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Research Report

Mapping the Socioeconomic Vulnerability of Small-Scale Fishers to the Impacts of Climate Change, Access to Subsidized Fuel and Fishing Grounds

Case Studies: South Aceh (Aceh), Pemalang (Central Java), Pangkep (South Sulawesi) and Ambon (Maluku)

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 This publication and research collaboration are supported by the Walton Family Foundation (WFF).

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To cite

Djamaludin, S., Saragih, M., Hasly, I. R. J. (2024). Mapping the socioeconomic vulnerability of small-scale fishers to the impacts of climate change, access to subsidized fuel and fishing grounds. EcoNusa, KNTI, FEB UI. Jakarta: EcoNusa.

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Table of Contents


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List of Figures

List of Tables

List of Abbreviations and Acronyms

BBM	**: Fuel (*Bahan Bakar Minyak*)**
BPAN	**: Fishers' Insurance Premium Assistance (*Bantuan Premi Asuransi Nelayan*)**
BPJS	**: Social Security Agency (*Badan Penyelenggara Jaminan Sosial*)**
FAO	**: Food and Agriculture Organization**
FGD	**: Forum Group Discussion**
GT	**: Gross Tonnage**
IKLI	**: Indonesian Marine Health Index (*Indeks Kesehatan Laut Indonesia*)**
IPCC	**: Intergovernmental Panel on Climate Change**
KKP	**: Ministry of Marine Affairs and Fisheries (*Kementrian Kelautan dan Perikanan*)**
KUSUKA	**: Marine and Fisheries Business Actor Card (*Kartu Pelaku Usaha Kelautan dan Perikanan*)**
LVI	**: Livelihood Vulnerability Index**
PKH	**: Family Hope Program (*Program Keluarga Harapan*)**
PBI	**: Premium Assistance Recipients (*Penerima Bantuan Iuran*)**
PNBP	**: Non-Tax State Revenue (*Pendapatan Negara Bukan Pajak*)**
SD	**: Elementary School (*Sekolah Dasar*)**
SMP	**: Junior High School (*Sekolah Menengah Pertama*)**
SMA	**: Senior High School (*Sekolah Menengah Atas*)**
SPBN	**: Fishers' Fuel Station (*Stasiun Pengisian Bahan Bakar Nelayan*)**

Executive Summary

This study titled "Mapping the Socioeconomic Vulnerability of Small-Scale Fishers to the Impacts of Climate Change, Access to Subsidized Fuel and Fishing Grounds," examines the social and economic challenges faced by small-scale fishers in Indonesia. The study is a collaborative effort led by EcoNusa Foundation, the Indonesian Traditional Fishers' Union (KNTI) and FEB UI. The study maps vulnerabilities across four regions: South Aceh (Aceh), Pemalang (Central Java), Pangkep (South Sulawesi) and Ambon (Maluku).

The research employed a primary data collection approach, utilizing questionnaire-based surveys and focus group discussions (FGDs) with 236 fishers respondents located in four regions. The survey population comprised 67 respondents from Ambon, 70 respondents from Pemalang, 50 respondents from South Aceh and 49 respondents from Pangkep.

The study revealed significant vulnerabilities faced by small-scale fishers, particularly from climate change (54%), fishing ground vulnerability (60%) and access to subsidized fuel (77%). Notably, a majority of fishers fall within the severe vulnerability category, indicating exposure to multiple vulnerability sources.

Difficulties in accessing subsidized fuel, fishing ground disturbances and climate change were identified as the leading vulnerability sources. In descending order of vulnerability severity, the regions are Ambon City, Pangkep Regency, Pemalang Regency and South Aceh Regency. Vulnerable fishers typically share common characteristics, including low education levels, lack of fishing equipment (boats), inadequate zoning knowledge, limited access to climate information, sole reliance on fishing for income, low socioeconomic status, lack of health insurance and absence of the Marine and Fisheries Business Actor Card (KUSUKA). The accumulation of these vulnerabilities exposes fishers to severe risks.

Addressing the vulnerabilities faced by fishers necessitates a concerted and collaborative effort from all stakeholders and policymakers in the face of climate change threats, fishing ground disturbances and fuel access disruptions. This collective action can be achieved by reducing disaster risks and vulnerabilities, empowering fishers to adapt to the challenges they encounter daily.

Policy Recommendations

Echoing the Intergovernmental Panel on Climate Change (IPCC) report of 2018, nations worldwide have a mere ten years to avert extreme climate disasters. However, the Indonesian government faces a more pressing deadline, with just six years remaining until 2030, it must prepare for the imminent impacts of climate change already being felt across the globe. Before this critical deadline arrives, the government must implement effective mitigation measures and adaptation strategies for the marine and fisheries sectors, which will bear the brunt of the impacts. These strategies must be implemented through well-crafted policies that are equitable and support small-scale and traditional fishers.

The recommendations presented in this report include:

1. Reducing disaster risks and disturbances/exposures. This can be achieved by implementing disaster mitigation measures, facilitating fishers participation in insurance programs, enhancing fisher literacy regarding climate information and zoning knowledge, providing protection in fishing grounds, offering assistance in renovating house heights in flood-prone areas, improving accessibility to fuel by ensuring adequate supply and distribution, simplifying access requirements for subsidized fuel and expanding the distribution network through SPBUNs (Fishers' Public Fueling Stations) or other official outlets.

2. Decreasing fisher sensitivity to disasters and disturbances. This can be achieved by facilitating alternative employment opportunities for fishers during non-fishing periods and providing cold storage facilities to preserve the quality and marketability of their catch.

3. Enhancing fisher adaptive capacity. This can be achieved by enhancing fisher knowledge and skills, increasing the value addition of fishery products to boost fisher income, empowering family economies, ensuring fisher ownership of Marine and Fisheries Business Actor Cards (KUSUKA) to enable access to government support, re-registering impoverished fishers for the Family Hope Program (PKH) and providing assistance and revitalizing fishing gear (vessels and fishing tools).

4. Protecting the fishing grounds of small-scale fishers is crucial to minimizing disturbances. Adopting inclusive fisheries management concepts like OECM (other effective conservation measures) safeguards the protection of these grounds, especially those managed through traditional and communal practices that support sustainable fisheries resource utilization.

5. Regular monitoring of fisher vulnerability risks, assessed through climate vulnerability indices, fishing ground vulnerability indices and fuel vulnerability indices, is essential for policymakers to formulate appropriate policies that reduce these risks and improve the livelihoods of fishers in all regions.

Foreword

Greetings for fair and just ocean,

Since its establishment in 2009, the Indonesian Traditional Fishers' Union has played an active role in advocating for and promoting various efforts to protect and empower the rights of small-scale and traditional fishers at the national and even global levels. This is driven by two primary factors: first, the marginalized conditions faced by small-scale and traditional fishers, including coastal women. Second, the crucial role small-scale and traditional fishers play in the economy, employment creation, nutrition security and the marine environment preservation, which cannot be ignored.

At the international level, KNTI, as part of the World Forum of Fisher People (WFFP), played a significant role in establishing the world's first and only international instrument for the protection of small-scale fisheries, namely The Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines), adopted by the FAO in 2014. At the national level, KNTI actively promoted the implementation of the SSF Guidelines by advocating for Law No. 7 of 2016 concerning the Protection and Empowerment of Fishers, Fish Farmers and Salt Farmers. However, the implementation of Law No.7 of 2016 has stalled, failing to keep pace with the dynamic changes on the ground, particularly those driven by natural factors that exacerbate the deterioration of the marine environment and policy changes that lack adequate consideration of fishers' aspirations.

For traditional fishers, the ocean is not just a passageway or a dumping ground; it is their lifeline, their ancestral heritage and the very foundation of their maritime civilization. Yet, these fishers, whose lives are deeply intertwined with the coastal waters, face an increasingly arduous struggle for survival. Their livelihoods are threatened by the illegal exploitation of high-value fish stocks by large-scale fishing vessels, both domestic and foreign. Additionally, coastal fisheries are under mounting pressure due to overcrowding, pollution from land-based sources such as waste and debris, and the conversion of traditional fishing grounds into mining sites, reclamation projects and infrastructure development.

Continuous efforts are required to update, map and more accurately describe the socioeconomic vulnerabilities faced by Indonesia's small-scale and traditional fishers. This is crucial to ensure that policy formulation is grounded in strong evidence and effectively addresses the challenges faced on the ground. The vulnerabilities of fishers are currently exacerbated by a range of factors, including climate change, access to fishing grounds and limited access to production facilities and fuel.

We wholeheartedly endorse the research collaboration between KNTI, EcoNusa and the University of Indonesia's Faculty of Economics and Business. This initiative represents a commendable partnership between a fisher organization, NGO and university, aiming to enhance data availability for informed policymaking that promotes the progress and well-being of Indonesia's small-scale and traditional fishers.

Dani Setiawan
President of KNTI

Foreword

EcoNusa Foundation, also known as Yayasan Ekosistim Nusantara Berkelanjutan, is a non-profit organization dedicated to promoting just and sustainable natural resource management in Indonesia. To achieve its goals, EcoNusa empowers civil society groups, collaborates with communities to develop advocacy, campaign, communication and stakeholder engagement strategies, and foster dialogue among stakeholders to prioritize sustainable natural resource management, upholding principles of equity, conservation and transparency.

Indonesia, the world's largest archipelagic nation, boasts an abundance of marine resources and fisheries potential. This, however, has not translated into equitable distribution of benefits, hindering the realization of self-reliance and resilience. At the grassroots level, 25% or 7.87 million of Indonesia's poor population reside in coastal and small island regions, primarily engaged in fishing. Across Indonesia's 10,743 coastal villages, fishing remains the primary livelihood, with the majority of these communities concentrated in less developed areas.

Efforts to reform fisheries governance and transform the sector to address various challenges remain insufficient, including the lack of adequate social protection for fishers during fishing bans and seasonal fluctuations. Indonesia experiences climate anomalies of varying frequencies, ranging from a month to several months, further impacting fisheries.

Despite the mandate to support fishers under Law No.7 of 2016 on the Protection and Empowerment of Fishers, Fish Farmers and Salt Farmers, which includes providing weather information, infrastructure improvements, gear replacement, safety equipment and fishers' insurance, the implementation of these measures has been slow and inadequate.

Recognizing the strategic importance of small-scale fisheries to Indonesia, EcoNusa Foundation is proud to support collaborative research with KNTI and FEB UI. This initiative aims to strengthen evidence-based policymaking in the fisheries sector through collaborative research. By undertaking this research, we seek to drive transformative policy and program shifts towards more participatory, sustainable, relevant and innovative governance. The research findings presented in this publication are a testament to our commitment to this endeavor.

Bustar Maitar
CEO EcoNusa

Foreword

As a maritime nation, Indonesia's fisheries sector, a crucial component of the agricultural sector, serves as the backbone of the national economy. This sector provides livelihoods for over 2.9 million (2021) fishers across the archipelago. Despite its resilience, demonstrated by its average annual growth rate of 2.7% during the 2020-2022 pandemic, the positive growth trend has not translated into improved well-being for fishers. The high poverty rate among fishers, coupled with the pressing threats of climate change, disruptions to fishing grounds and limited access to fuel, raises concerns about their deteriorating welfare.

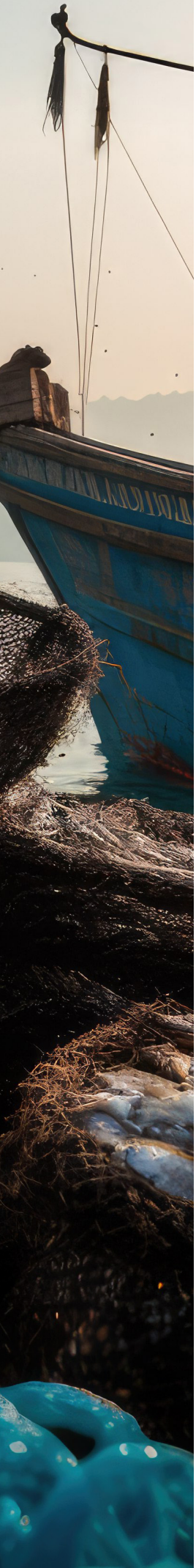
In a joint effort to foster stakeholder collaboration in Indonesia's development transformation process and promote impactful social research, the Faculty of Economics and Business at the University of Indonesia, represented by Dr. Sartika Djamaluddin, SE, MSi, partnered with KNTI (Indonesian Traditional Fishers' Union) and EcoNusa to undertake a collaborative research project. This five-month study, initiated in May 2023, was conducted in four regions: Pemalang Regency, Ambon City, South Aceh Regency and Pangkep Regency. The research involved 236 traditional fishers under KNTI's mentorship.

This research yielded three key findings. First, the study successfully developed a socioeconomic vulnerability index, providing a valuable tool for mapping and comparing vulnerability levels across different regions. Second, the research identified the sources of socioeconomic vulnerability faced by traditional fishers, categorized by the nature of the threats. Finally, the study successfully determined the factors contributing to a fisher's socioeconomic vulnerability. These findings are expected to serve as a foundation for policy recommendations from the government regarding mitigation, management and protection strategies for traditional fishers in the face of climate change threats, disruptions to fishing grounds and limited access to fuel.

We extend our sincere gratitude to KNTI and the EcoNusa Foundation for their invaluable collaboration in this research endeavor. This partnership marks a promising step towards fostering future research initiatives, ensuring a sustained commitment to enhancing the well-being of traditional fishers and contributing to Indonesia's economic development. Together, we can effectively address the nation's challenges and work in synergy to build a thriving Indonesia.

Greetings of synergy,

Teguh Dartanto, Ph.D
Dean of the Faculty of Economics and Business, University of Indonesia



I. Introduction

1.1 Background

Small-scale fisheries hold immense significance as a global livelihood source. According to the Food and Agriculture Organization (FAO), "Small-scale fisheries are traditional fisheries carried out by individual fishers or households, using relatively small amounts of capital and energy; small fishing vessels (if any); fishing for relatively short periods of time; and mostly for local consumption, although some may be for subsistence or commercial purposes." Encompassing the entire value chain, from pre-harvest to post-harvest activities, small-scale fisheries engage both men and women and serve as a vital provider of local food security. However, given the diverse characteristics of small-scale fisheries across the globe, a single definition cannot fully capture the richness and complexity of this sector.[1]

A joint study conducted by the FAO, Duke University and WorldFish in 2021 revealed the substantial contribution of small-scale fisheries to global food production. On average, between 2013 and 2017, small-scale fisheries accounted for 40%, or 37 million tons, of global capture fisheries production, with 31% originating from marine waters and 99% from inland waters. Notably, 94% of the 120 million individuals engaged in fishing activities worldwide are involved in small-scale fisheries. This includes 45 million women actively participating in the global fisheries value chain, representing 40% of the estimated total workforce in small-scale fisheries.

The fisheries sector plays a pivotal role in Indonesia's national economy. According to Statistics of Marine Affairs and Fisheries (2022), the sector's production value experienced a significant positive growth trend between 2016 and 2021, expanding by 8.2%. This remarkable growth rate far outpaced Indonesia's overall GDP growth in 2021 (6.58%) and the growth of other sectors such as food crops (0.82%), horticulture (7.01%), livestock (5.98%), agricultural and hunting services (5.93%), and forestry and logging (5.06%). During this period, the fisheries sector on average contributed approximately 2.66% to Indonesia's GDP. Notably, during the COVID-19 pandemic recovery in 2022, fisheries revenue surged by a remarkable 68% compared to the previous year, generating non-tax state revenue of 1.2 trillion rupiah[2]. Given the vast untapped potential of Indonesia's fisheries resources across various management areas, including the Malacca Strait, Banda Sea, Sulawesi Sea, Arafura Sea and other regions, it is anticipated that the sector's revenue will continue to rise in the coming years.[3]

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[1] https://ssfhub.org/about-ssf-hub/about-small-scale-fisheries

[2] LKPP 2022 dalam Nota Keuangan Buku II

[3] Minister of Marine Affairs and Fisheries Regulation No. 19 of 2022 concerning Estimation of Fish Resource Potential, Permissible Amount of Fish Catch, and Level of Utilisation of Fish Resources in the Fisheries Management Area of the Republic of Indonesia

Amidst the global economic downturn caused by the COVID-19 pandemic, Indonesia's fisheries sector demonstrated remarkable resilience, emerging as a key driver of the national economy. In 2022, the sector provided employment opportunities for an estimated 2.4 million fishers, an increase from 2.3 million in the previous year. Small scale fishers make up a significant portion of Indonesia's fishing fleet, with a dominant 93.6% utilizing vessels under 10 gross tonnage (Ministry of Marine Affairs and Fisheries, Indonesia, 2023). More precisely, 59.2% of these fishers rely on outboard motorboats or non-motorized boats. This dominance of small-scale fishers is crucial for Indonesia's economy, propelling the country to become the world's second-largest producer of wild-caught fish, following China (FAO, 2023).

