COPING STRATEGIES OF ELDER SAMA-BAJAU FISHERMEN IN RESPONSE TO CLIMATE CHANGE IN WANGI-WANGI ISLAND, INDONESIA

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ABSTRACT: This qualitative study explores how elder Sama-Bajau fishermen on Wangi-Wangi Island, Wakatobi National Park, Indonesia, cope with climate-related livelihood stress. Based on 19 in-depth interviews, the research identifies three coping domains: immediate physical adjustments to heat and storms, household and social resource mobilisation, and emotional and relational practices that maintain household harmony. These strategies differ from those of younger fishers who often diversify livelihoods or migrate. Elders rely on familiarity with local marine conditions, accumulated ecological knowledge, and family-based support systems to adapt within their physical and social limits. Climate change amplifies existing livelihood pressures, increasing the use of practices such as meal sharing, borrowing from middlemen, and food rationing. Age-related factors, including declining physical capacity and limited mobility options, make emotional stability, spousal support, and small daily adjustments especially important. These findings show that elder fishers contribute to household and community resilience and underscore the need to integrate their perspectives and knowledge systems into climate adaptation planning.

KEYWORDS: Sama-Bajau, elder fishermen, climate change, coping strategies, Indonesia

I. Introduction

Small islands are at the forefront of the climate crisis. They are exposed to rising sea levels, erratic weather patterns, and biodiversity loss, which pose increasing challenges for their communities, especially those dependent on natural resources (IPCC, 2022; Duvat et al., 2017). Indonesia, home to thousands of small islands and some of the world's richest marine ecosystems, is particularly vulnerable. The country's vast archipelago, with its dense coastal populations, exemplifies these risks. The climatic crisis and unsustainable fishing techniques have led to devastating impacts on its marine fisheries sector (Napitupulu et al., 2022). Without effective adaptation strategies, over 4.2 million people in Indonesia may face permanent flooding by the year 2100 (Neumann et al., 2015; Climate Risk Profile: Indonesia, 2021). Among Indonesia's many coastal groups, the Sama-Bajau, a traditionally seafaring and fishing ethnic community, are significantly affected by these disruptions. Climate change directly threatens their livelihoods, mobility, and health, particularly for elder Sama-Bajau fishermen residing on Wangi-Wangi Island within Wakatobi National Park, where a substantial population of Sama-Bajau fishers live. In 2021, Wangi-Wangi Island, along with other islands in Wakatobi, hosted approximately 46% of Wakatobi's 6,264 registered fishermen (BPS Wakatobi, 2022).

While the impacts of climate change on fisheries and island communities have been widely studied (Badjeck et al., 2010; Rukminasari et al., 2024; Samah et al., 2024), scholars have largely overlooked the experiences of older fishers, particularly elder Sama-Bajau in Wakatobi Island. There is a lack of empirical focus on how aging fishers, who are socially and physically vulnerable and also key custodians of Traditional Ecological Knowledge (TEK), adapt to climate-related disruptions (Islam et al., 2013; Hosen et al., 2020). Elder fishers often face overlapping constraints such as declining physical capacity, economic precarity, and limited access to adaptation resources, especially modern technologies. However, they possess accumulated knowledge that allows them to anticipate and respond to environmental shifts through experience-based insights and adaptability (Hosen et al., 2020; Macusi et al., 2021; Islam et al., 2013; Rosales et al., 2015; Berkström et al., 2019).

This study highlights the need to address individual narratives and situated coping strategies among elder Sama-Bajau fishermen. Understanding how individuals frame and respond to crises reveals the connection between structural vulnerability and personal agency in everyday life, as demonstrated in localised studies of small-scale fishers and elder labourers navigating environmental stress (Patrick, 2021; Mbaye et al., 2023; Rukminasari et al., 2024). Furthermore, centring elder perspectives offers insights into intergenerational resilience and the continuity of indigenous marine knowledge, particularly in communities where oral traditions and experience-based knowledge systems remain strong but underrecognised (Zainuddin, 2023; Adam et al., 2021). By focusing on the specific group of elder Sama-Bajau fishermen, this article aims to bridge the gap between large-scale policy narratives and lived community experiences. The study is based on in-depth interviews with elder Sama-Bajau fishermen in five coastal villages on Wangi-Wangi Island. These interviews capture a range of adaptive behaviours, both active such as shifting fishing zones, relying on kin networks and passive, for example rationing food and resting during heatwaves, that reflect a culturally grounded understanding of climate and sea behavior, and are often triggered or intensified by specific climate impacts like heatwaves and storms. These narratives illustrate how coping responses integrate immediate physical

measures, household-level resource adjustments, and interpersonal practices, reflecting how cultural norms shape practical responses to stress.

While the narratives collected from elder Sama-Bajau fishermen underscore the significance of localised coping strategies in navigating environmental challenges, it is equally crucial to explore how these insights can be translated into effective policy measures. Investigating ways to incorporate and scale their activities within policy frameworks is essential for ensuring context-specific and sustainable adaptation efforts. Indonesia's National Action Plan for Climate Change Adaptation (RAN-API) encourages the integration of local knowledge and traditional practices into its adaptation strategies (Bappenas, 2019). The aim is to utilise scientific, inclusive, and iterative methodologies that leverage local resources. However, its impact is diminished by the limited access of Indigenous communities to climate funding and a lack of acknowledgment of their rights and participation. Tackling these challenges is vital to bridging the divide between local practices and national adaptation efforts, and ensuring the knowledge of vulnerable groups like elder fishers is included.

This study addresses two questions: 1) What coping practices do elder Sama-Bajau fishermen employ in response to climate-related stressors? and 2) How do these practices contribute to household and community resilience? While previous research has examined the general adaptation of small-scale fishers, the differentiated experiences of older fishers remain underexplored, despite their physical vulnerability and their role as repositories of traditional ecological knowledge. This article contributes to filling that gap by documenting age-specific coping strategies and their relationship to climate change triggers, offering insights that are relevant for designing inclusive adaptation interventions in small-island fisheries.

