာတွေလုပ်နေပါသလဲ။

၅။ သင့်ပတ်ဝန်းကျင်နေရာများသည် သမုဒ္ဒရာညစ်ညမ်းမှုများကို ကာကွယ်ရာတွင် အစိုးရ (သို့) NGO များ၏ ထောက်ပံ့မှုများကို လုံလောက်စွာ ရသည်ဟု သင်ထင်ပါသလား။

□ အပြည့်အဝ အထောက်အပံ့ရပါသည်။

□ တစ်စိတ်တစ်ပိုင်း အထောက်အပံ့ရပါသည်။

□ အထောက်အပံ့ မရပါ။

□ သေချာစွာ မသိပါ။

၆။ ပင်လယ်ပြင်ညစ်ညမ်းမှုကို ကာကွယ်ရန် ဒေသန္တရအစိုးရမှ တံငါသည်များအတွက် စည်းမျဉ်းများထုတ်ပြန်ထားပါသလား။

□ ထုတ်ပြန်ထားပါသည်။ □ မထုတ်ပြန်ထားပါ။

၇။ ထုတ်ပြန်ထားပါက သမုဒ္ဒရာညစ်ညမ်းမှုကို ကာကွယ်ရန် ရေလုပ်သားများအတွက် ဒေသဆိုင်ရာ အစိုးရက မည်သည့်စည်းမျဉ်းများ ထုတ်ပြန်ထားသနည်း။

၈။ သမုဒ္ဒရာညစ်ညမ်းမှုများကို ကာကွယ်ရန်အတွက် မူဝါဒများနှင့် ဥပဒေစည်းမျဉ်းများချမှတ်ခြင်းသည် ဒေသခံငါးဖမ်းသူများအတွက် ဘယ်လိုသက်ရောက်မှုရှိကြောင်း သင်ထင်ပါသလဲ။

- □ အလွန်အကျိုးရှိပါသည်။
- □ အကျိုးမရှိပါ။
- □ တချို့အတွက် အကျိုးရှိသော်လည်း တချို့ အတွက် အကျိုးမရှိပါ။
- □ သေချာ မသိပါ။

၉။ သမုဒ္ဒရာညစ်ညမ်းမှုကို ကာကွယ်ရန် ဒေသန္တရအစိုးရ၏ ကြိုးပမ်းမှုတွင် ငါးဖမ်းသမားများ ပူးပေါင်းပါဝင်မှု ရှိပါသလား။

- □ ပါဝင်ပါသည်။
- □ မပါဝင်ပါ။

၁၀။ သင်တို့၏နေရာတွင် ပင်လယ်ရေညစ်ညမ်းမှုကို တားဆီးရန်အတွက် မည်ကဲ့သို့ ပညာပေးလုပ်ငန်းများ (သို့) သတိပေးလုပ်ဆောင်ချက်များလုပ်ဆောင်လေ့ရှိပါသလဲ။

၁၁။ ပင်လယ်ရေညစ်ညမ်းမှုကို ကာကွယ်ရန် အတွက် ပညာပေးလုပ်ဆောင်ချက်များကို ဘယ်နှစ်ကြိမ်ခန့်ကျင်းပလေ့ရှိပါသလဲ။

- □ အပတ်စဉ်
- □ လစဉ်
- □ သုံးလတစ်ကြိမ်
- □ တစ်နှစ်တစ်ကြိမ်
- □ ပုံမှန်ကျင်းပလေ့ရှိသည်။
- □ တစ်ခါမှ မကျင်းပဖူးပါ။