Small-scale fisheries hold a significant position in the lives of many Indonesian communities, providing sustenance and livelihoods for generations. As noted in studies by Bavinck (2011) and Chuenpagdee (2018), these fisheries represent more than just a means of economic survival. They embody a traditional way of life, deeply intertwined with the management of marine resources. Many small-scale and traditional fishing communities adhere to a principle of "sufficiency" rather than a relentless pursuit of profit maximization. This principle underscores the inherent value placed on preserving fisheries resources and the marine environment for future generations. Small-scale fisheries typically involve individual fishers or families employing traditional or small-scale technologies. These operations often target fish resources managed or co-managed by local communities through customary laws or time-honored traditions passed down through generations.

Rooted in local communities, traditions and values, small-scale fisheries play a vital role in the lives of coastal Indonesians. These fisheries are often operated by individual fishers who provide their families with fresh catch or sell it directly to local traders in markets. Women fishers also hold a significant role in the sector, particularly in post-harvest activities and fish processing. Small-scale fisheries serve as a social and economic engine, ensuring food and nutrition security, creating employment opportunities and generating other livelihoods for coastal communities.

Despite their positive contributions and substantial economic impact, the well-being of small-scale fishers often remains disproportionately low. Their work is not always financially rewarding and often fails to provide an adequate position within the value chain. Confined to coastal areas, their catches tend to decline due to the presence of larger fishing vessels and the deterioration of marine resources. With limited capital investment and assets, small-scale fishers are particularly vulnerable during crises. They often face unfair competition from industrial fisheries in terms of supply chains, refrigeration facilities and market access. Additionally, they are susceptible to exploitation by moneylenders and dominant traders who dictate prices.

The well-being of small-scale fishers in Indonesia remains far from satisfactory, leaving them marginalized and increasingly vulnerable. The low level of prosperity among traditional fishers is evident in the 2020 Indonesia Marine Health Index (IKLI), which assigns low scores (7.27) to five key variables related to traditional fisheries: (1) Employment and Business Opportunities in Capture Fisheries; (2) Employment and Business Opportunities in Aquaculture and Fish Processing; (3) Fishers' Exchange Rate; (4) Fishers' Access to Capital.

Climate crisis poses a significant threat to Indonesia's fishing communities, whose livelihoods are inextricably linked to the delicate balance of marine ecosystems. The unpredictable nature of extreme weather events, coupled with a lack of adequate insurance and safety measures, leaves these communities particularly vulnerable. Studies like Mustika et al. (2023) highlight the alarming economic vulnerability of over half of Indonesian fishing households (61%) due to pervasive impacts of climate change. These impacts include extreme weather patterns, unpredictable seasons, rising sea levels and intense wave surges.

Patriana dan Satria's (2013) research further underscores the disruption caused by climate change to fishing activities. Erratic weather patterns have altered fish migration patterns and disrupted wind seasons, making it challenging for fishers to predict catch seasons, increasing risks at seas and hindering their ability to venture out. In response, some fishers have adapted by venturing into new fishing grounds. Climate change poses a multifaceted threat to Indonesia's fisheries sector. According to Diposaptono et al. (2009), climate change has several detrimental consequences for marine ecosystems, directly affecting fishing communities: First, changes in sea surface temperatures disrupt fish migration patterns, making it challenging for fishers to locate and catch fish. Second, stratification of the water column hinders upwelling processes, which are positively correlated with the presence of fish schools. This, in turn, makes it difficult for fishers to catch fish. Third, changes in fishing grounds. Fourth, the worsening situation for small-scale fishers due to the increased time and cost required for sailing at sea, caused by both fish migration and destruction of fishery habitat and fishing grounds. Meanwhile, the rampant overexploitation of fisheries and the destruction of coastal ecosystems pose serious threats to the sustainability of the fisheries sector.

The FAO report underscores the disproportionate impact of climate change on small-scale fishers, identifying them as the most vulnerable group. Indonesia, the world's second largest archipelago with 17,504 islands, has been significantly affected by climate change. Unfortunately, these real impacts are often met with misguided solutions, leading to new problems. For instance, the proposed construction of massive seawalls raises environmental, social and economic concerns for local fishers.

Climate change, as a tangible threat and vulnerability for fishing communities, has yet to be adequately considered by the government in its strategy development for climate change mitigation and adaptation. The influence of climate change on coastal and marine areas, where fishers reside and work, profoundly impacts their livelihoods. Amidst the challenges of catching fish due to extreme weather events, they are also burdened with raising the foundations of their homes, purchasing clean water and other expenses. These additional burdens have far-reaching social consequences, including an increased household burden on women and spouses, cases of domestic violence and rising crime rates. Furthermore, the social impacts on fishing families extend to children, who may lose their play areas, suffer from malnutrition and experience higher dropout rates due to financial constraints.

Beyond climate change, small-scale fishers grapple with a range of vulnerabilities stemming from environmental changes and development pressures that impact their socioeconomic well-being. These communities face threats such as "ocean grabbing," which involves the conversion of coastal mangroves and natural forests into industrial aquaculture, tourism-driven displacement, and large-scale maritime infrastructure projects, such as artificial islands and land reclamation, often prioritize interests other than those of fishers and their livelihoods.

Existing fisheries management approaches, including fishing gear regulations and access restrictions, have not effectively promoted responsible and sustainable fisheries practices. Efforts to combat illegal fishing have not adequately addressed the root causes of illegal, unregulated and unreported (IUU) fishing. As evident in Fisheries Management Plans, small-scale fisheries lack adequate representation and prioritization in national fisheries management decision-making processes. Traditional knowledge held by local small-scale fishers and indigenous communities remains largely confined to ad-hoc solutions rather than being integrated into holistic, equitable and environmentally conscious fisheries management strategies.

One significant issue is the precariousness of access to fishing resources and the lack of recognition of fisher rights (Jentoft et al., 2022). This situation often leads to the loss of fishing grounds, both in coastal areas and at sea. Meanwhile, basic knowledge of fishing zone is crucial for fishers to avoid horizontal conflicts with fellow fishers over fishing territory. Research by Zulham et al. (2022) indicates that 85% of small-scale fisheries operate in waters beyond 12 nautical miles.

The marginalization of fishers is further exacerbated by limited access to subsidized fuel due to complex procedures, incomplete documentation among fishers, inadequate supply, long distances to Fishers' Fuel Station (SPBNs) and the scarcity of SPBNs themselves. According to a 2021 KNTI survey, over 80% of fishers cannot access subsidized fuel. The primary reasons include a lack of awareness about subsidized fuel (36,2%) and the absence of subsidized fuel vendors (22,2%). Additionally, fishers often find it easier and cheaper to purchase non-subsidized fuel from gas stations and retailers.

Another pressing concern is the suboptimal

social protection provided to small-scale fishers and fisherwomen, particularly during adverse conditions, especially extreme weather events. For fishers, such periods represent lean seasons, lasting from a month to several months. Every year, these challenges occur with varying frequencies and intensities for Indonesian fishers. The implementation of protective measures clearly outlined in Law No. 7 of 2016 concerning the Protection and Empowerment of Fishers, Fish Farmers and Salt Farmers, such as weather information, coastal infrastructure repairs, fishing gear replacement, provision of safety equipment for seafaring and comprehensive fishers insurance, has been ineffective. For instance, the Fishers' Insurance Premium Assistance (BPAN) implemented from 2016 to 2019 only reached 1,198,177 fishers with a total realized insurance claim value of 410 billion rupiah (Ministry of Marine Affairs and Fisheries, 2021). Meanwhile, KNTI's findings (2023) in several regions highlight the slow

processing of insurance claims, including the misallocation of BPAN. This inadequate social protection is particularly concerning given the diverse risks and vulnerabilities, both physical, economic and social, faced by fishers, especially those living in poverty. Social protection is expected to mitigate the risks experienced by the population, preventing prolonged hardship, enhancing the capacity of poor and vulnerable groups to cope with and escape the clutches of poverty and socioeconomic disparities. Fishers aspire to achieve a dignified standard of living, ensuring that poverty is not passed down from one generation to the next (Social Protection in Indonesia, Bappenas, 2014).

The well-being of small-scale fishers in Indonesia has further deteriorated in the face of the COVID-19 pandemic. A rapid survey conducted by KNTI in 24 coastal districts/cities in April 2020 revealed that fishers are among the groups most adversely affected by the spread of the coronavirus in Indonesia. This is due to a decline in public purchasing power for seafood and various restrictions imposed by both local and national governments. A follow-up KNTI survey in June 2020 on the impact of the COVID-19 pandemic on fishers in five regions (Medan, Semarang, Aceh, Gresik and East Lombok), involving 2,700 fishers, found that the government's social assistance was ineffective in reaching eligible fisher recipients. Even for fisher families who received it, the social assistance was only enough to cover less than two weeks of living expenses. The assistance scheme provided by the government clearly fails to provide effective protection and economic recovery.

Within Indonesia's fisheries business ecosystem, another prominent issue is the lack of full recognition of the crucial role of fisherwomen in the fisheries sector. Law No. 7 of 2016 still categorized fisherwomen as "fisher's wives" or part of "fisher households." The low recognition of women's roles in fisheries is also evident in the composition of female recipients of the Fisheries and Marine Business Actor Card (KUSUKA) as of June 2019, which stood at only 7.8%, while males accounted for 92.2%. Despite Article 45 of Law No. 7 of 2016 stating that fisher empowerment activities must consider the involvement and roles of women in fisher households, fish farming households and salt farmer households, fisherwomen play a vital role in creating economic value added for fisher families. According to data from the Ministry of Women's Empowerment and Child Protection (Kemen PPPA) in 2016, out of 6 million workers in post-harvest activities, 61% or around 3.6 million were women. Post-harvest activities include processing and marketing of fishery products. This highlights that the number of female entrepreneurs is higher than that of males. These fisherwomen are involved in the socioeconomic chain of the fisheries sector, from

pre-harvest, harvest, post-harvest (marketing, processing and direct consumption).

In reality, fisherwomen bear a double burden in both household duties and as workers in the fisheries sector. These various problems are driven by a social construct that views only men as fishers and patriarchal views that restrict women's mobility in social activities. In this position, the government needs to consistently promote affirmative action policies for fisherwomen. Their active participation in decision-making processes at all levels of government, from central to village level, should also be encouraged through policy. Other enabling conditions for change that have been identified include strengthening women's awareness of their rights, strengthening organizations and networks and enhancing economic business capacities in production, processing and marketing.

The multiple pressures faced by small-scale fisheries in Indonesia hinder their ability to generate employment opportunities and provide a path to a prosperous livelihood. Small-scale fishers grapple with volatile and uncertain incomes, perishable catches, speculative and high-risk work patterns. These factors limit their bargaining power in sales transactions and hinder their access to capital from formal financial institutions, which demand business and income certainty.

Unsurprisingly, poverty and vulnerability rates among fishers are relatively high. A study by Anna (2019) revealed that in March 2018, over 700,000 individuals were impoverished in the fisheries sector, with self-employed fishers being more vulnerable than those in nearly all other agricultural sectors. Additionally, the study found a high aggregate poverty rate among fisheries workers (11,4%) and a high vulnerability rate among fishers (61,68%). Poverty is further exacerbated by low health standards, an inability to withstand unforeseen financial crises (Sabri & Poh, 2017), and limited asset ownership (According to Sitorus (2004). The high vulnerability of fisher households stems from the lack of livelihood strategies and financial management (Mustika et.al, 2023). Consequently, fishers require better financial management practices to enhance financial security (Jeyarajah, 2016) and increase income to meet daily needs (Sugiharto et al., 2016).

Given the strategic aspects and multifaceted challenges faced by small-scale fisheries, policy innovation is imperative to protect, empower and enable small-scale fisheries and coastal women. Empowered fishers can effectively and proactively contribute to fisheries management. Governance improvements require attention to three key areas: decision-making; institutional arrangements; and articulation of values and principles for sustainable and equitable fisheries management. Several institutions, such as KNTI, EcoNusa and FEB UI, are actively promoting governance reforms and a shift towards more participatory and cooperative approaches in small-scale fisheries, both nationally and internationally. These positive developments must be accompanied by innovative policies and concrete programs.

To address data gaps and inform policy innovation at both national and regional levels, EcoNusa Foundation, Indonesian Traditional Fishers' Union (KNTI) and the Faculty of Economics and Business at the University of Indonesia have undertaken a collaborative research project focused on "Mapping the Socioeconomic Vulnerability of Small-Scale and Traditional Fishers to the Impacts of Climate Change, Access to Subsidized Fuel and Fishing Grounds." This collaborative research aims to contribute to evidence-based policymaking processes.

1.2 Objectives

This study aims to achieve the following objectives:

1. Map and identify the socioeconomic vulnerabilities of small-scale fishers in relation to climate change, access to subsidized fuel and access to fishing grounds. The findings from this mapping will contribute significantly to data refinement, core issue identification and socioeconomic recommendations for small-scale fishers within the framework of sustainable fisheries management, to protect small-scale fishers from various challenges and limitations;

2. Develop actionable policy recommendations that can guide policymakers in crafting fair, equitable and sustainable small-scale fisheries development policies and regulations.

1.3 Socioeconomic Vulnerability

Vulnerability is defined as the extent to which a system, or a part of that system, reacts negatively to a harmful event. This concept of vulnerability implies the existence of physical, social and economic risks that may arise from a harmful event and the system's ability to cope with those risks (Proag, 2014). In the context of society, harmful events or often referred to as external disturbances that cause stress or loss can be experienced by individuals or groups of people (Briguglio et al., 2012, Adger, 1998).

Socioeconomic vulnerability refers to the risk of economic loss or financial loss caused by disasters or disruptions. In the context of fishers, exogenous shocks can stem from disruptions to fishing grounds, climate change, access to fuel and other factors. Measuring community vulnerability generally involves three elements: exposure, sensitivity and adaptive capacity (Senapati and Gupta, 2017, McCarthy JJ, 2001, Moss, R. et al., 2001, Adger et al., 2004, Adger, 1998, Dolan and Walker, 2004, Luers, A.L. et al., 2003, Brenkert, A and E. Malone, 2005, https://serc.carleton.edu).

Figure 1 Socioeconomic Vulnerability Elements

- Exposure refers to the likelihood that individuals or communities, along with their valuable assets, may be subjected to or exposed to hazards. (https://serc.carleton.edu, Cinner et al., 2012). The degree of exposure to disturbances or shocks can be assessed based on the magnitude, frequency and duration of these events (Cinner et al., 2012). Compared to the other dimensions, exposure to disturbances is the component that contributes most significantly to the vulnerability of small-scale fishers (Molina and Frapolli, 2022).

  In Phuong et al., (2023), the exposure variable measures disaster-related losses or damage to infrastructure or assets. However, this study does not specifically examine a particular disaster event and therefore does not measure the losses experienced by fishers. The likelihood of fishers being exposed to external shocks, such as climate change, fishing grounds and fishing intensity, is observed through fishers' behavior or activities.

  The climate change exposure dimension is observed through the fishing intensity variable. The higher the fishing intensity, the more likely fishers are to be exposed to climate change. Fishers can avoid the adverse effects of climate change by limiting or even stopping fishing. Furthermore, the exposure dimension to fishing grounds refers to disruptions that fishers may encounter during fishing activities. This dimension is observed through the variable of the distance fishers travel to their fishing grounds. This variable reflects the fishing grounds managed by fishers. The farther the fishing distance, the greater the likelihood of disruptions. If the managed area is disrupted (e.g., there is interference with fishing gear, large vessels, or waste disposal), the fishing grounds and catches of fishers are also affected. The exposure dimension due to fuel access is observed through the fuel consumption variable. Fishers with high fuel consumption levels are considered to have easy access in terms of economic capacity, affordable prices and infrastructure access. If fuel prices are relatively high, this situation will disrupt fishers' economic capacity, resulting in a relatively low level of consumption affordability (Pindyck, 2018).