II. Traditional knowledge and coping strategies in Bajau small-scale fisheries

Climate change poses a serious threat to small island communities, whose geographical isolation, limited land area, and low-lying topography increase their exposure to rising sea levels, extreme weather, and biodiversity loss (Duvat et al., 2017; Kumar & Tehrany, 2017). The concentration of infrastructure, livelihoods, and populations along coastlines worsens these risks, putting fishing-dependent societies at particular risk (Schleussner et al., 2018). Among the most at risk are the Sama-Bajau, often called the "Sea Nomads" of maritime Southeast Asia (Adam et al., 2021). They number about 1.1 million, with populations in the Philippines (564,000), Malaysia's Sabah region (347,000), and eastern Indonesia (200,000) (Stacey et al., 2018). Linguistically, they speak ten Sama-Bajau languages and many dialects within the Western Malayo-Polynesian family (Stacey et al., 2018). Settlement styles range from fully maritime boat-dwelling groups like the Sama Dilaut to coastal stilt villages (Stacey et al., 2018). Historically, mobility shaped their social and economic systems, allowing them to relocate based on resource availability and obligations (Sather, 1997). This mobility once helped them withstand environmental and economic shocks but is now limited by sedentarisation policies and conservation programs aimed at static, village-based communities (Pauwelussen, 2016).

Marine dependence remains central. Fishing and shellfish gathering provide food, income, and social cohesion, as fishers harvest more than 300 marine species through inshore trips, reef visits, and long-distance expeditions (Stacey et al., 2018). Climate-driven coral reef degradation, seagrass decline, and mangrove loss threaten these ecosystems, adding to

pressures from overfishing and coastal development. These changes threaten food security and economic stability (Stacey et al., 2018). Cultural beliefs also affect how risks are perceived: sea spirits, ancestral ties, and fate influence views of environmental decline, sometimes delaying recognition of climate impacts and the adoption of technical adaptation measures (Sather, 1997; Stacey et al., 2018).

Despite constraints, Sama-Bajau communities use multiple coping strategies. Social network diversification helps fishers reduce power disparities by working with multiple patrons (Samah et al., 2024). Infrastructure adaptations, such as raising stilt house floors and modifying boats, decrease exposure to floods and storms, while technology-assisted fishing gear boosts efficiency and safety (Gunggut et al., 2024; Ilmi et al., 2025). Government and organisational programs also offer social and economic support, complemented by small-scale daily actions like pooling resources and buying water during shortages (Ilmi et al., 2025). Traditional ecological knowledge remains vital. Fishers shift target species, altering fishing grounds, and supplement incomes through non-fishing activities (Barua et al., 2020). These immediate responses help sustain livelihoods and cultural heritage (Carmen et al., 2022). However, as Bennett et al. (2014) point out, many still live day-to-day with limited capacity for long-term planning, emphasising the need for adaptation strategies supported by broader socioeconomic development and environmental management (Gunggut et al., 2024).

a. The Traditional Ecological Knowledge (TEK) of Sama-Bajau elders

Older fishers in small-island contexts occupy a critical yet often overlooked role in environmental adaptation. They are not only among the most physically and socially vulnerable to climate change, but they also embody decades of TEK, passed orally through generations (Hosen et al., 2020; Datta et al., 2024). TEK includes intuitive knowledge of ocean currents, animal migration, seasonal calendars, and culturally embedded risk management strategies. Research conducted in Samoa and post-tsunami Aceh illustrates how these local knowledge systems enabled fishers to foresee and recover from environmental disruptions (Lefale, 2010; Wilson & Linkie, 2012). Among the Sama-Bajau, TEK manifests in their ability to read sea and sky conditions, interpret fish movement, and adjust fishing patterns without formal instruments (Adam et al., 2021; Zainuddin, 2023). Rituals, social gatherings, and spiritual beliefs also reflect a cosmology where humans, the sea, and the weather are interconnected, shaping both practical and emotional responses to environmental stress (Hussin, 2019; Mbaye et al., 2021). However, these knowledge systems are at risk of erosion due to modernisation, restricted mobility, and younger generations' shifting livelihood preferences (Ariando & Arunotai, 2022; Perumal, 2018).

Despite its richness, TEK is also rarely incorporated into climate policy or marine resource governance. Studies on climate change and fisheries adaptation in Southeast Asia tend to focus on community or institutional responses, often overlooking how individual fishers, particularly elders, cope with disruptions in their daily lives (Barua et al., 2020; Islam et al., 2013). Additionally, the loss of indigenous knowledge greatly threatens their ability to adapt, especially as livelihood practices evolve due to dependence on external technologies (Adam et al., 2021). As Samah et al. (2019) contend, the elderly remain one of the least studied vulnerable groups in climate research, despite their crucial role in cultural continuity and social resilience. The perspectives of aging fishermen are still understudied, even as they face compounded vulnerabilities related to declining physical strength, limited mobility, and reduced access to government support systems (Hosen & Anwar, 2019).

b. Coping and adaptation in small island fishing communities

As climate change intensifies, understanding how communities respond is essential, particularly for those facing recurring environmental and economic stressors. Coping, as defined by Latack and Havlovic (1992), encompasses active or passive responses aimed at reducing immediate threats or alleviating stress. In climate discourse, coping is often viewed as short-term and reactive, distinct from adaptation, which is long-term and anticipatory (Mukheibir, 2007; Alemayehu & Bewket, 2017; Antwi-Agyei et al., 2018). Coping may involve behavioural, emotional, or social adjustments, such as altering fishing grounds, rationing food, or postponing sea travel during storms (Antwi-Agyei et al., 2018). However, the distinction between coping and adaptation is fluid; reactive responses can evolve into longer-term adaptive practices when they become routinised or institutionalised (Mukheibir, 2007; Alemayehu & Bewket, 2017; UNISDR, 2009; IPCC, 2012).
In small island and coastal fisheries, coping often combines physical adjustments with social mechanisms. Fishers in Togo and Cambodia, for instance, modify fishing schedules or relocate to reduce climate-related risks (Fiorella et al., 2021; N'Souvi et al., 2024). In Indonesia's Spermonde and Wakatobi Islands, communal strategies such as cooperative food sharing and debt-based reliance on middlemen provide short-term survival during lean seasons (Rukminasari et al., 2024; Wardhani et al., 2023). Nigerian fishers cope with reduced income by cutting food consumption, seeking family assistance, or livelihoods, while coastal Bangladeshi households often send members to seek temporary employment elsewhere (Barua et al., 2020). These examples illustrate how social networks and reciprocity serve as critical safety nets in places with limited formal state support.

Among the Sama-Bajau, coping strategies are similarly rooted in social ties and environmental knowledge. Practices include meal-sharing, seeking support from adult children, and sheltering in safer parts of homes during storms (Collardeau et al., 2021; Patrick, 2021). Community and family networks play an essential role in building resilience, enabling households to pool resources, access assistance, and make collective decisions during disruptions (Carmen et al., 2022). These responses are shaped by cultural values, social norms, and shared identities, which influence how climate risks are perceived and acted upon (Carrico et al., 2019; Skerratt, 2013; Cox & Perry, 2011; Smith et al., 2012). Supporting these social foundations is vital; without them, resilience-building efforts risk overlooking how local relationships and cultural beliefs guide coping behavior (Carmen et al., 2022).

Local-level coping is highly dependent on context, shaped by how often and how intensely stressors occur, as well as community perceptions of risk (Dewe, 1993; Patrick, 2021). Small-scale fishers who lack formal safety nets often rely on ecological knowledge, household labor, and collective action to maintain livelihoods during crises (UNISDR, 2009; IPCC, 2012). However, research is still limited on how these strategies are used by aging, low-income populations, despite their increased vulnerability to climate changes. Older individuals, especially those involved in resource-dependent livelihoods, are often underrepresented in adaptation studies (Islam et al., 2013; Barua et al., 2020). Incorporating their lived experiences into formal adaptation frameworks is essential for creating inclusive, bottom-up responses.

Short-term responses to climate shocks frequently involve spatial or physical adjustments. Fishers seek shelter in nearby safe zones, anchor in protected areas, or shift to familiar fishing grounds perceived as less exposed (Patrick, 2021; Latack & Havlovic, 1992; Bloomquist et al., 2008). In some island settings, households reorganise living spaces to

maximise safety, and reefs serve both as fishing grounds and as emergency refuge areas (Beck et al., 2018; Darling & D'Agata, 2017). Coping strategies also include food-related practices such as storing staple goods, simplifying meals, and engaging in communal eating, which help maintain emotional and social stability during food or income shortages (Béné et al., 2016; Cordero-Ahiman et al., 2018; Smith & Lawrence, 2014; Avrutina et al., 2020; Middleton et al., 2022). These practices reinforce emotional and social resilience, particularly in older populations. Intergenerational support, especially from adult children, provides vital supplemental income and caregiving for elders (Salman et al., 2021; Carmen et al., 2022). However, repeated reliance on social assistance can signal chronic vulnerability (Latack & Havlovic, 1992; Dewe, 1993; Patrick, 2021). In cases where support networks are insufficient, borrowing from middlemen offers an immediate, albeit often exploitative, financial safety net (IPCC, 2012; UNISDR, 2009; Fabinyi et al., 2022; Parappurathu et al., 2019). Emotional resilience, including strong spousal relationships and community solidarity, also contributes significantly to coping, particularly among older fishers with declining physical capacity (Carmen et al., 2022).

Many coping practices, such as food sharing, borrowing, and adjusting fishing times, have long been part of small-scale fishing livelihoods, but climate change stressors have increased both their frequency and significance (Barua et al., 2020). Literature notes that these practices, while often framed as short-term responses, may also signal more profound livelihood vulnerability and the potential for gradual shifts toward more adaptive behaviours over time. Understanding how such coping mechanisms evolve under changing environmental pressures provides critical insight for designing inclusive, locally relevant adaptation strategies.

II. Research design and conceptual framework

This study employs a qualitative case study design to examine how elder Sama-Bajau fishermen in Wangi-Wangi Island, Wakatobi National Park, Indonesia, experience and respond to climate-related livelihood challenges. A case study approach is suitable for addressing "how" and "why" questions and for capturing context-specific realities that are often invisible in broad survey-based assessments (Yin, 2009). Focusing on older individuals in a culturally distinct fishing community foregrounds perspectives that are rarely documented in climate change research. Narrative inquiry is used to document participants' accounts, emphasising how individuals interpret and respond to environmental change through storytelling (Clandinin & Connelly, 2000). This approach highlights meaning-making and agency, which are essential for understanding responses rooted in lived experience rather than external technical solutions.

The conceptual framework draws on coping theory, focusing on how individuals draw on material, social, and cognitive resources to manage stressors and maintain stability (Latack & Havlovic, 1992). The study applies coping theory as an analytical lens to explore how older fishers mobilise experiential knowledge, community ties, and culturally informed values when facing unpredictable weather, shifting fish availability, and health-related limitations (UNISDR, 2009; IPCC, 2012). A key premise is that coping is influenced by the combination of personal traits (like age, physical ability, experience), social resources (such as kinship and community support), and environmental stressors (for example, extreme heat, storms, resource shortages). Elder Sama-Bajau fishers have deep knowledge of sea behavior, seasonal patterns, and fishing methods, but they are physically vulnerable and financially limited. Their responses, including anchoring in calmer waters, borrowing from

middlemen, or sharing meals with relatives, are guided by practical survival needs and culturally rooted moral principles, such as emphasising collective well-being or enduring hardships silently. By framing coping as both a strategy and a story, this study examines how older Sama-Bajau fishers apply their knowledge, experience, and cultural values to adapt to environmental change. In doing so, it contributes to the understanding of how age and experiential knowledge shape livelihood coping strategies in small-scale fisheries facing climate stress.

a. The collection of narratives and ethics

Wangi-Wangi Island in Wakatobi National Park was selected for this research because its substantial population of Sama-Bajau fishers, providing a relevant context for exploring local strategies to deal with climate change impacts. The map (Figure 1) illustrates the research location, highlighting small island areas where Sama-Bajau fishermen reside. Notably, in 2021, the island of Wangi-Wangi alongside with other islands in Wakatobi hosted approximately 46% of Wakatobi's 6,264 registered fishermen (BPS Wakatobi, 2022).