- The sensitivity dimension refers to the extent to which fishers can be harmed by exposure or disturbances (https://serc.carleton.edu). In the study by Cinner et al. (2012), these two dimensions are combined with two indicators: a livelihood indicator and a perceived disturbance indicator. The livelihood indicator reflects the economic impact of losses that can disrupt fishers' livelihoods, and the perceived disturbance indicator refers to the presence or absence of indications of shocks perceived by fishers.

  The sensitivity dimension is represented by indicators of economic capacity and family size. The economic capacity indicator is income. The family size indicator is the number of family members dependent on the fisher. The adaptive dimension indicators include individual demographic conditions (Phuong, 2023), physical capital (Chen and Lopez-Carr, 2014) and social capital (Chen and Lopez-Carr, 2015). Social capital refers to the form of cooperation in fishing. In this study, it is represented by the form of an agreement to share the catch. Physical capital is the capital that fishers have to carry out fishing. In this study, physical capital is represented by the ownership of a boat or fishing gear. Demographic conditions are measured by the fisher's age variable.

- Adaptive capacity refers to the extent to which individuals or communities can mitigate potential hazards by taking actions to reduce exposure or sensitivity (https://serc.carleton.edu). Adaptive capacity reflects the ability of fishers to adapt to their environment to reduce the risk of disturbances. Adaptive capacity is positively correlated with access to information, technology, institutional capacity, wealth and finance (Senapati and Gupta, 2017, Shaffril et al., 2016, Dolan and Walker, 2004). In addition, adaptive capacity is also related to political, social and economic conditions (Senapati and Gupta, 2017).

  Socioeconomic factors are viewed as assets that can help fishers strengthen their adaptive capacity and strategies, such as demographic, physical, financial, socio-political and governance assets (Senapati and Gupta, 2017, Ekin and Tapia, 2008, Scoones, 1998). These assets can help households mitigate risks and build viable subsistence and adaptation strategies (Senapati and Gupta, 2017, Maiti et al., 2014). Demographic indicators generally include age, education, number of adults in the household and distance to hospital. Financial resource indicators include total income, savings, loans, fishing expenses, fish sales and government subsidies.

1.4 Research Design

a. Types, Elements and Indicators of Vulnerability Indices

This study develops three types of vulnerability indices based on the source of vulnerability: the climate change vulnerability index (LVI climate), the fishing grounds vulnerability index (LVI fishing grounds) and the fuel access vulnerability index (LVI fuel). The vulnerability indices are constructed following the LVI calculation procedure, where each indicator consists of three elements: exposure element, sensitivity element and adaptive capacity element.

Indeks kerentanan iklim (LVI Iklim)

The climate change vulnerability index specifically observes the exposure element using two indicators: the occurrence of tidal flooding and the land subsidence experienced by fishers. The tidal flooding occurrence indicator is categorical data where 1 if there is no tidal flooding; and 0 otherwise. The land subsidence indicator is 1 if there is no land subsidence; and 0 otherwise.

The sensitivity element is observed through two indicators: the existence of other jobs besides fishing and the existence of cold storage. Both indicators are categorical. The existence of other jobs indicator is 1 if the fisher has another job; and 0 for otherwise. The existence of a cold storage indicator is 1 if the

fisher has cold storage. Fishers who do not have other jobs have a high level of sensitivity to climate change, fishing grounds, or fuel access. Likewise, if the fisher does not have cold storage, the risk of damage to the catch is high. Cold storage is a cooling room to maintain the quality of fish and other catches. Cold storage allows fishers to store and maintain the quality of their catches until they get a buyer who pays a better price. If there is a climate disruption where fishers cannot go to sea, they still have a reserve catch in cold storage to sell.

The adaptive capacity element refers to the extent to which fishers are able to cope with potential hazards. Table 1 shows that the adaptation indicators are assumed to be the same for all indices. Fisher's adaptive capacity indicators include government program assistance (PKH, KUSUKA and BPJS program), ownership of production equipment, productive age, education and fisher's income. The greater the adaptive capacity, the lower the vulnerability index. The PKH indicator is assigned a value of 1 if a fisher receives the program's benefits, and 0 otherwise. Similarly, the KUSUKA indicator is 1 for fishers possessing a KUSUKA card and 0 for those who do not. The BPJS score is assigned as follows: 0 for no BPJS coverage, 1 for BPJS with government-subsidized premiums and 2 for BPJS coverage with self-paid premiums. The other indicators are the number of boats owned by the fisher (units), years of education completed, income (average per month) and age (years). The adaptive capacity element in this index is the same as the adaptive capacity element in the climate change vulnerability index.

Fishing grounds vulnerability index (LVI Fishing Grounds)

The fishing grounds vulnerability index specifically observes the exposure element using an indicator of the presence or absence of disruptions experienced by fishers in their fishing activities. The types of disruptions often faced by fishers include fishing gear disruptions, disruptions from large ships and waste disruption. The disruption occurrence indicator is 1 if there is no disruption in the fishing grounds and 0 otherwise. The sensitivity element is reflected by indicators of the existence of other jobs besides fishing, the existence of cold storage and the intensity of fishing or the intensity of trips to fishing grounds. Fishers who have a high frequency of fishing trips (within 1 month) tend to be more sensitive to disruptions in the fishing grounds.

Table 1 Elements and Indicators of Vulnerability Index

Elements	Climate change vulnerability index	Fishing grounds vulnerability index	Fuel access vulnerability index
	Indicators and Sub-Indicators		
Disaster Exposure	1. Occurrence of rob 2. Occurrence of land subsidence	Fishing grounds disruptions	Fuel Affordability
Sensitivity	1. Ada tidaknya penghasilan selain nelayan 2. Ketersedian *Cold Storage*	1. Existence of other jobs besides fishing 2. Cold storage availability 3. Fishing frequency	1. Existence of other jobs besides fishing 2. Cold storage availability 3. Fuel consumption
Adaptive Capacity	1. Government programs. Sub-indicators: PKH Program, KUSUKA Program and BPJS (3) 2. Average income 3. Education level 4. Number of vessels 5. Age		

Fuel access vulnerability index (LVI BBM)

The exposure to fuel access disruptions is assessed using the fuel accessibility indicator. This indicator is assigned a value of 1 if fishers have access to fuel and 0 otherwise. The sensitivity component of the index measures the magnitude of negative impacts experienced by fishers due to climate change, fishing ground disruptions and fuel access disruptions. The higher the fishers' reliance on these factors, the greater the potential damage they may experience. When disruptions or disasters occur due to climate change, fishing grounds, or fuel access, fishers with high sensitivity are more vulnerable. The sensitivity of fishers to exposure factors is reflected in the index by indicators such as the presence of alternative livelihoods, the availability of cold storage and the average monthly fuel consumption. Fishers with high fuel consumption are considered more sensitive to fuel access disruptions.

b. Constructing the Vulnerability Index (LVI)

Vulnerability mapping of areas is based on the livelihood vulnerability index (LVI-livelihood vulnerability index). This index is widely used in vulnerability studies related to climate change (Phuong et.al, 2023, Raihan and Hossain, 2021, Chen and Lopez-Carr, 2014). Vulnerability measurement follows the IPCC (Intergovernmental Panel on Climate Change) framework developed by Hahn et al., 2019. The LVI-IPCC index ranges from -1 to 1. A value of –1 indicates no vulnerability, while a value of 1 indicates high vulnerability. Values closer to 1 suggest that fishers are increasingly vulnerable.

The construction of the index begins with the standardization of all indicators to ensure they fall within a range of 0 to 1. Different indicators have different units of measurement, necessitating this normalization. As shown in Table 2, each vulnerability index comprises a total of 10 indicators. The climate vulnerability index is subdivided into two indicators for exposure to disaster, two for sensitivity and six for adaptive capacity, for a total of 10 indicators. The fishing ground and fuel access vulnerability indices each have one indicator in the exposure to disaster component, three in the sensitivity component and six in the adaptive capacity component, for a total of 10 indicators for the areas vulnerability index and 10 indicators for the fuel access vulnerability index. The calculation of the index follows the formula as shown below:

$$\text{Indeks}_{sh} = \frac{S_h - S_{min}}{S_{max} - S_{min}}$$

Index_{sh} is the value of the index for indicator s for fisher h. S_{max} and S_{min} are the maximum and minimum values of the total sampling indicators. h represents the 1, 2, …h fisher.

The next step involves calculating the average indicator index for each component i. M_{ih} represents the average index for fisher h on component i. The number of indicators in each component is denoted by n. Components i include exposure to disaster (e), sensitivity (s) and adaptive capacity (a). The formula for the average index is as follows:

$$M_{ih} = \frac{\sum_{1}^{n} Indeks_{sh}}{n}$$

The next step involves calculating the contribution of each component to the overall index. Specifically, the contributions of the exposure to disaster (e), sensitivity (s) and adaptive capacity (a). CF_{ih} represents the contribution of component i for fisher h. The weight value w_{ih} for each component i is obtained by summing the values of all indicators within that component.

$$CF_{ih} = \frac{\sum_{1}^{n} w_{ih} \,.\, M_{ih}}{\sum_{1}^{n} w_{ih}}$$

The final step involves calculating the vulnerability index k or LVI_k where k = 1, 2, 3. LVI_1 represents the climate vulnerability index, LVI_2 represents the fishing ground vulnerability index and LVI_3 represents the fuel access vulnerability index. The LVI_k is calculated by subtracting the contribution of the adaptive capacity component (CFa) from the contribution of the disaster exposure element (CFe) and multiplying it by the contribution of the sensitivity element (CFs) for each fisher h. The calculation follows the formula below:

$$LVI_k = (CFe_{kh} - CFa_{kh}) \times CFs_{kh}$$

where CFe_h is the contribution of the disaster exposure component (e) to index k of fisher h, CFs_h is the contribution of the sensitivity component (s) to the index k of fisher h, CFa_h is the contribution of the adaptive capacity component (a) to index k of fisher h.

1.5 Research Location, Data and Time

This study encompasses a comprehensive mapping of fisheries issues in four locations across Indonesia: South Aceh (Aceh), Pemalang (Central Java), Pangkep (South Sulawesi) and Ambon (Maluku). These locations were carefully selected to represent the diverse fisheries and marine environments of Western, Central and Eastern Indonesia. The purposive selection of these sites considered several factors to address potential limitations in access, time and cost. These factors included representation across time zones, the presence of KNTI and the presence of EcoNusa regional offices.

The selection of research locations was further guided by the recognition that the challenges faced by fishers vary significantly across Indonesia. The nature of the challenges is shaped by a complex interplay of factors, including the specific location, the prevailing socio-cultural conditions and values, the historical relationship with nearby fisheries resources and the existing social structures. Small-scale fisheries, in particular, exhibit a remarkable diversity in terms of fishing gear, target species, vessels, fishing grounds, market orientation and other aspects. This diversity is reflected in the distinct threats faced by different fishers communities, each employing unique coping mechanisms to navigate these challenges.

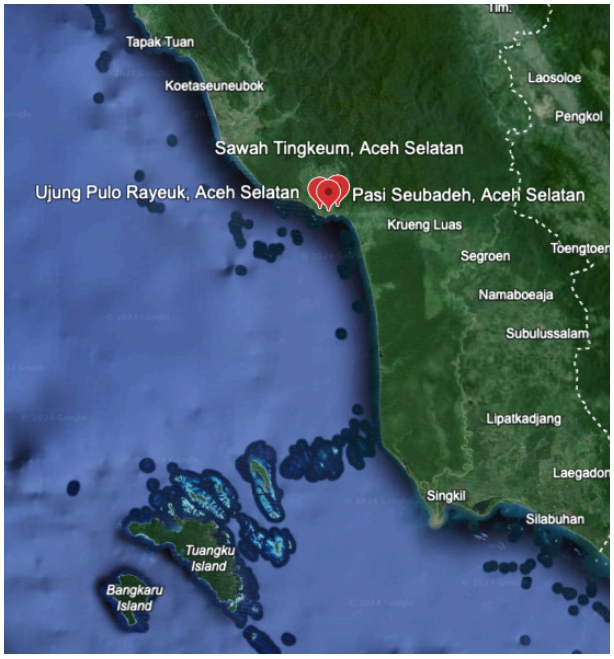
Figure 2 illustrates the residential locations of the fishers respondents in this study. Fishers in South Aceh Regency reside near the coast bordering the Indian Ocean, those in Pemalang Regency live near the coast bordering the Java Sea, those in Pangkep Regency reside near the coast bordering the Makassar Strait and those in Ambon City live near the coast bordering the Ambon Strait. The selection of these locations was carefully considered to ensure representation across Eastern, Western and Central Indonesia. The data utilized in this study comprises both primary and secondary sources.

Primary data was gathered through structured surveys or interviews utilizing questionnaires and focus group discussions (FGD) with 236 respondents. The survey involved 67 respondents from Ambon, 70 respondents from Pemalang, 50 respondents from South Aceh and 49 respondents from Pangkep. In Ambon City, surveys were conducted in Negeri Laha (40 respondents) and Negeri Latulahat (27 respondents). In Pemalang City, the survey was conducted in Desa Danarsari. In South Aceh Regency, surveys were conducted in Desa Sawah Tingkeum (15 respondents), Desa Ujong Pulo Rayeuk (20 respondents) and Desa Seubadeh (15 respondents). In Pangkep Regency, the survey was conducted in Desa Bulu Cindea (25 respondents) and Desa Pudata Baji (24 respondents).

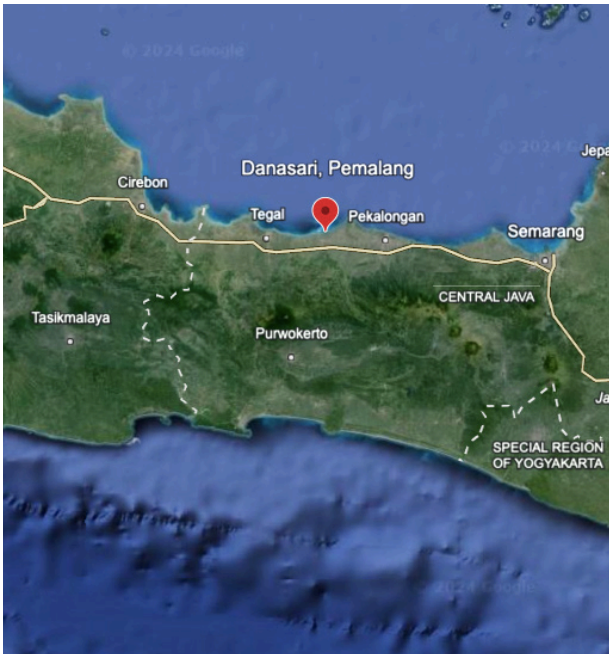
Surveys and FGDs were conducted between May and July 2023. The questionnaire-based interviews included seven blocks of questions addressing economic vulnerability, social vulnerability, fishing grounds, access to fuel, climate change and fishers' adaptation capacity over four months (January-April 2023). The FGDs involved representative fisher respondents to further explore and confirm the initial findings

from the interviews. The research manuscript was subsequently subjected to expert review by invited reviewers in December 2023 and revisions were incorporated in January-February 2024. The reviewers included Prof. Dr. Ir. Rilus A Kinseng, MA (IPB), Mohammad Faisal, Ph. D (Core Indonesia) and Dr. Umi Muawanah (BRIN).

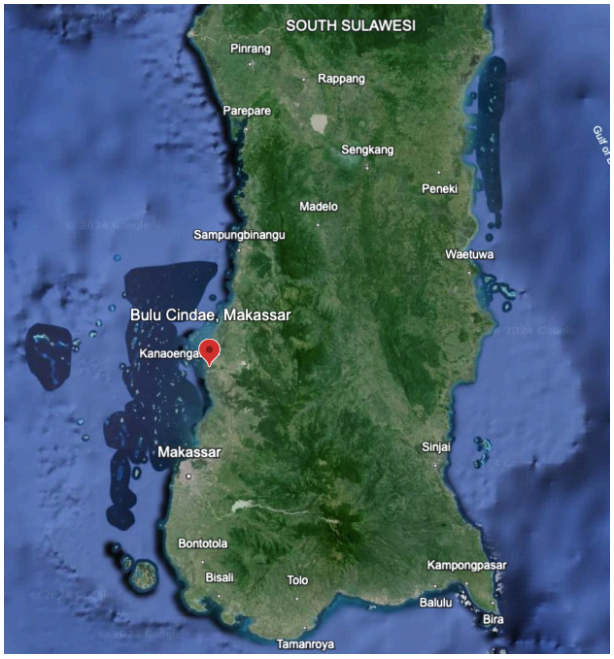
Figure 2 Research Location Map



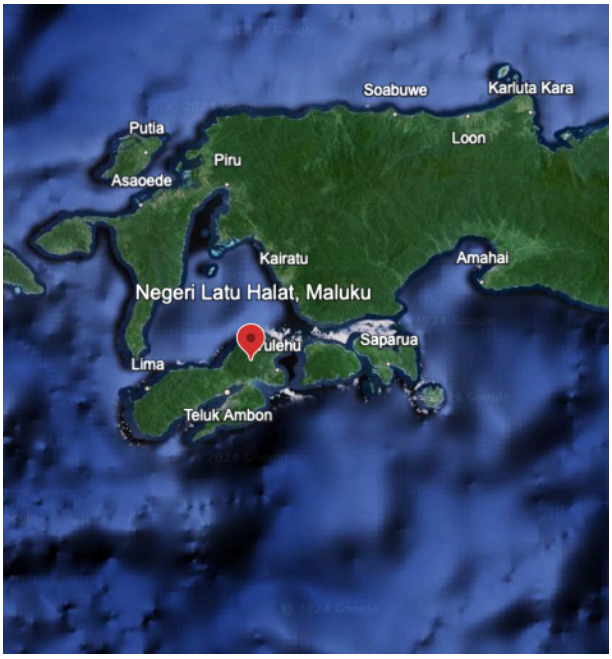
South Aceh



Pemalang



Pangkep



Ambon

II. Discussion of Research Findings

2.1 Fishers Profile

- **Productive Age, Low Education**

A total of 236 fishers participated in this study, with an average age of above 41 years. The majority (50.85%) of respondents completed their education at the elementary school level (SD), while 18.64% of fishers did not complete elementary school. The low level of education among fishers is suspected to be one of the causes of low job mobility across sectors. A significant portion (80%) of fishers lack alternative sources of income beyond fishing. This high dependence on a single income stream makes them particularly vulnerable to economic fluctuations, especially when faced with challenges like climate change, changes in fishing grounds, or limited access to fuel, all of which can hinder their ability to fish and earn a living.

- **Low income, big burdens**

The majority of traditional fisher respondents in the study come from low-income families. This is reflected by the fact that 62.29% of fishers receive assistance under the Family Hope Program (PKH) and 56.36% of fishers receiving BPJS Kesehatan (national health insurance) benefits hold the status of Premium Assistance Recipients (PBI), indicating their low-income status. While the majority of fishers have BPJS, 27.12% remain uninsured. This highlights their relative vulnerability to health risk. Furthermore, fishers face a significant economic burden. A substantial 70% of fishers have families with more than four members. Family members are often involved in supporting fishing activities, such as repairing damaged nets or with fisher wives engaging in fish processing or other businesses. In contrast, only 30% of fishers have relatively smaller families with less than four members.

The majority of fishers, or 71.58%, are the sole breadwinners in their families. Average fishers earnings vary across regions. The average earnings for four months (January - April 2023) in Ambon City are 4.3 million rupiah, and 2.5 million rupiah in Pemalang, exceeding the minimum wages in their respective cities (Ambon minimum wage 2.8 million rupiah and Pemalang minimum wage 2.081 million rupiah). Meanwhile, the average fisher earnings for four months in South Aceh reach 3.056 million rupiah, lower than the South Aceh minimum wage of 3.413 million rupiah per month. In Pangkep Regency, fisher earnings

average 3.443 million rupiah, falling below the Pangkep minimum wage of 3.467 million rupiah per month. The income of fishers in South Aceh and Pangkep is relatively low as it is below the minimum wage per month. The combination of single-income households and low earnings makes fishers more vulnerable to economic hardships, especially during climate change events, disruptions to fishing grounds or difficulties accessing fuel that prevent them from going out to sea.

- **Adequate income and marketability of catch**

Overall, a majority of 65.68% of fishers are able to meet their daily needs. In detail, 49% of Ambon fishers and 42% of South Aceh fishers cannot meet their daily needs. Regarding the marketability of fish catches, although more than 50% of catches are sold in each region, namely Ambon City (89.55%), Pemalang Regency (98.57%), South Aceh Regency (100%) and Pangkep Regency (83.67%), there are still a number of fishers who do not sell more than 50% of their catches, namely in Ambon City (1.49%) and Pangkep Regency (6.12%). There are also fishers in each region who only sell 50% of their catches, namely Ambon City (8.96%), Pemalang Regency (1.43%) and Pangkep Regency (10.20%). This marketability of catches is suspected to be related to the fishing purpose. In Ambon City (88%) and South Aceh Regency (56%), the main fishing purpose for most fishers is for consumption and sale. While in Pemalang Regency (98.57%) and Pangkep Regency (59.18%), the main purpose is for sale.

- **Weak health protection and higher occupational risks**

. While most fishers have BPJS, there remains a group of fishers with relatively high health vulnerability, namely those who do not have BPJS health insurance (27,12%). In addition to health risks, most fishers face significant risks in carrying out their profession. A majority (77.12%) do not have fisher insurance and 13.56% have inactive insurance due to unpaid premiums. Only 5% have self-paid insurance and 4.24% have insurance with premiums paid by the government.

- **Lack of fisher protection**

Beyond health risks, fishers face significant occupational hazards in their line of work. A significant proportion (77.12%) of fishers lack fisher insurance and 13.56% have inactive insurance due to unpaid premiums. Only a small percentage of fishers (5%) have self-paid insurance and another 4.24% have insurance with premiums paid by the government.

- **Control over means of production, fishing patterns and wage systems**

Most fishers own their work tools. The majority of fishers own their fishing vessels (77.54%), granting them control over the means of production. This ownership empowers them to make independent decisions about fishing patterns, gear selection, the number of days spent at sea and the specific fishing grounds they target. However, a significant portion (18.22%) work as hired labor, lacking ownership

of vessels and facing greater vulnerability due to limited control over their work conditions and a smaller share of the profits.

Most fishing practices are short-term (97%), with nets (41,95%), lines and hooks (38%) and traps (10%), arad/hela (6.78%) and hand-cast net and towed net (2.1%) contribute to the diverse fishing practices. Profit-sharing is the dominant wage system. Over half of the fishers (51.16%) receive a 50% share of the profits, while the remaining share percentages vary, with 23.25% receiving 30%, 6.9% receiving 40% share and 2.32% receiving 25%.

- **Economic motivations, high catch absorption and short-term fishing patterns**

Fishing activities are primarily driven by economic motivations, with fishers seeking to generate income through the sale of their catch. This is evident in the fact that a majority (53.81%) of fishers sell their catch entirely, while a smaller portion (1.69%) consumes their catch for personal use. Additionally, 44.49% of fishers engage in a mixed approach, selling a portion of their catch and consuming the rest. Contributing to their market success is the high quality of the fish caught by Indonesian fishers. This quality is evident in the high market absorption rate, with 93.22% of the catch being readily absorbed by the market. The maintenance of fish quality is largely attributed to the availability of adequate fish cold storage facilities for 56.78% of fishers. However, for 41.95% of fishers lacking access to cold storage,preserving the freshness of their catch can be challenging. To further ensure fish quality, a majority of fishers employ short-term fishing patterns. This approach is evident in the fact that 45% of fishers engage in fishing trips lasting less than half a day, while 52% fish for a full day.

- **Asset ownership, limited banking access**

While an impressive 86.6% of fishers own their own vehicles and 83% own their own homes, a significant portion lack these resources (12.71% without vehicles and 16.10% without homes). The absence of vehicles hinders their ability to transport their catch and can restrict their market reach. Owning assets can provide a valuable financial safety net for fishers, offering a means to address financial needs during difficult times. Fishers face significant challenges in accessing formal financial services, particularly banking institutions. Only 30.51% of fishers have access to banking services, while 14.53% have access to non-banking services. Limited access to banking institutions can constrain fishers' ability to secure credit and other financial support from the formal banking sector. Despite that, there are indications that non-bank services are emerging as an alternative source of financial support for fishers. Many fishers rely on informal lending arrangements with non-bank entities, such as boat owners or fishmongers. These informal relationships often involve social ties.

- **A promising future for the fisheries and marine sector**

The fisheries and marine sector remains a promising and lucrative livelihood for fishers. This is evident from the respondents' job statuses as indicated on their National Identification Card (KTP), where the majority (89%) identify as fishers. This is further emphasized by the fact that within this group, a significant portion 70.7% relies solely on fishing as their primary profession, with no other recorded occupation. The Indonesian government has demonstrated its commitment to supporting the fisheries and marine sector through the issuance of the KUSUKA Card. This card serves as an official identification for individuals engaged in marine and fisheries businesses. Recognizing the sector's significance, the government has established KUSUKA as a comprehensive database and platform for interventions aimed at supporting fishers. However, the low adoption rate, with only 47% of fishers possessing a KUSUKA Card, raises significant concerns. This means that over half (more than 50%) of the fishing community risk being excluded from crucial government programs and support initiatives.

- **Low zoning knowledge**

Fishers face a significant challenge due to their extremely low knowledge of catch zone zoning regulation. Only 5% of fishers demonstrate awareness of these regulations. This widespread lack of understanding likely contributes to frequent violations. Notably, 99% of fishers operate in Fishing Lane III (beyond 12 nautical miles) without the required fishing permits. The lack of zoning knowledge among fishers compels them to venture into industrial and fish breeding zones. This unauthorized entry into industrial zones, which are highly susceptible to the presence of large vessels, poses a significant threat to the safety of fishers. Moreover, the intrusion of fishers into breeding zones disrupts the delicate process of fish reproduction.

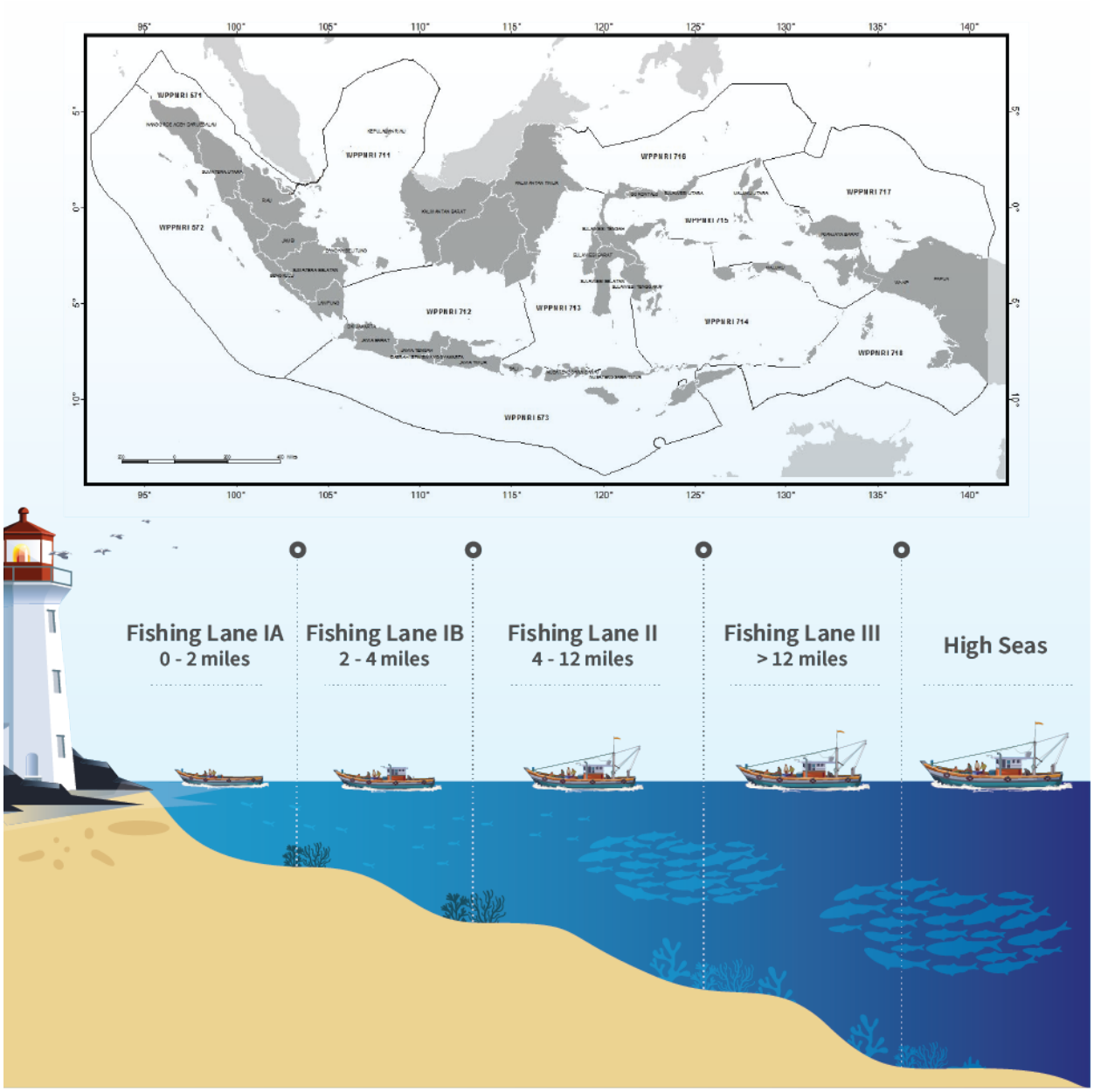
- **Threats of climate change**

Fishers are experiencing the impacts of climate change firsthand in the form of land subsidence and tidal floods. A survey revealed that 37% of fishers reported experiencing land subsidence, while 32% reported tidal floods. Land subsidence was most prevalent in Pemalang Regency (77%) and South Aceh Regency (23%). No reports of land subsidence have been received from Ambon City or Pangkep Regency. Meanwhile, tidal floods were most commonly reported in Pemalang Regency (89%), followed by Ambon City (3%) and Pangkep Regency (8%).

- **High incidence of fishing ground disruption**

Fishers reported various incidents of fishing ground disruption in January 2023 across all fishing zones. These disruptions were caused primarily by fishing gear interference. Fishing Lane II was the most affected, with 54.76% of fishers reporting disruptions due to this issue. Currently, the most common disruptions involve large vessels, primarily occurring in Fishing Lane II and III. Waste-related disruption was only reported by fishers operating in Fishing Lane III. Fishing Lane II and III are characterized by bustling fishing activities, but they also experience the most fishing ground disruptions. The highest average catch per month is recorded in Fishing Lane II (551.59 kg), followed by Fishing Lane III (251.71 kg) and Fishing Lane I (239.31 kg).

Figure 3 Fishing Lanes in the WPP NRI Waters and High Seas



Source: Minister of Marine Affairs and Fisheries Regulation No. 18 of 2021 concerning Placement of Fishing Equipment and Fishing Aids in the Fisheries Management Area of the Republic of Indonesia and the High Seas and Arrangement of Fishing Andon.

Minister of Marine Affairs and Fisheries Regulation No. 18 of 2021 concerning Placement of Fishing Equipment and Fishing Aids in the Fisheries Management Area of the Republic of Indonesia and the High Seas and Arrangement of Fishing Andon establishes fishing lanes and fishing gear. Article 3 stipulates that the Fisheries Management Area includes: (1) Fishing Lane I, consisting of Lane IA covering 0-2 nautical miles and Lane IB covering 2-4 nautical miles; (2) Fishing Lane II covering Fishing Lane I up to 0-12 nautical miles; and, (3) Fishing Lane III covering the waters of Fishing Lane I and II, including the Exclusive Economic Zone (see Graphic).