No	Village	Total Population	Number of Households	Number of Full Fishermen	Number of Elder Fishermen
1	Mola Bahari	3079	389	289	173
2	Mola Utara	1586	322	237	67
3	Mola Selatan	1924	577	482	62
4	Mola Nelayan Bakti	2508	637	538	58
5	Mola Samaturu	1750	328	245	150
	Total	**10847**	**2253**	**1791**	**510**

Table 1 - Population of Sama-Bajau and its elder fishermen in Wangi-Wangi Island, Wakatobi in 2022 (Source: Village Administrative Office of Mola Region 2023).

This study is based on data collected through two rounds of fieldwork: from August 2021 to February 2022 and November to December 2024. The primary method of data collection was in-depth, semi-structured interviews, supplemented by informal conversations, field observations, and reviews of secondary sources. A purposive sampling technique was used to select participants who met three criteria: (1) aged 60 years or older, (2) had over 30 years of fishing experience, and (3) demonstrated familiarity with climate-related challenges. Initial participants were identified through local contacts. After the first interview, a snowball sampling approach was used, with the initial informants recommending others who also met the study's criteria. Although a pre-existing list of names was available, these referrals helped ensure the inclusion of participants who were experienced and knowledgeable. A total of 19 interviews were conducted, reaching data saturation when no new information emerged during the last set of interviews.

Interviews followed a semi-structured guide with open-ended questions on fishing routines, environmental changes, livelihood adjustments, and social support. Questions explored responses to disruptions, shifts in fish availability, and strategies for sustaining livelihoods, allowing participants to reflect on past and present conditions. Data collection included informal conversations and field observations of coastal erosion, fish habitat shifts, and infrastructure adaptations, providing contextual insights. Interviews were conducted in Bahasa Indonesia and the Sama-Bajau language, with translation support when necessary, and recorded for accuracy. All interviews were manually transcribed and

translated into English for analysis, ensuring participants could express themselves fully and comfortably.

Ethical protocols guided all research activities. Participants were informed about the study's purpose, voluntary participation, and use of their information. Verbal and written consent was obtained, and pseudonyms were used to protect identities. Identifying details were excluded from transcripts and reports, ensuring privacy and respectful representation of experiences. Participant comfort and confidentiality were prioritised, with sensitive information omitted. Ambiguities were clarified through follow-ups and result presentations. This approach fostered trust, encouraged open communication, and ensured accurate representation of informants' perspectives. Combining structured interviews with observations allowed participants' voices and lived experiences to remain central to the analysis and reporting process.

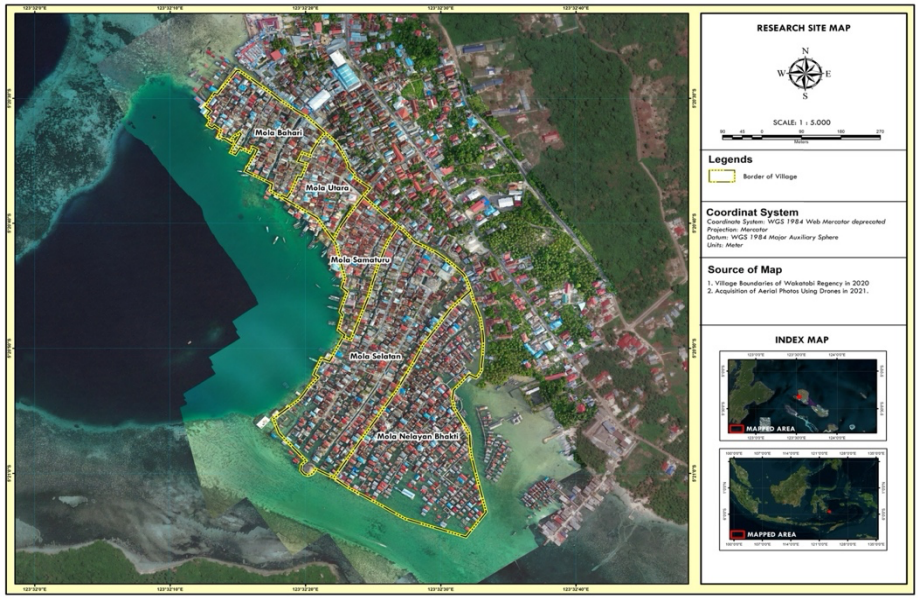

Figure 1 - Map of research area (Amar Maruf).

b. Data analysis

Initial data analysis began with the data collection process, which involved recording and transcribing in-depth interviews with elder fishers. Following this, open coding and theme development ensued, with transcripts undergoing dual coding for both organisation and interpretation (Waitt, 2010). Utilising the thematic method outlined by Kitchin and Tate (2000), researchers manually defined codes, grouped them, classified them, and linked them to existing literature, leading to the identification of recurring themes. While initial transcriptions were made using a mobile phone, the researchers manually transcribed the first interview due to software limitations encountered during the fieldwork. Annotations on protocols highlighted discussions regarding the impacts of climate change, noting terms such as "coping" and "adaptation" to reflect strategy-focused responses. The transcripts were reviewed for clarity, and ambiguous or repetitive language was verified with informants during result presentations.