Table 2 Vulnerability Index

Vulnerability Index	Average Value	Standard Deviation	Minimum Value	Maximum Value	Number of Fisher	Number of Vulnerable Fisher*
Climate	0.039	0.088	-0.246	0.647	236	54% (0,09)
Fishing Ground	0.079	0.233	-0.413	0.604	236	60% (0,25)
Fuel Access	0.1539	0.153	-0.2721	0.607	231	77% (0,22)

*Index value above 0, source: survey (processed)

- **High demand for subsidized fuel, but limited supply**

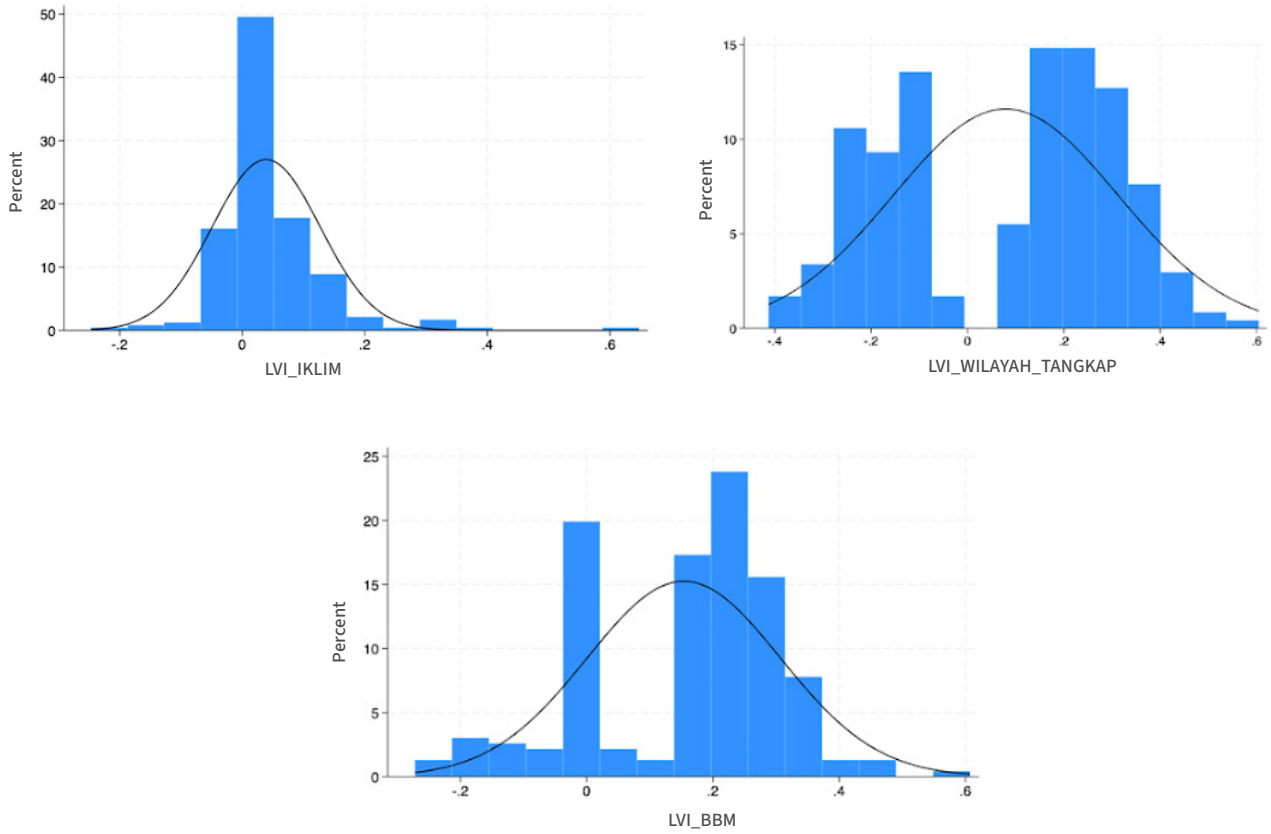
Fishers face a high demand for fuel for their fishing activities. This is evident in the average fuel consumption of respondent fishers over a four-month period. The highest consumption is from subsidized fuel, at 695.7 liters per month, compared to 551.45 liters per month for non-subsidized fuel. However, most users perceive the supply of subsidized fuel to be relatively limited compared to non-subsidized fuel. In contrast, the majority of non-subsidized fuel users (86.29%) claim the supply is sufficient. Users of both types of fuel also generally consider the supply is sufficient. Regarding affordability, most fishers indicate that both subsidized and non-subsidized fuels are affordable. However, a significantly larger portion (29%) cannot afford non-subsidized fuel compared to those who cannot afford subsidized fuel (17.65%). A crucial finding from this research is the mismatch between fishers' high demand for subsidized fuel and the ease of access. This is evident in the fact that a majority of subsidized fuel (69.44%) require approximately 16 days to complete the paperwork for the subsidy.

2.2 Fishers Vulnerability Index

Fishers are vulnerable to climate change, fishing ground disruption and fuel access. The results of calculating the three vulnerability indices show that most fishers tend to be more vulnerable to climate change, fishing ground disruption and fuel access. Table 2 shows that the average index is greater than 0, which means that fishers on average tend to be more vulnerable to these factors. The greatest source of vulnerability comes from fuel access, followed by fishing ground disruption and climate change.

More than 54% of fishers are vulnerable to climate change with an average vulnerability score of 0.09. Meanwhile, around 60% of fishers are vulnerable to disturbances in fishing grounds with an average vulnerability index of 0.25. Another finding is that more than 70% of fishers are vulnerable to access to fuel with an average vulnerability index of 0.22. Although less than 50% of fishers fall into the not or less vulnerable category, the standard deviation shows that the difference in vulnerability between fishers is relatively small. This means that there are quite a number of fishers whose vulnerability levels tend to be close to the average or tend to be vulnerable. Figure 4 shows that overall, the level of climate vulnerability of fishers tend to move to the right (vulnerable). There are even fishers with vulnerability levels reaching almost 0.6.

Figure 4 Distribution of Vulnerability Index

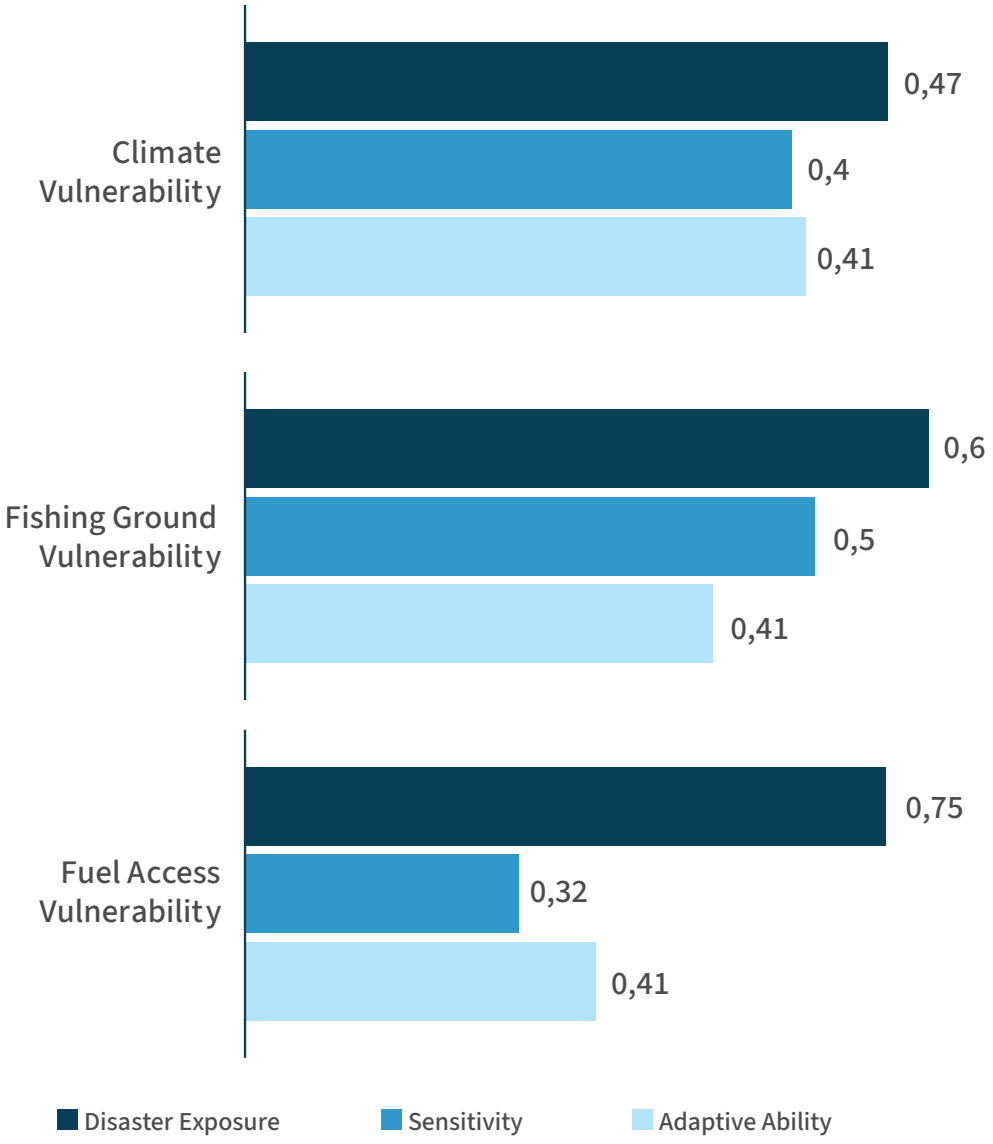


The same is shown by the distribution of the fuel vulnerability index, where most fishers have a vulnerability index above 0 or are relatively more vulnerable to fuel access. The distribution of the fishing ground vulnerability index is relatively more even. This means that the number of fishers facing high-risk and low-risk fishing ground disturbances is relatively the same.

- **The high vulnerability is caused by the high exposure to disasters and the sensitivity of fishers compared to their adaptive capacity**

Figure 5 explains the factors that contribute to the high vulnerability of fishers. In the climate vulnerability index, the contribution of exposure to disasters (0.47) and sensitivity (0.4) is relatively higher than the contribution of adaptive capacity (0.41). The same is true for the fishing area index, where the average contribution of exposure to disasters (0.6) and sensitivity (0.5) far exceeds the adaptive capacity of fishers (0,41). In the fuel access index, the sensitivity of fishers is relatively low (0.32), but because the contribution of exposure to disasters is twice (0.75) of adaptive capacity (0.41), the vulnerability tends to be higher.

Figure 5 Elements of the Vulnerability Index



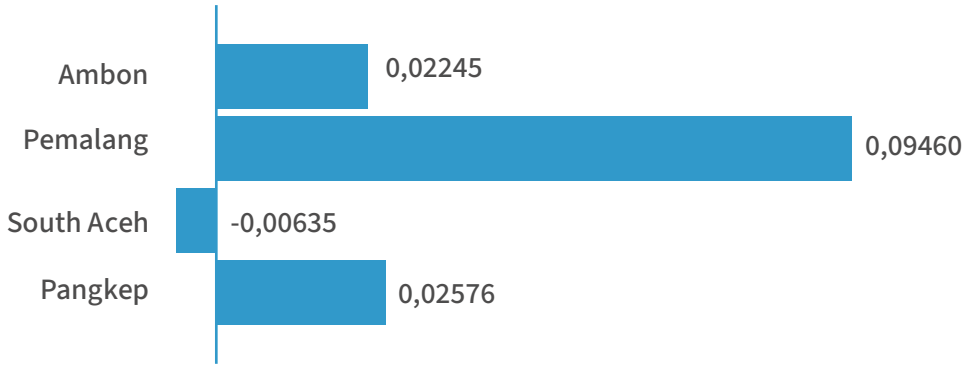
Source: Survey (processed)

Figure 6 shows a comparison of fishers' vulnerability between cities and districts. Ambon City grapples most with disruptions to fishing grounds (0.02245) and fuel access (0.2145). In contrast, Pemalang Regency's fishers are more susceptible to climate change (0.0946) alongside fuel access issues (0.267). South Aceh Regency and Pangkep Regency stand out with the highest vulnerability indices for both fishing ground disturbances and fuel access. These findings underline the urgent need to address fuel availability for fishers in all areas.

Figure 6 Vulnerability Index by Region

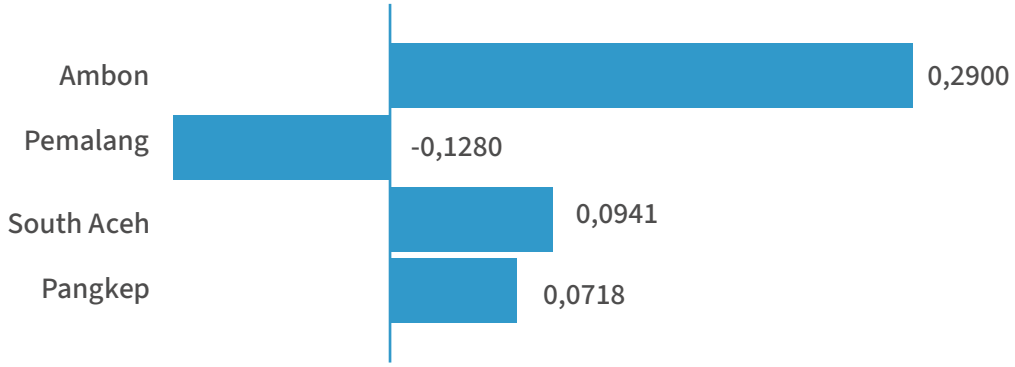
6 (a)

Climate Vulnerability



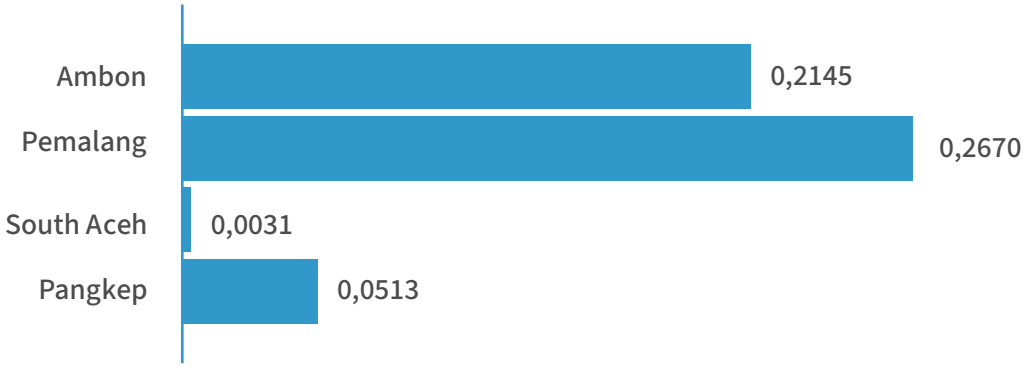
6 (b)

Fishing ground vulnerability



6 (c)

Fuel access vulnerability



Source: Survey (processed)

Climate Vulnerability

Climate vulnerability refers to the risk of losses that fishers may experience as a result of climate change, such as land subsidence and flooding, taking into account the level of sensitivity and adaptive capacity of fishers.

- **Pemalang Regency fishers face the highest climate vulnerability**

Figure 6 reveals that Pemalang Regency has the highest climate vulnerability index (0.136). This indicates a high level of exposure to disasters and the sensitivity of fishers' adaptive capacity. Exposure to climate disturbances in Pemalang Regency is quite high, with the highest frequency of flooding and land subsidence (77%). Similarly, the sensitivity level of fishers in Pemalang Regency is relatively higher. While cold storage facilities are available, most fishers (93%) rely solely on fishing as their only source of income. Thus, when climate change prevents them from going to sea, fishers cannot earn a living and will lose their income. Several factors contribute to the lower adaptive capacity of fishers in Pemalang Regency. These include high poverty levels, limited education, an older demographic, and a significant proportion (29%) of part-time or borrowed-equipment workers. Additionally, a substantial number of fishers (21%) lack KUSUKA Cards. Survey results further support this: 51% of fishers qualify for poverty assistance (PKH), 36% have not completed elementary school (the highest percentage compared to other regions), and the average age of fishers (47%) is higher than in other regions.

- **The lack of climate information tends to increase climate vulnerability**

Anticipation of extreme climate change can be achieved if fishers have sufficient climate information. However, the results of the survey show that most fishers do not receive climate information. Sixty-seven percent (67%) of fishers in Pemalang Regency and 82% of fishers in Pangkep Regency reported that climate information is not available. Climate information allows fishers to adjust their fishing patterns and times to be safe. The results of the survey show that fishing patterns in most areas last for one day. However, there are 10% of fishers in Pemalang Regency who fish for more than one day. The impacts of climate change in the form of land subsidence and tidal floods are widely felt by fishers in Pemalang Regency (97%).

- **Fishers facing high climate vulnerability are more likely to be unable to meet their basic needs**

Fishers facing high climate vulnerability are more likely to be unable to meet their basic needs. Fishers whose income is insufficient to meet their basic needs tend to have a higher level of climate vulnerability. Table 3 shows that fishers in Pemalang Regency whose income is insufficient tend to have a higher vulnerability index (0.1277) compared to fishers whose income is sufficient (0.0848). The same is true in Pangkep Regency, where the vulnerability index of fishers whose income is insufficient tends to be higher (0.0659) compared to those with sufficient income (0.01412).

Tabel 3 Average Climate Vulnerability Index Based on Income Adequacy in Pemalang and Pangkep Regencies

Income Adequacy	Pemalang Regency	Pangkep Regency
Adequate	0.0848	0.01412
Inadequate	0.1277	0.0659
Number of Respondents	70	49

Source: Survey (processed)

A uniform linear relationship between climate change risk and fishers' ability to meet their livelihood needs has not been found across all study areas. Risk levels tend to vary. Data shows that the majority of fishers who are able to meet their livelihood needs in Ambon City (62%) and South Aceh Regency (90%) are categorized as not vulnerable to climate change risk. Conversely, in Pemalang Regency (96%) and Pangkep Regency (61%), fishers who are able to meet their livelihood needs are actually vulnerable to climate change. For fishers who are vulnerable to climate change, it is certainly necessary to be aware of the risk of reduced ability to meet their livelihood needs if there is extreme climate change that prevents fishers from going to sea.

- **Climate vulnerability tends to be higher for working fishers**

Working fishers who work using other people's fishing gear, don't own a boat and don't rent one, are generally more susceptible to climate change risks. Table 4 shows that fishers in Pemalang Regency who lack boat ownership tend to be more vulnerable to climate change (average climate vulnerability index above 0.13). The same pattern is observed in Pangkep Regency, where the average climate vulnerability index for fishers without boat is lower (0.0371) compared to those who don't own a boat (0.02475). Working fishers who rely solely on fishing for their livelihood (79%) and lack boat ownership face significant difficulties adjusting their fishing patterns, times and frequencies in the face of climate change threats.

Tabel 4 Average Climate Vulnerability Index Based on Boat Ownership in Pemalang and Pangkep Regencies

Boat Ownership	Pemalang Regency	Pangkep Regency
Own	0.0788	0.02475
Not owned	0.1309	0.0371
Not owned or rent	0.1429	-
Number of respondents	70	49

Source: Survey (processed)

- **Many fishers lack awareness of the importance of insurance in mitigating risk**

Data indicates the majority of fishers in Pemalang Regency (79%) and Pangkep Regency (69%) are uninsured. The relationship between insurance ownership and climate vulnerability can be positive. Ownership of insurance by fishers reflects the high potential risks they may face. Data indicates that fishers with insurance tend to have a higher vulnerability level (0.0204) than those without insurance (0.0126). Another possible relationship is a negative one in which the presence of insurance can

reduce the potential vulnerability that fishers may face. The more insurance fishers have, the lower the risk they face. Table 5 shows that in Pemalang Regency, fishers with insurance tend to have lower vulnerability or low risk (0.1).

Tabel 5 Average Climate Vulnerability Index Based on Insurance Ownership in Pemalang and Pangkep Regencies

Insurance Ownership	Pemalang Regency	Pangkep Regency
Have, pay premiums myself	-	0.0204
Have, do not pay premiums	0.0643	0.086
None	0.1076	0.0126
Number of respondents	70	49

Source: Survey (processed)

- **Fishing Ground Vulnerability**

Fishing ground vulnerability refers to the risk of losses that fishers may experience as a result of disruptions in their fishing grounds, taking into account the level of sensitivity and adaptive capacity of fishers. Disruptions to fishing grounds can arise from the use of destructive fishing gear, the presence of large vessels or the dumping of waste.

- **Fishing ground vulnerability is higher in Ambon City**

Table 6 (b) shows that the fishing ground vulnerability index for Ambon City reaches 0.29. This high figure is mainly caused by the relatively higher level of disaster exposure and fisher sensitivity compared to their adaptive capacity. Although the exposure to disasters from fishing gear disturbances is relatively small (1.5%), most fishers in Ambon City fish in Fishing Lane III (82%), which is at risk of disturbance from large vessels or waste disposal. Meanwhile, in terms of sensitivity, fishers in Ambon City tend to be relatively high, where most fishers (99%) do not have other jobs or only depend on fishing for their

livelihood. Furthermore, the fishing intensity of fishers in Ambon City is relatively the highest, with an average of 22 times per month. On a positive note, most fishers (96%) have access to sufficient cold storage facilities. However, the adaptive capacity of fishers in Ambon City is low. This is likely due to several factors, including the lack of assistance and protection based on KUSUKA ownership. Data shows that 97% of fishers lack KUSUKA, and over 25% are classified as poor and receive PKH assistance. Despite the challenges, the average age of fishers in Ambon City (above 41 years old) suggests a productive workforce. Additionally, education attainment is relatively good, with most fishers having completed elementary education (66%) and secondary education (31%). Boat ownership is not universal among fishers. Only 79% own their boats, with 10% working as hired labor for other fishers and another 10% relying on renting boats.

- **Fishers in Ambon City face high vulnerability across all fishing zones**

Analyzing vulnerability in relation to fishing zones, there is a tendency for fisher vulnerability to increase with increasing distance from the shoreline. Table 6 shows that the farther the fishing zone is from the shoreline, the higher the fisher vulnerability tends to be. In Ambon City, the fishers with the highest average vulnerability (0.3523) operate in Fishing Lane II. Meanwhile, in South Aceh Regency, the fishers with the highest vulnerability (0.1306) operate in Fishing Lane III.

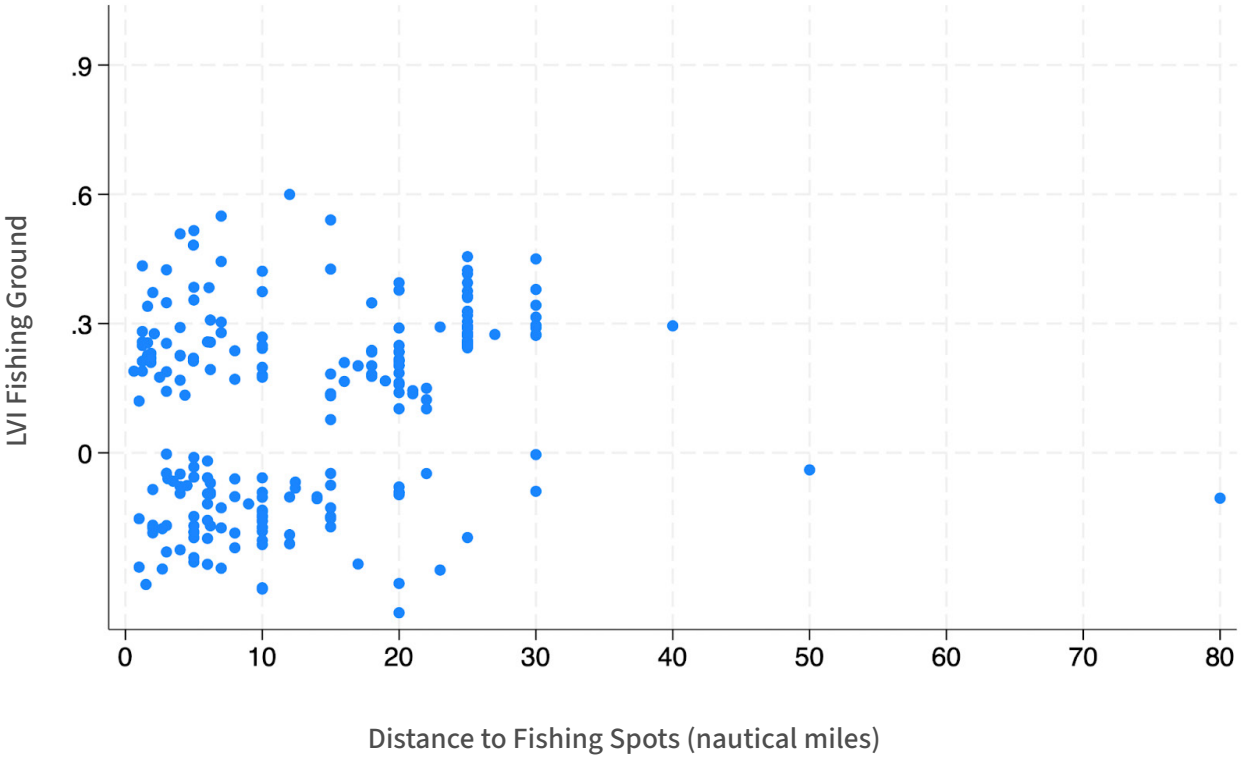
Table 6 Average Vulnerability Index of Fishing Zones in Ambon City and South Aceh Regency

Fishing Zone	Ambon City	South Aceh Regency
Fishing Lane 1	0.3156	-0.0332
Fishing Lane 2	0.3523	0.101526
Fishing Lane 3	0.278	0.1306
Number of respondents	67	50

Source: Survey (processed)

Most fishers with relatively higher vulnerability levels operate in Fishing Lane II and III[4]. In Ambon City, 15% of fishers operate in Fishing Lane II and 82% operate in Fishing Lane III. Similarly in South Aceh Regency, 24% of fishers operate in Fishing Lane II and 58% operate in Fishing Lane III. Figure 5 supports the findings above, demonstrating a tendency for the vulnerability index to increase with increasing distance traveled by fishers.

Figure 7 Vulnerability Index of Fishing Lanes and Distance to Fishing Points



- **Fishers facing high fishing ground vulnerability are more likely to be unable to meet their basic needs**

Fishers whose income is insufficient to meet their basic needs tend to have a higher level of climate vulnerability. Table 9 shows that Ambon City fishers with insufficient income tend to have a higher vulnerability index (0.285) compared to fishers with sufficient income (0.295).

[4] Fishing Lane I is less than 4 miles from the coastline, Fishing Lane II is 4-12 miles from the coastline, and Fishing Lane III is more than 12 miles from the coastline

Tabel 7 Average Vulnerability Index of Fishing Grounds Based on Income Sufficiency in Ambon City

Income Sufficiency	Fishing ground vulnerability index
Sufficient	0,295
Insufficient	0,285
Number of Respondents	67

Source: Survey (processed)

- **Fishers without zoning knowledge are more likely to be vulnerable**

Zoning knowledge in the Fisheries Management Area (WPP) includes fishing zones for commercial operators, local fisher zones and fish spawning and breeding zones. Fishers without zoning knowledge tend to have a higher level of vulnerability. Table 8 shows the vulnerability level of fishing grounds for fishers without zoning knowledge in Ambon City to be 0.29 and in South Aceh Regency to be 0.096.

Table 8 Average Fishing Ground Vulnerability Index Based on Zoning Knowledge in Ambon City and South Aceh Regency

Zoning Knowledge	Ambon City	South Aceh Regency
Has knowledge	0.246	0.0871
Does not have knowledge	0.290	0.096
Number of Respondents	67	50

Source: Survey (processed)

- **No correlation exists between primary fishing gear usage and vulnerability**

Despite similar primary fishing gear usage (87%) using fishing rods in Ambon City and 58% in South Aceh Regency), no correlation has been found between the vulnerability level of fishing grounds and the type of fishing gear used. In Ambon City, fishers using nets tend to have a higher vulnerability level (0.361) compared to fishers using fishing rods. The opposite occurs in South Aceh Regency, where the vulnerability level of fishers is relatively higher (0.131) for those using fishing rods.

- **Fishers without fishing permits are more vulnerable**

Table 9 indicates that the vulnerability level of fishing grounds tends to be higher for fishers without fishing permits. In Ambon City, the vulnerability level for those without fishing permits is 0.29, compared to 0.246 for fishers with permits. In South Aceh Regency, all fishers lack fishing permits, with an average vulnerability index of 0.094. Vulnerability indices greater than 0 (zero) fall into the relatively high vulnerability category. Despite this, according to Article 27(5) of Law No. 45 of 2009, small-scale fishers do not require a fishing permit (SIPI) for their fishing activities.

Table 9 Average Vulnerability Index of Fishing Grounds Based on Fishing Permits in Ambon City and South Aceh Regency

Fishing Permit Ownership	Ambon City	South Aceh Regency
Yes	0.246	-
No	0.29	0.094
Number of Respondents	67	50

Source: Survey (processed)

- **Fuel Access Vulnerability**

Fuel access vulnerability refers to the potential risk of losses that fishers may experience due to the accessibility or inaccessibility of fuel, considering the sensitivity level and adaptive capacity of fishers.

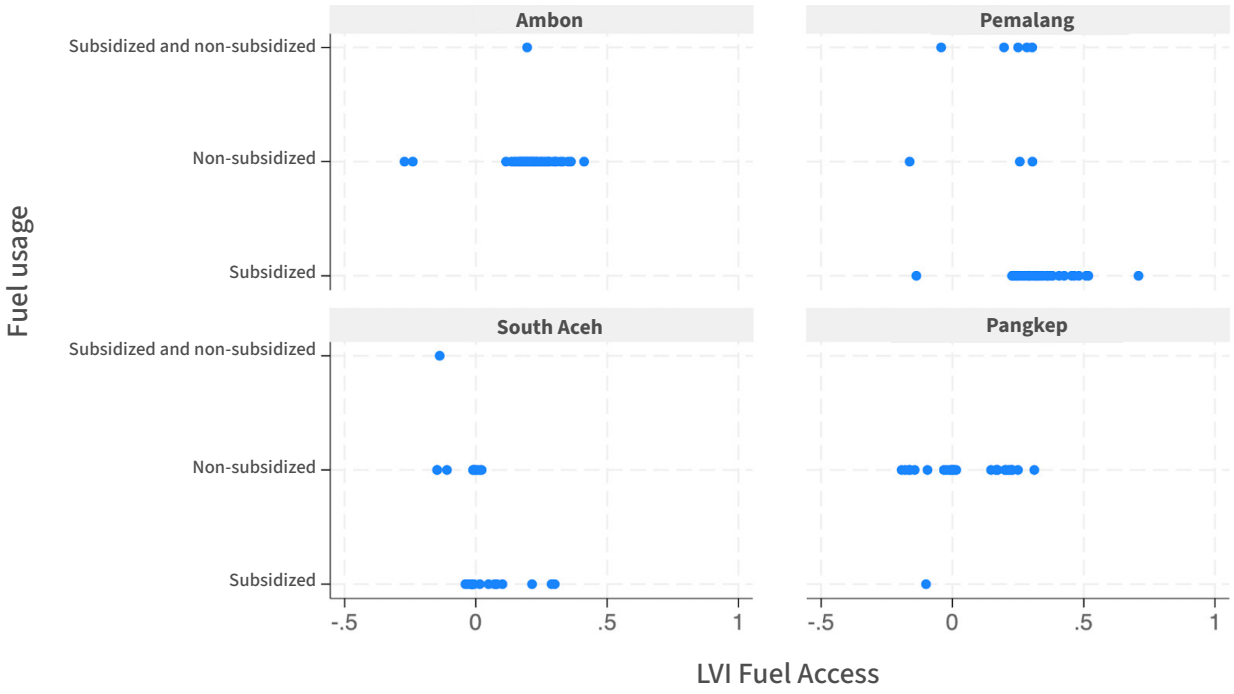
- **Fishers in Pemalang Regency face the highest fuel access vulnerability**

Figure 6 (c) reveals that the fuel access vulnerability index for Pemalang Regency stands at 0.267, the highest among the surveyed areas. This vulnerability stems from a combination of factors. Pemalang's fishers experience higher exposure to disasters and have greater sensitivity to fuel issues compared to their ability to adapt. While most fishers (97%) can purchase fuel, consistent supply is a major challenge. Pemalang has the highest reported rate of inadequate fuel supply (81%) compared to other regions. Additionally, 93% of Pemalang's fishers lack alternative income sources, making them highly reliant on fishing. Cold storage access isn't a concern, with 100% of fishers reporting sufficient facilities. However, fuel consumption is high, averaging 549 liters per person per month (around 18 liters per day), which makes them especially vulnerable to supply disruptions. Pemalang's fishers also exhibit a low adaptive capacity, likely due to several factors: high poverty rates (51% receive PKH), low education levels (36% haven't completed elementary education), an older average age (47% compared to other regions), a lack of KUSUKA certificates (21%), a significant proportion of fishing laborers (29%) and limited boat ownership (only 70% own their vessels).

- **Fuel access vulnerability affects all fuel types**

As Figure 8 illustrates, while there's no direct correlation between vulnerability and fuel type (subsidized or non-subsidized), both categories are affected. In Ambon City, fishers relying solely on non-subsidized fuel appear more vulnerable compared to those using both options. In contrast, Pemalang Regency fishers who use subsidized fuel tend to experience higher vulnerability.