Coding captured key concepts supported by transcripts, notes, and initial codes from the first interview. These steps were consistently applied across subsequent interviews until data saturation was reached (Elder Fisherman #19). Interactions with residents continued throughout the fieldwork to cross-reference findings. Open codes structured the data into categories, facilitating comparative evaluations for accuracy. Patterns and relationships among categories were discerned, leading to interpretations, inferences, and conclusions drawn from the coded data. The data were then mapped against the broader conceptual framework of coping theory, emphasising the relationships between personal capacities, environmental stressors, and social context.

III. Results and Discussions

This article presents the results and analysis in three sections that categorise the coping strategies: Immediate Physical Coping Strategies, Household and Social Resource Strategies, and Emotional and Relational Coping. Each section represents a dimension of elder fishermen's coping strategies, rooted in both individual experiences and communal practices, which are outlined in Table 2. The Sama-Bajau fishermen, referred to here as "informants" and "fisher (#)," include verbatim statements as illustrative examples, representing broader thematic patterns identified through the analysis of 19 informants' in-depth interviews.

Climate-Related Trigger	Coping Strategy Category	Sub-strategies	Specific Actions
Rising temperature, indoor heat	Immediate Physical Coping	Heat management on land	Frequent bathing, sleeping outdoors, use of fans
Sun exposure, seawater splash at sea	Immediate Physical Coping	Cooling techniques at sea	Jumping into the sea, rinsing eyes with fresh water
Strong winds, storms, reduced visibility	Immediate Physical Coping	Storm-time safety practices	Staying near exits/light structures, anchoring near reefs, nearshore fishing
Inability to fish due to prolonged bad weather	Household and Social Resource	Food security and resource use	Storing rice, reducing meal portions, skipping meals
Reduced income, limited food access	Household and Social Resource	Intergenerational and neighbourly support	Assistance from adult children, sharing meals with neighbours
Exhausted household or social resources	Household and Social Resource	Access to informal financial support	Borrowing from middlemen (as a last resort)
Economic hardship and prolonged stress periods	Emotional and Relational Coping	Household communication and emotional regulation	Spousal understanding, mutual patience, managing tension during disruptions

Table 2 - Coping Strategies of Elder Sama-Bajau Fishermen to Climate Change Impacts
Source: Primary Data 2022 & 2024.

1. Immediate physical coping strategies

For elder Sama-Bajau fishermen, environmental changes are most acutely felt through their bodies and daily routines. As climate variability intensifies, it manifests in hotter temperatures, extreme weather events, and increased discomfort at sea conditions that intersect directly with aging and declining physical endurance.

Heat Management on Land

Elder Sama-Bajau fishermen repeatedly described rising air temperatures as one of the most taxing climate-related changes. The heat affected their ability to work, rest, and recover. Simple daily routines, such as sleeping indoors, became unbearable during hotter months. To cope, most turned to familiar, practical strategies such as frequent bathing, using electric fans, or sleeping outside at night.

> *I bathe more often because the heat is unbearable. It is the easiest way to cool off and feel refreshed.* (Fisher #6)
> *You have to use a fan now, sir; otherwise, it is hard to rest because of the heat.* (Fisher #9)
> *I prefer to sleep outside, it feels less suffocating compared to staying indoors where it is too hot.* (Fisher #7)

These stories show how people handle environmental discomfort using embodied knowledge and simple techniques. Informants stressed that these coping methods are not new, but they have become more important because of perceived temperature changes. Their experiences highlight how climate shifts cause disruptions in comfort and routines.

Cooling Techniques at Sea

Informants endure prolonged exposure to sun and salt, coping with heat and seawater splashes driven by strong winds and waves during the extended time at sea. They described recurring eye irritation and skin discomfort due to seawater splash combined with high sun exposure.

> *My eyes sting when they are splashed by seawater. It usually happens when the waves are high, so I deal with it by washing my eyes with fresh water.* (Fisher #9)

Others narrated they jump into the water to relieve body heat while fishing.

> *While fishing, I often jump into the water to cool off for a bit, but as soon as I get back on the boat, the heat catches up with me again, so I jump into the sea again.* (Fisher #14)

Fishers reported practical measures such as rinsing their eyes with fresh water and jumping into the sea to manage heat while fishing. These techniques, familiar from daily experience but now more routine as temperatures rise, especially for older fishers.

Storm-Time Safety Response

Elder fisher households on land are becoming increasingly vulnerable to heavy rain, strong winds, and sudden weather shifts. Instead of evacuating, they choose to stay home and find safety in certain parts of their houses. They may move to lighter structures, stay near exit points, or select rooms that are less likely to collapse.

> *When there are strong winds and heavy rain, we are close to the outside door… if we are in the living room, we usually run to the kitchen. There's also an exit there and the wood is light, so there is less risk to safety if it collapses.* (Fisher #11)

The decision to stay in familiar surroundings shows how vulnerability is managed spatially. Without external shelter, these elders rely on their knowledge of home structures to reduce injury risk, focusing on escape routes rather than structural protection. At sea, they adapt to storms by anchoring near coral reefs or quickly heading back home. However, they also need to secure food for their families, which often leads them to fish near the island.

> *If I am out fishing and a storm comes with heavy rain, it is too dangerous to continue, and I cannot see the fish. I usually anchor my boat near a safe spot, like a floating fish aggregating device or the coral reefs, and wait until the weather clears. It depends on where I am fishing—if I am far from the reef, I will stay near the floating device.* (Fisher #1*)*

> *Sometimes fishermen still go to sea even though the weather is bad, but only to look for additional side dishes (food), just on the edge, not far away. So even if there are strong winds and waves, we can still face them or we can immediately return to land if the weather is worse.* (Fisher #7)

These decisions reflect a balance between necessity and caution. Informants noted actions were shaped by experience, environment, and household needs. Some saw storm downtime as an opportunity to repair fishing gear or work on house repairs.

2. Household and Social Resource Strategies

In response to climate-induced disruptions to fishing and income, elder Sama-Bajau fishermen depend on a mix of household practices and social support systems. These strategies, which range from food storage to borrowing, show how families and communities manage basic needs like food, rest, and economic stability under pressure. Whether saving rice, adjusting meals, relying on children, or sharing food with neighbours, these resourceful actions reflect both foresight and adaptability. When household and community support fall short, some turn to middlemen, highlighting the limits of informal coping networks and the structural vulnerabilities that elder fishers must face.

Food Security and Resource Use

One of the most common domestic strategies involved relying on stored rice during periods of prolonged bad weather. As fishing activities were paused due to strong winds or high tides, informants turned to what they already had at home. These informal food reserves, though modest, played a crucial role in sustaining the household.

> *In our family, we keep extra rice stored at home. When bad weather prevents me from fishing for several days, we rely on those reserves, so we do not have to worry about running out of food.* (Fisher #14)

Rice storage reflects foresight but also the precariousness of the household economy. The reserves were typically not extensive, revealing how fragile food security could become during extended disruptions. This strategy, while essential, functioned more as a buffer than a solution. When food supplies dwindled, fishermen adapted by altering consumption patterns, including reducing meal portions, simplifying diets, and skipping meals.

> *Nowadays, sometimes the food lacks variety, the important thing is to be able to eat… It is no longer about how much we can eat, but just that no one goes hungry at home…* (Fisher #3)

These dietary adjustments are driven by necessity. Informants highlighted that coping involves prioritising food and avoiding hunger. For many, these changes were not signs of helplessness but common ways to handle scarcity.

Intergenerational and neighbourly support

Meal-sharing with neighbours

Community solidarity was crucial during periods of bad weather when accessing food was difficult. Meal sharing eased the burden on households while reinforcing social bonds. These informal exchanges are often spontaneous and seen as reciprocal acts rather than charity.

> *Sharing meals is common in this region, particularly when the weather is poor. Those who still have extra food bring it to a certain place, while those who are in need bring whatever they can… then everyone eats together. (Fisher #5)*

These traditional practices, now more frequent during prolonged fishing disruptions, show how coping is embedded in everyday cultural routines.

Support from elder children

As climate change influences economic stability, the informants grapple with the financial strains it imposes, notably through diminished incomes. Elder Sama-Bajau fishermen rely heavily on social and kin-based networks to mitigate the impacts of climate change. These practices highlight a collective dimension of coping shaped by social expectations, cultural norms, and adaptive reciprocity. Consequently, there is a shift in familial roles, prompting some elder fishermen to seek financial support from their elder children.

> *We used to manage everything ourselves, but now, when times are hard, my older son helps with food or money.* (Fisher #2*)*

The reliance on children signifies more than just an economic transaction; it indicates a shift in household dynamics and shows how kin relationships adapt during a crisis. Informants viewed this support not with shame, but with gratitude, highlighting how

intergenerational solidarity plays a vital role in sustaining household resilience during climate-related stress.

Figure 2- Food sharing as a coping strategy among Sama-Bajau households (Amar Maruf).

Access to informal financial support

During prolonged stormy weather that reduced income, elderly fishermen, especially those without family support, turned to middlemen for loans, a longstanding but reluctantly used practice:

> *Only in times of urgency do I usually borrow money from my boss. For example, I have not been fishing for a few days because of the weather, the money saved at home has also decreased, so I have to borrow.* (Fisher #3)

Informants emphasised that climate-related disruptions, such as irregular storms, and changes in fish availability, have increased reliance on such coping strategies, extending their frequency and duration.

3. Emotional and Relational Coping

Beyond tangible resources, emotional stability and household harmony are critical to how elder Sama-Bajau fishers cope with prolonged climate uncertainty. Spousal communication, trust, and mutual understanding emerge as subtle yet essential coping tools. These relational practices help to diffuse financial and emotional stress, enabling elder couples to maintain solidarity during difficult times. In this way, emotional and relational coping, though often less visible, becomes foundational to their resilience, influencing how climate impacts are understood, accepted, and managed within the household sphere.

Spousal communication and household harmony

A recurring thread in the interviews was the importance of maintaining emotional balance within the household. It was described as critical in coping with prolonged climate uncertainty. Informants emphasised spousal communication and mutual patience in managing tension caused by weather disruptions and financial strain:

> *That is why in the family we have to build trust and understanding, so she also understands the risks that come with this man's work.* (Fisher #6)

Emotional and relational strength was described not as something separate from climate adaptation, but as part of what allows elder fishers to endure uncertainty, navigate hardship, and maintain a shared sense of purpose with their households.

The coping strategies described by elder Sama-Bajau fishers build on long-standing practices shaped by years of fishing experience, environmental knowledge, and household support. Age and physical limitations reduce their ability to shift strategies or pursue alternative livelihoods, making emotional stability, spousal support, and small daily adjustments especially important. Many practices, like borrowing from middlemen or sharing meals, are not new. However, informants observed they are now being used more often and for longer durations, as a response to unpredictable weather and decreasing fish supplies.

Conclusion and Policy Implications

This study examined how elder Sama-Bajau fishermen cope with climate-related stressors and how these practices contribute to household and community resilience. The findings show three interrelated coping domains: (1) immediate physical and environmental adjustments, (2) household and social resource mobilisation, and (3) emotional and relational practices. These responses demonstrate that vulnerability and resilience are embedded in daily life and shaped by age, physical capacity, and accumulated experience at sea. Rather than adopting entirely new strategies, older fishers primarily cope by stabilising their existing livelihoods, a conservative way reflecting the constraints of necessity and the influence of cultural norms. They adjust fishing schedules, remain nearshore or shelter at home during storms, ration food, and draw on kin support and reciprocal food sharing. When necessary, they access small-scale credit through middlemen, a longstanding but reluctantly used safety net. Emotional and relational coping, especially spousal communication and patience, reduces household conflict and helps maintain morale during extended disruptions. Together, these strategies preserve food security, sustain social bonds, and maintain household stability despite environmental and economic uncertainty.