Figure 8 Fuel Access Vulnerability Index and Fuel Type by Region

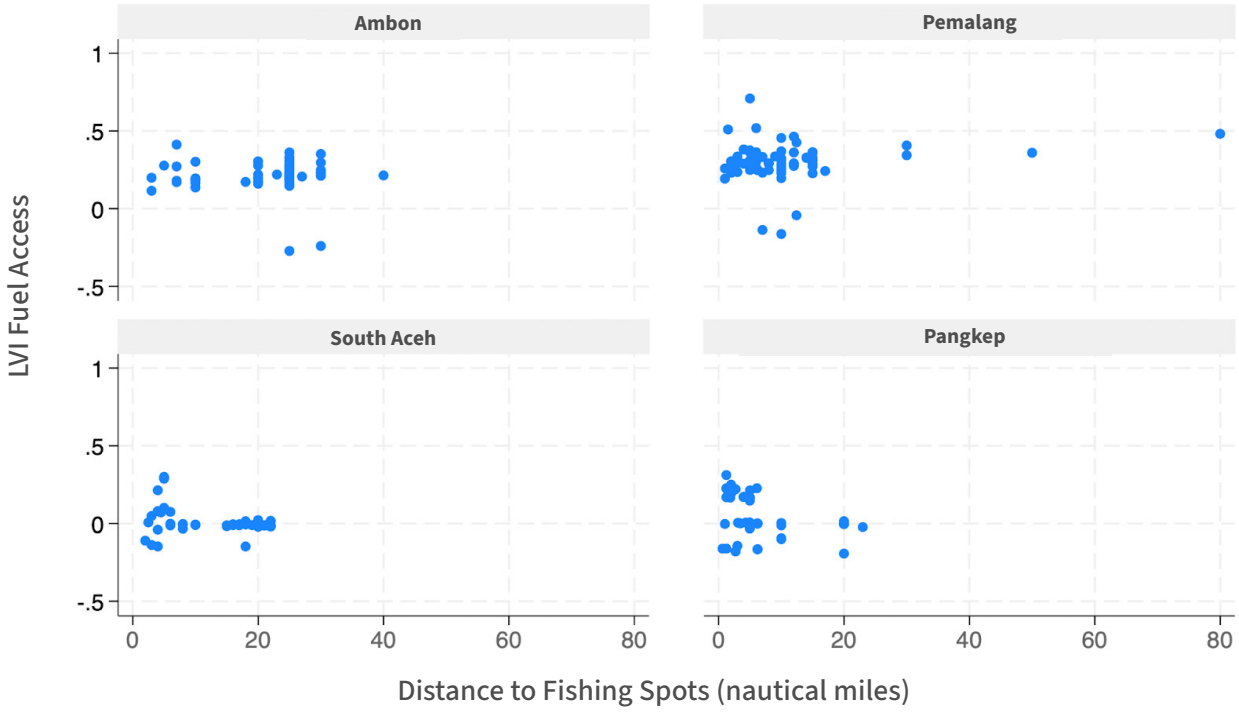


Source: Survey (processed)

- **Fuel access vulnerability linked to fishing distance**

A clear link exists between fuel access vulnerability and fishing distance, according to Figure 9. The data shows that vulnerability increases as fishing distance grows. This correlation is likely due to the higher fuel consumption required for longer fishing trips. As a result, fishers operating at a greater distance become more susceptible to disruptions in fuel supply.

Figure 9 Fuel Access Vulnerability Index and Fishing Distance



Source: Survey (processed)

- **Fishers facing fuel supply shortages are more vulnerable to fuel access challenges**

In Ambon City, document processing time for subsidized fuel isn't a major concern since most fishers rely on non-subsidized fuel. The primary challenge lies in the availability of fuel itself at Fishers' Public Fueling Station (SPBUN). Research findings presented in Table 10 corroborate this. The average fuel vulnerability level is demonstrably higher (0.223) among fishers experiencing fuel supply shortages compared to those whose needs are met (0.213). A similar pattern emerges in Pemalang Regency, where fishers facing fuel shortages are more vulnerable (0.28) than those with sufficient supply (0.21). Despite these variations, the overall fuel vulnerability index remains above 0 (zero), indicating that all fishers are susceptible to fuel access challenges, even those who perceive the current supply as adequate.

Table 10 Average Fuel Access Vulnerability Index Based on Fuel Supply Adequacy in Ambon City and Pemalang Regency

Fuel Supply	Ambon City	Pemalang Regency
Adequate	0.213	0.21
Insufficient	0.223	0.28
Number of Respondents	67	70

Source: Survey (processed)

- **Fuel access vulnerability linked to lower incomes for fishers**

Limited access to fuel, due to either supply constraints or high prices, could lead to decreased earnings for small-scale fishers. Consequently, these fishers may face difficulty meeting their basic needs. Table 11 presents findings from Pemalang Regency, where fishers with a slightly higher vulnerability index (0.27) tend to have lower incomes (0.264). The difference between these two groups is noticeable, but not substantial. A similar pattern emerges in Ambon City, where both groups - those with sufficient income (0.22) and those with insufficient income (0.2) - exhibit high fuel vulnerability.

Table 11 Average Fuel Access Vulnerability Index Based on Income Adequacy in Ambon City and Pemalang Regency

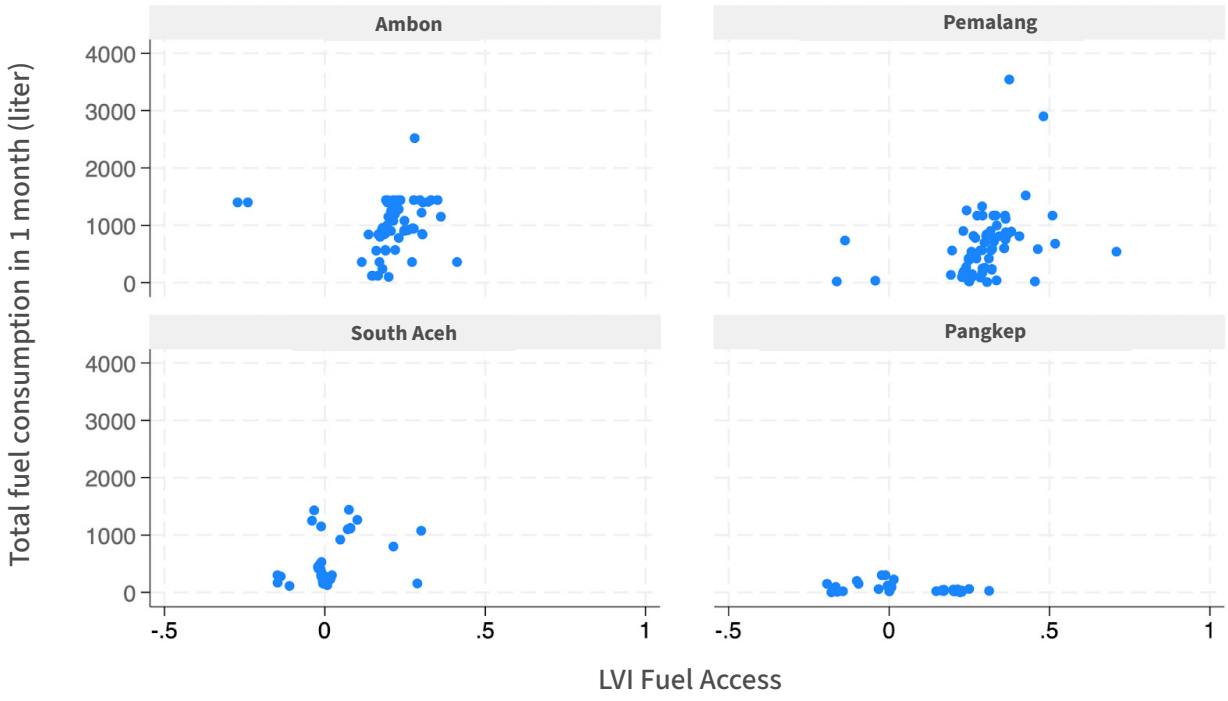
Income Adequacy	Ambon City	Pemalang Regency
Adequate	0.22	0.264
Insufficient	0.20	0.27
Number of Respondents	67	70

Source: Survey (processed)

- **High fuel consumption makes fishers more vulnerable**

Fishing activities that heavily rely on fuel make fishers more susceptible to disruptions in fuel access. High fuel consumption reflects a high level of dependence. Figure 10 shows the relationship between fuel access vulnerability and fuel consumption (month/liter). In general, across all regions, the higher the fuel consumption, the greater the fuel access vulnerability.

Figure 10 Fuel Access Vulnerability Index and Average Fuel Consumption (Month/Liter)



Source: Survey (processed)

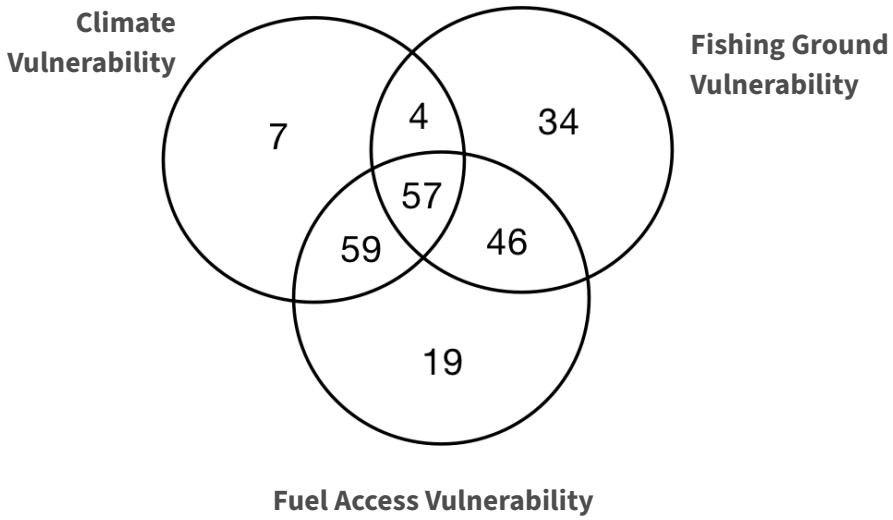
- **Multiple vulnerability**

As described earlier, the lives of small-scale fishers face a multitude of challenges. These challenges, or sources of disruption, surround and constrain their livelihood. This study analyzed three sources of vulnerability for fishers: climate vulnerability, fishing ground vulnerability and fuel access vulnerability. The data suggests that fishers are highly likely to experience multiple vulnerabilities. This phenomenon is referred to as "multiple vulnerabilities." The sheer number of disruptions faced by fishers indicates the severity of their overall vulnerability. Fishers confronting all three sources of disruptions tend to experience a higher level of vulnerability compared to those facing two or one disruption.

- **Fuel access vulnerability is a major issue across all regions**

Fuel access presents a significant challenge for fishers in all studied regions. Compared to other areas, Pemalang Regency, Ambon City and Pangkep Regency exhibit the highest vulnerability in obtaining subsidized fuel. While all regions grapple with fuel access issues, the specific challenges differ. In Pemalang Regency, the primary concern is access to subsidized fuel, used by 88% of fishers. Conversely, most fishers in Ambon City and Pangkep regency face difficulties acquiring non-subsidized fuel. Despite variations in fuel types across regions, some fishers in all areas rely on retailers instead of SPBUNs for fuel acquisition. Findings from FGD interviews with fishers suggest that purchasing fuel from retailers is generally more convenient due to the closer proximity. However, there is a risk that retailer fuel prices may be higher than those at SPBUNs.

Figure 11 Number of Fishers with Multiple Vulnerabilities



- **Multiple vulnerabilities threaten fishers**

The study reveals that a significant portion of fishers face multiple vulnerabilities. The accumulation of these vulnerabilities intensifies the risks they confront. The greater the number of vulnerabilities encountered, the greater the socioeconomic pressure experienced by fishers. Figure 11 illustrates that 24% (57 individuals) of fishers are vulnerable to climate risks, fishing ground disruptions and fuel access constraints. Among those surveyed, 49% (116 individuals) are susceptible to both climate risks and fuel access issues, while 44% (103 individuals) are vulnerable to fishing ground disruptions and fuel access constraints. Additionally, 26% (61 individuals) are susceptible to climate risks and fishing ground disruptions.

- **Ambon City fishers face the highest rates of multiple vulnerabilities**

As shown in Table 12, compared to other regions, Ambon City has the highest percentage of fishers facing three types of vulnerabilities (70%). By comparison, 16% come from Pangkep Regency, 12% from Pemalang Regency and 2% from South Aceh Regency. Pemalang Regency has the most fishers experiencing both climate vulnerability and fuel access vulnerability (53%). This is followed by Ambon City (36%), Pangkep Regency (10%) and South Aceh Regency (1%). When it comes to climate vulnerability and fishing ground disruption vulnerability, Ambon City again has the highest proportion of affected fishers (61%), followed by Pangkep Regency (21%), Pemalang Regency (11%) and South Aceh Regency (2%). For fishing ground disruption vulnerability and fuel access vulnerability, Ambon City maintains the highest prevalence (61%), followed by Pangkep Regency (21%), South Aceh Regency (11%) and Pemalang Regency (7%).

Table 12 Percentage of Fishers with Multiple Vulnerabilities by Region

Region	Multiple Vulnerability			
	Climate, Fishing Ground & Fuel Access	Climate and Fuel Access	Climate and Fishing Ground	Fishing Ground and Fuel Access
Ambon City	48%	23%	43%	61%
Pemalang Regency	13%	57%	12%	7%
South Aceh Regency	4%	2%	4%	11%
Pangkep Regency	35%	18%	41%	21%
Number of Respondents	**52 fishers**	**114 fishers**	**58 fishers**	**103 fishers**

Source: Survey (processed)

Data in Table 13 reveals the concerning socioeconomic conditions faced by vulnerable fishers. Most lack alternative employment opportunities to support their families, which average five members. The economic pressure is often high due to the prevalence of single-earner households in the fishing community. Limited job mobility further complicates the situation, as many fishers are over 41 years old and have low levels of education (primarily elementary education graduates, with some not completing elementary school). Reflecting these challenges, fishing remains the primary occupation listed on the identity cards of 89% of these fishers, and most own only one vessel for fishing activities.

Tabel 13 Socioeconomic Conditions of Fishers with Multiple Vulnerabilities

Characteristics	Multiple Vulnerability			
	Climate, Fishing Ground, Fuel Access	Climate and Fuel Access	Climate and Fishing Ground	Fuel Access and Fishing Ground
Average age	43 years	44 years	43 years	41 years
Average household size	5 persons	5 persons	5 persons	5 persons
Elementary School graduates (majority)	49%	53%	49%	50%
No other work besides fishing	79%	84%	74%	76%
PKH Recepients	49%	51%	48%	32%
BPJS PBI Recipients No BPJS	32% 58%	53% 40%	33% 57%	33% 40%
No KUSUKA	77%	49%	77%	81%
1 vessel 2 vessels 0 vessel	30% 67% 4%	27% 70% 3%	28% 69% 3%	24% 74% 2%
Single-Income Households	79%	75%	74%	76%
Number of Respondents	57 fishers	116 fishers	61 fishers	103 fishers

Source: Survey (processed)

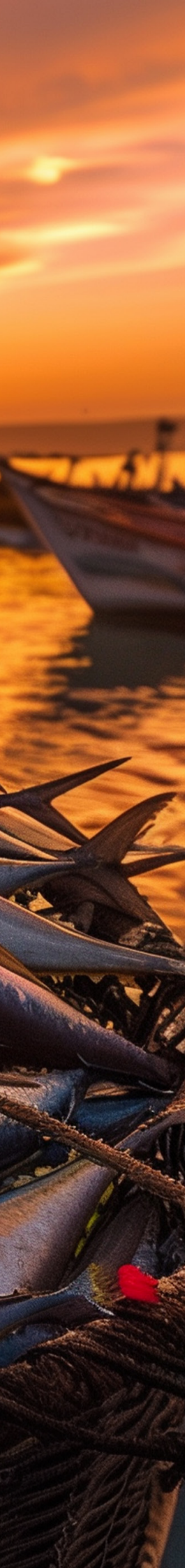
The vulnerability of fishers is further exacerbated by the high health risks they face. Table 13 shows that more than 40% of fishers lack BPJS health insurance. This lack of coverage significantly increases their vulnerability. Limited income and heavy family financial burdens push many vulnerable fishers into poverty. A significant portion rely on government assistance programs such as the PKH and BPJS premium subsidies. Furthermore, a large number of fishers lack KUSUKA cards, which grant access to government protection and empowerment programs for those involved in the marine and fisheries sectors. The absence of both health insurance and KUSUKA cards leaves these fishers at risk of falling through the cracks of the social safety net.