These findings indicate that climate change amplifies existing livelihood pressures rather than producing entirely new responses. Age-related factors such as declining physical capacity and fewer options for mobility make emotional stability, spousal support, and small daily adjustments especially critical for elder fishers. Their coping relies heavily on experiential ecological knowledge, household networks, and informal safety nets, highlighting the importance of social and cultural resources in shaping resilience.

Policy implications include the need to: (1) design adaptation programs that address age-specific vulnerabilities, including safety infrastructure and health services for older workers; (2) integrate traditional ecological knowledge into local climate information and risk management systems; and (3) support informal safety nets while expanding access to affordable, formal credit and social protection. By focusing on a demographic often overlooked in climate adaptation planning, this study shows how older fishers, despite physical constraints, remain knowledge holders and household stabilisers whose perspectives are essential for inclusive and context-specific climate resilience strategies.

Limitations and Future Research

This study offers a grounded account of elder Sama-Bajau fishermen's coping strategies within the context of climate change. However, it is important to recognise several limitations. The research is location-specific, and the results may not represent the full range of experiences among Sama-Bajau communities in other parts of Indonesia or Southeast Asia. While efforts were made to handle language translation and cultural interpretation carefully, these processes may still have influenced the analysis. Additionally, the viewpoints of women, youth, and non-fishing household members were not included in this study. Their insights could add depth to the understanding of household and community adaptation to climate change. Future research could use a longitudinal or comparative approach to examine generational changes in coping strategies or explore differences across various island and marine environments. Despite these limitations, the narratives shared here provide valuable entry points for developing more inclusive and culturally aware climate adaptation strategies in small island and coastal communities.

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REFERENCES:

Adam, A.A., Othman, N. & Halim, A. A. (2021). Indigenous knowledge transfer among Dusuns and Bajaus in Kota Belud, Sabah, Malaysia: Approaches and challenges. *International Journal of Academic Research in Business and Social Sciences, 11*(11), 1722–1734.

Ahmad, S. S. (2018). Water related ocular diseases. *Saudi Journal of Ophthalmology*, *32*(3), 227–233.

Alemayehu, A. & Bewket, W. (2017). Smallholder farmers' coping and adaptation strategies to climate change and variability in the central highlands of Ethiopia. *Local Environment, 22*(7), 825–839.

Antwi-Agyei, P., Dougill, A. J., Stringer, L.C., & Codjoe, S.N.A. (2018). Adaptation opportunities and maladaptive outcomes in climate vulnerability hotspots of northern Ghana. *Climate Risk Management, 19*, 83-93.

Ariando, W., & Arunotai, N. (2022). The Bajau as a left-behind group in the context of coastl and marine co-management system in Indonesia. *Journal of Marine and Island Cultures, 11*(1), 260-278.

Avrutina, S., Murphy, H. & Patne, E. (2020). Community-led food resilience: Integrating grassroots food access into municipal emergency planning. *Journal of Agriculture, Food Systems, and Community Development, 10*(1), 215–217.

Badjeck, M.-C., Allison, E.H., Halls, A.S. & Dulvy, N.K. (2010). Impacts of climate variability and change on fishery-based livelihoods. *Marine Policy*, *34*(3), 375–383.

Bappenas: Ministry of National Development Planning/National Development Planning Agency of Indonesia. (2019). *National Adaptation Plan Executive Summary 2019*. Jakarta.

Barua, P., Rahman, S.H., Barua, S. & Rahman, I.M.M. (2020). Climate change vulnerability and responses of fisherfolk communities in the south-eastern coast of Bangladesh. *World Climate and Marine, 1,* 20–31.

Beck, M.W., Losada, I.J., Menéndez, P. et al. (2018). The global flood protection savings provided by coral reefs. *Nature Communications 9*, 2186.

Béné, C., Al-Hassan, R.M., Amarasinghe, O. et al. (2016). Is resilience socially constructed? Empirical evidence from Fiji, Ghana, Sri Lanka, and Vietnam. *Global Environmental Change*, 38, 153-170p

Berkström, C., Papadopoulos, M., Jiddawi, N., & Nordlund, L.M. (2019). Fishers' local ecological knowledge (LEK) on connectivity and seascape management. *Frontiers in Marine Science, 6*.

Bloomquist, C. D., Gyurcsik, N.C., Brawley, L.R. et al. (2008). The road to exercise is filled with good intentions: Why do my proximal exercise intentions match my actions? *Journal of Applied Biobehavioral Research 13* (20), 102-118.

BPS Wakatobi. (2022). *Kecamatan Wangi-Wangi Selatan, Kaledupa dan Tomia dalam angka* 2022. Wakatobi.

Carmen, E., Fazey, I., Ross, H. et al. (2022). Building community resilience in a context of climate change: the role of social capital. *Ambio, 51*(6), 1371-1387.

Carrico, A.R., Truelove, H.B. & Williams, N.E. (2019). Social capital and resilience to drought among smallholding farmers in Sri Lanka. *Climatic Change, 155*(2), 195–213.

Clandinin, D.J., & Connelly, F.M. (2000). *Narrative inquiry: Experience and story in qualitative research.* Jossey-Bass.

The World Bank Group and Asian Development Bank. (2021). *Climate Risk Profile: Indonesia.*

Collardeau, F., Aftab, M.U.B., Jibeen, T. & Woodin, E.M. (2021). Pakistani immigrants' nuanced beliefs about shame and its regulation. *International Perspectives in Psychology, 10*(1), 25-38.

Cordero-Ahiman, O.V., Santellano-Estrada, E. & Garrido, A. (2018). Food access and coping strategies adopted by households to fight hunger among Indigenous communities of Sierra Tarahumara in Mexico. *Sustainability,* 10 (2), 1-14.

Cox, R.S. & Perry, K.-M.E. (2011). Like a fish out of water: Reconsidering disaster recovery and the role of place and social capital in community disaster resilience. *American Journal of Community Psychology, 48*(3–4), 395–411.

Darling, E.S. & D'agata, S. (2017). Coral reefs: Fishing for sustainability. *Current Biology,* 27, 65–68.