Info Box. Cold Storage

The need for cold storage or cooling rooms to maintain fish quality varies across regions. Several factors contribute to this, including relatively small catch, immediate economic needs and a preference for not selling all fish at once. Fishers often prioritize sales to prepare for their next fishing trip.

Fishers typically store their catch in basic styrofoam coolers before direct transport to middlemen. These intermediaries facilitate sales and guarantee a market, albeit at a slightly lower price than potential direct sales. However, this approach eliminates transportation costs and the risk of unsold inventory.

In regions with plentiful fish catches, cold storage facilities become crucial. These facilities preserve fish quality, enabling premium pricing. The benefits are particularly evident during bad weather when fishing is impossible. By storing fish in cold rooms, fishers maintain a steady supply and income, even when unable to go out to sea.



III. Conclusions, Recommendations and Limitations

3.1 Conclusions

An analysis of compiled indices, including vulnerability, climate vulnerability, fishing grounds and fuel access, yields several key findings.

1. Small-scale fishers are particularly vulnerable due to climate change, fishing ground disruptions and challenges in accessing fuel. The heightened vulnerability of these fishers stems from the disproportionate impact of disasters and their reduced adaptive capacity compared to their larger-scale counterparts.

2. Fuel access disruptions are identified as the primary source of vulnerability for fishers. Limited supply and uneven distribution hinder the availability of subsidized fuel, with Pemalang Regency being the most affected region. Fishers facing these challenges often struggle to meet their basic needs and may resort to using subsidized or non-subsidized fuel, venturing further from the coastline, experiencing fuel shortages and ultimately failing to meet their livelihood needs, which can lead to high fuel consumption rates.

3. The second source of vulnerability stems from disruptions to fishing grounds. The distance of fishing routes correlates with the potential for encountering disruptions, with reports of fishing gear interference concentrated along Fishing Lane II and III. Ambon City bears the brunt of these disruptions. Fishers facing such challenges often struggle to meet their basic needs and may resort to fishing farther from the coastline, primarily in Fishing Lane II and Fishing Lane III. This behavior can be attributed to a lack of awareness of zoning regulations and, in some cases, operating without proper fishing permits.

4. The third source of vulnerability stems from climate change-induced disruptions, including tidal flooding and land subsidence in coastal areas. Pemalang Regency faces heightened vulnerability to these climate-related phenomena. Fishers impacted by climate change often struggle to meet their basic needs, lacking both insurance protection and boat ownership. Additionally, limited access to climate information further hinders their ability to prepare and adapt.

5. Multiple vulnerabilities are a common challenge for fishers, reflecting the overall seriousness of their situation. Those facing more sources of disruption tend to experience a heightened level of vulnerability compared to their counterparts with fewer disruptions. The regions experiencing the highest severity of vulnerability are, in descending order, Ambon City, Pangkep Regency, Pemalang Regency and South Aceh Regency.

6. Fishers with a high level of vulnerability are predominantly characterized by low educational attainment, a high burden of family economic responsibilities, being the sole source of income for their households, limited alternative employment opportunities beyond fishing, living in poverty-stricken households, lack of health insurance, absence of a KUSUKA card and reliance on a single vessel for fishing activities, which are frequently disrupted by breakdowns.

3.2 Recommendations

Echoing the Intergovernmental Panel on Climate Change (IPCC) report of 2018, nations worldwide have a mere ten years to avert extreme climate disasters. However, the Indonesian government faces a more pressing deadline, with just six years remaining until 2030, it must prepare for the imminent impacts of climate change already being felt across the globe. Before this critical deadline arrives, the government must implement effective mitigation measures and adaptation strategies for the marine and fisheries sectors, which will bear the brunt of the impacts. These strategies must be implemented through well-crafted policies that are equitable and support small-scale and traditional fishers

The study's findings highlight the critical need for collaboration among all stakeholders and policymakers. Their focus should be on enhancing and strengthening the resilience of fishers in the face of climate change threats, fishing ground disruptions and fuel access challenges. This can be achieved by:

1. Reducing disaster risks and disturbances/exposures. This can be achieved by implementing disaster mitigation measures, facilitating fishers participation in insurance programs, enhancing fisher literacy regarding climate information and zoning knowledge, providing protection in fishing grounds, offering assistance in renovating house heights in flood-prone areas, improving accessibility to fuel by ensuring adequate supply and distribution, simplifying access requirements for subsidized fuel and expanding the distribution network through SPBUNs (Fishers' Public Fueling Stations) or other official outlets.

2. Decreasing fisher sensitivity to disasters and disturbances. This can be achieved by facilitating alternative employment opportunities for fishers during non-fishing periods and providing cold storage facilities to preserve the quality and marketability of their catch.

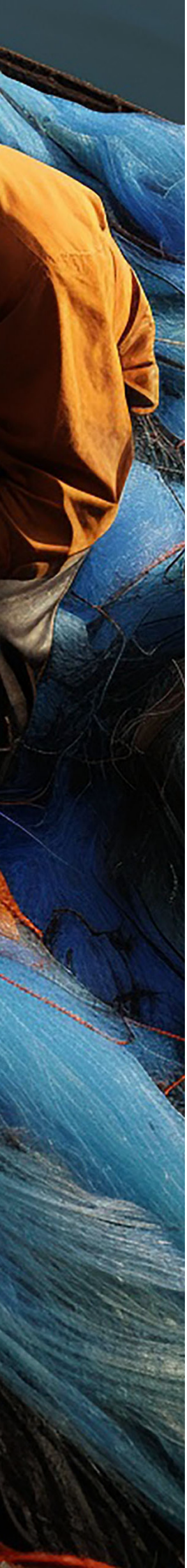
3. Enhancing fisher adaptive capacity. This can be achieved by enhancing fisher knowledge and skills, increasing the added value of fishery products to boost fisher income, empowering family economies, ensuring fisher ownership of Marine and Fisheries Business Actor Cards (KUSUKA) to enable access to government support, re-registering impoverished fishers for the Family Hope Program (PKH) and providing assistance and revitalizing fishing gear (vessels and fishing tools).

4. Regular monitoring of fisher vulnerability risks, assessed through climate vulnerability indices, fishing ground vulnerability indices and fuel vulnerability indices, is essential for policymakers to formulate appropriate policies that reduce these risks and improve the livelihoods of fishers in all regions.

5. Protecting the fishing grounds of small-scale fishers is crucial to minimizing disturbances. Adopting inclusive fisheries management concepts like OECM (other effective conservation measures) safeguards the protection of these fishing grounds, especially those managed through traditional and communal practices that support sustainable fisheries resource utilization.

3.3 Limitations

This study acknowledges several limitations. First, the information provided by fishers regarding the disaster and disruptions they experience may be incomplete. Some fishers may not be fully aware of, or may not have detected, potential threats. Additionally, the study design yielded a limited range of responses from participants. Finally, the relatively short research timeframe may not have captured significant changes in behavior that could occur over a longer period.



Bibliography

Adger, W., N. Brooks, M. Kelly, G. Bentham, M. Agnew, S. Eriksen. "New Indicators of Vulnerability and Adaptive Capacity". Technical Report 7, Tyndall Centre for Climate Change Research, U.K., (2004)

Adger, W.N. "Social Vulnerability to Climate Change and Extremes in Coastal Vietnam". World Development 27, 2 (1999): pp. 249-269

Adger, W.N. "Indicator of Social and Economic Vulnerability to Climate Change in Vietnam". CSERGE Working Paper GEC 98-02, (1998): pp. 1-39

Anna, Suzy, 2019, Pemanfaatan Model Bio-Ekonmi dalam Pengelolaan Sumber Daya Perikanan yang berkelanjutan, Orasi Ilmiah Berkenaan dengan Penerimaan Jabatan Guru Besar dalam bidang Ekonomi Sumber daya Perikanan pada Fakultas Perikanan dan Ilmu Kelautan, Universitas Padjadjaran Bandung, 8 November 2019.

Briguglio, L., N. Farrugia, S. Vella, G. Cordina. "Economic Vulnerability and Resilience: Concepts and Measurements". Oxford Development Studies 37, 3 (2009): pp. 229-247.

Brenkert, A., E. Malone. "Modeling Vulnerability and Resilience to Climate Change: A Case Study of India and Indian States". Climate Change 72, (2005): pp. 57-102.

Chen, Cheryl, David Lopez-Carr. "The Importance of Place: Unraveling the Vulnerability of Fisherman Livelihoods to the Impact of Marine Protected Areas". *Applied Geography* 59, (2015): pp. 88-97.

Chen, Cheryl, D López-Carr, B.L.E Walker. "A Framework to Assess the Vulnerability of California Commercial Sea Urchin Fishermen to the Impact of MPAs Under Climate Change". Geo Journal 79, (2014): pp. 755-773.

Cinner,J.E. , T.R. McClanahan , N.A.J. Graham, T.M. Daw , J. Maina , S.M. Stead, A. Wamukota , K. Brown , Ö. Bodin. "Vulnerability of Coastal Communities to Key Impacts of Climate Change on Coral Reef Fisheries". Global Environmental Change 22, (2012): pp. 12-20.

Chuenpagdee, R. "Too big to fail". Maritime Studies 17 (3), (2018): 305-314. DOI: 10.1007/s40152-018-0114-8

Dolan,A.H., I.J. Walker. "*Understanding Vulnerability of Coastal Communities to Climate Change Related Risks"*. Journal Coastal Research 39, (2004): pp. 1317-1324.

Ekin, H., A.B., Tapia. "Insights Into the Composition of Household Vulnerability from Multicriteria Decision Analysis". *Global Environment Change* 18, (2008): pp. 112-127.

Hahn, Micah., Anne Riederer. "The Livelihood Vulnerability Index: A Pragmatic Approach to Assessing Risks from Climate Variability and Change—A Case Study in Mozambique". *Global Environmental Change* 19, 1(2009): pp. 74-88.

Jentoft, S., Chuenpagdee, R. "Interactive Learning and Governance Transformation for Securing Blue Justice for Small-Scale Fisheries". *Administration & Society* 54, 7 (2022): pp. 1255-1282.

Jeyarajah, S. . Livelihood security of marine small scale fisheries households in Batticaloa District of Sri Lanka. *International Journal of Humanities and Social Science Invention*, 5(8) (2016), pp. 9–16.

Minister of Finance. Book II Financial Notes FY 2022, (2021)

Karen O'Brien , Robin Leichenko , Ulka Kelkar ,Henry Venema , Guro Aandahl , Heather Tompkins , Akram Javed , Suruchi Bhadwal , Stephan Barg , Lynn Nygaard , Jennifer West. "Mapping Vulnerability to Multiple Stressors: Climate Change and Globalization in India". *Global Environmental Change* 14, 4 (2004): pp. 303-313.

Minister of Marine Affairs and Fisheries (MMAF). MMAF Regulation No. 19 of 2022 concerning Estimation of Fish Resource Potential, Permissible Amount of Fish Catch, and Level of Utilisation of Fish Resources in the Fisheries Management Area of the Republic of Indonesia, (2022)

Luers, A.L., D.B. Lobell, L.S. Sklar, C.L. Addams, P.M. Matson. "A Method for Quantifying Vulnerability, Applied to the Yaqui Valley, Mexico". *Global Environmental Change* 13, 4(2003): pp. 255-267.

Luna, H.N.M., P.T. Boyer, M.M Baez. "Social Indicators of Vulnerability for Fishing Communities in the Northern Gulf of California, Mexico: Implications for Climate Change". *Marine Policy* 45, (2014): pp. 182-193.

M. Bavinck and S. Jentoft, "*Subsidiarity as a Guiding Principle for Small-scale Fisheries," in World Small-Scale Fisheries: Contemporary Visions, ed., R. Chuenpagdee. Delft: Eburon Aca- demic Publishing*, (2011): pp. 311–322

McCarthy, James. J., Osvaldo F. Canziani , Neil A. Leary, David J. Dokken, Kasey S. White, Climate Change 2001: *impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC),* Cambridge: University Press Cambridge, 2001.

Mavromatidi, A., E. Briche, C. Claeys. "Mapping and analyzing socio-environmental vulnerability to coastal hazards induced by climate change: An application to coastal Mediterranean cities in France". *Cities* 72, Part A (2018): pp. 189-200.

Molina, A.C., E.G. Frapolli. "A Review of Vulnerabilities in Worldwide Small-Scale Fisheries". *Fisheries Management and Ecology* 29, 5(2022): pp. 491-501.

Moss, R., A. Brenkert, E. Malone. Vulnerability to Climate Change: A Quantitative Approach. Report Prepared by Pacific Northwest National Laboratory: United States Department of Energy, 2001.

Maiti,S., S.K. Jha, S. Garai, A. Nag, R. Chakravarty, K.S. Kaidan, B.S. Chandel, K.K. Datta, C. Upadhyay. "Vulnerability to Climate Change Among the Livestock Rearers of Estern Coastal Region of India: A Household Level Assessment". *Indian Journal of Animal Sciences* 84, 10(2014): pp. 1048-1054.

Mulyasari, Gita, Irham, Lestari R. Waluyati, A. Suryantini. "Livelihood vulnerability to climate change of fishermen in the coastal area of Bengkulu Province, Indonesia, Aquaculture, Aquarium, Conservation & Legislation". *International Journal of the Bioflux Society* 13, 3(2020): pp. 1242-1254.

Mustika, I, T. Herawati, I. Muflikhati. "Strategi Penghidupan, Manajemen Keuangan, Kerentanan Ekonomi, dan Ketahanan Keluarga Nelayan". *Jurnal Ilmu Sosial dan Humaniora*, 12, 2(2023): pp. 269-279.

O'Brien et.al. "Mapping Vulnerability to Multiple Stressors: Climate Change and Globalization in India". *Global Environmental Change* 14, 4(2004): pp. 303-313.

Phuong, T.T., N.Q. Ta , N.C. Dinh, H.V. Chuong, H.D. Ha, H.T. Hung . "Livelihood Vulnerability to Climate Change: Indexes and Insights from Two Ethnic Minority Communities in Central Vietnam". *Environmental Challenges* 10, (2023): pp.

Poh, L.M., M.F. Sabri. "Financial Knowledge, Financial Management Practices, Financial Pressure and Financial Stability Among Single Female Households in Malaysia". *Malaysian Journal Consumer and Family Economics* (2017): pp 131-145

Proag, V. "The Concept of Vulnerability and Resilience". *Procedia Economics and Finance* 18, (2014): pp. 369-376.

Raihan, F., M.M. Hossain. "Livelihood Vulnerability Assessments and Adaptation Strategies to Climate Change: A Case Study in Tanguar Haor". *Sylhet Journal of Water and Climate Change* 12, 7(2021): pp. 3448–3463.

Senapati, S., V. Gupta. "Socio-Economic Vulnerability due to Climate Change: Deriving Indicators for Fishing Communities in Mumbai". *Marine Policy* 76, (2017): pp. 90-97.

Sugiharto, A., Hartoyo, & Muflikhati, I. "*Strategi penghidupan dan kesejahteraan keluarga pada keluarga petani tadah hujan." Jurnal Ilmu Keluarga Dan Konsumen*, 9(1), (2016): pp. 33–42

Shaffril, H.A.M., A. Hamzah, J.L. D'Silva, B. A. Samah, A. A. Samah. "Individual Adaptive Capacity of Small-scale Fishermen Living in Vulnerable Areas towards the Climate Change in Malaysia". *Climate and Development* 9, 4(2016): pp. 313-324.

Scoones, I., "Sustainable Rural Livelihoods: A Framework for Analysis". *IDS Working Paper,* 72 (1998): pp.

Shah , K.U., H.B Dulal, C. Johnson, A. Baptiste. "Understanding Livelihood Vulnerability to Climate Change: Applying the Livelihood Vulnerability Index in Trinidad and Tobago". *Geoforum* 47, (2013): pp. 125-137.

Shukla, P.R., S.K. Sharma, H. Rabindranat N, A. Garg, S. Bhattacraya (Eds.), *Climate Change and India, Vulnerability Assessment and Adaptation*. Universities Press, India Pvt Ltd., Hyderabad, 2003.

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