Datta, R., Starlight, T. & Mistaken, D.C. (2024). Indigenous elder perspectives on climate change challenges and solutions: Learning reflection from Blackfoot first nation perspectives, Canada. *AlterNative: An International Journal of Indigenous Peoples,* 20(3), 549-559.

Dewe, P. (1993). Coping and the intensity of nursing stressors. *Journal of Community & Applied Social Psychology, 3*(4), 299–311.

Duvat, V., Magnan, A., Wise, R., et al. (2017). Trajectories of exposure and vulnerability of small islands to climate change. *Wiley Interdisciplinary Reviews Climate Change, 8*(6), e478.

Fiorella, K.J., Bageant, E.R., Schwartz, N B. et al. (2021). Fishers' response to temperature change reveals the importance of integrating human behavior in climate change analysis. *Science advances*, *7*(18), eabc7425.

Gunggut, H., Bala, P., Lungkapis, G.J. & Harris, R.W. (2024). Climate change adaptation strategies among coastal community. *Environment-Behaviour Proceedings Journal, 9*(29), 171–178.

Hossen, M.A., et al. (2019). Governance challenges in addressing climatic concerns in coastal Asia and Africa. *Sustainability, 11*(7), 2148.

Hosen, N., Nakamura, H. & Hamzah, A. (2020). Adaptation to climate change: Does traditional ecological knowledge hold the key? *Sustainability, 12*(2), 676.

Hussin, H. (2019). Buwas kuning (yellow rice) and its symbolic functions among the Sama-Bajau of Malaysia. *Sage Open, 9*(4).

Ilmi, W.Z., Sunarharum, T.M., Santoso, H., & Prihanto, Y. (2025). Narrative research in climate change adaptation - Learning from communities resilience in informal area. *IOP Conference Series Earth and Environmental Science, 1447(*1), 012005.

IPCC. (2012). *Managing the risks of extreme events and disasters to advance climate change adaptation: A special report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC)*. Cambridge University Press.

IPCC. (2022). *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

Islam, M.M., Sallu, S.M., Hubacek, K. & Paavola, J. (2013). Limits and barriers to adaptation to climate variability and change in Bangladeshi coastal fishing communities. *Marine Policy, 39*, 84–96.

Latack, J.C. & Havlovic, S.J. (1992). Coping with job stress: A conceptual evaluation framework for coping measures. *Journal of Organizational Behavior, 13*(5), 479-508.

Lefale, P.F. (2010). Ua 'afa le Aso Stormy weather today: Traditional ecological knowledge of weather and climate. *Climatic Change, 100*(2), 317–335.

Kitchin, R. & Tate, N. (2000). Conducting research in human geography: Theory, methodology and practice. Routledge.

Kumar, L. & Tehrany, M.S. (2017). Climate change impacts the threatened terrestrial vertebrates of the Pacific islands. *Scientific Reports*, *7*(1). 5030.

Kyei, S., Owusu-Ansah, A., Boadi-Kusi, S.B., et al. (2016). Occupational hazards correlates of ocular disorders in Ghanaian fisheries. *Healthcare in low-resource settings 4*(2), 29-33.

Macusi, E.D., Camaso, K.L., Barboza, A. & Macusi, E.S. (2021). Perceived vulnerability and climate change impacts on small-scale fisheries in Davao Gulf, Philippines. *Frontiers in Marine Science: Sec. Marine Fisheries, Aquaculture and Living Resources*, 8.

Mbaye, A., Cormier-Salem, M-C., Schmidt, J. & Brehmer, P. (2021). Senegalese artisanal fishers in the apprehension of changes of the marine environment: A universal knowledge? *Social Sciences & Humanities Open 4* (1), 100231.

Middleton, G., Patterson, K.A., Muir-Cochrane, E. et al. (2022). The health and well-being impacts of community shared meal programs for older populations: A scoping review. *Innovation in Aging, 6*(7), 1–14.

Mukheibir, P. (2007). Water resources management strategies for adaptation to climate-induced impacts in South Africa. *Water Resources Management, 22*(9), 1259-1276.

Napitupulu, L., Tanaya, S., Ayostina, I. et al. (2022). *Trends in marine resources and fisheries management in Indonesia.* World Resources Institute Indonesia.

Neumann, B., Vafeidis, A.T., Zimmermann, J. & Nicholls, R. J. (2015). Future coastal population growth and exposure to sea-level rise and coastal flooding - A global assessment. *PLoS ONE, 10*(3). https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0118571&type=printable

N'Souvi, K., Adjakpenou, A., Sun, C., & Ayisi, C.L. (2024). Small-scale fishermen's perceptions of climate change and related impacts on catches in coastal Togo. *Environmental Development 49*, 100957.

Parappurathu, S., Ramachandran, C., Baiju, K.K. & Xavier, A.K. (2019). Formal versus informal: Insights into the credit transactions of small-scale fishers along the south west coast of India. *Marine Policy, 103*, 101–112.

Patrick, H.O. (2021). Climate change and water insecurity in rural Umkhanyakude district municipality: an assessment of coping strategies for rural South Africa. *H2Open Journal, 4*(1), 29-46.

Pauwelussen, A. (2016). Community as network: exploring a relational approach to social resilience in coastal Indonesia. *Maritime Studies, 15*(2).

Perumal, N. (2018). "The place where I live is where I belong": Community perspectives on climate change and climate-related migration in the Pacific Island nation of Vanuatu. *Island Studies Journal, 13*(1), 45–64.

Rukminasari, N., Idrus, R., Ardi, A. et al. (2024). Climate change adaptation and economic vulnerability of small-scale fishermen in the Spermonde Islands, Indonesia. *Journal of Marine and Island Cultures, 13*(2), Article 5.

Salman, D., Kasim, K., Ahmad, A. & Sirimorok, N. (2021). Combination of bonding, bridging and linking social capital in a livelihood system: nomadic duck herders amid the covid-19 pandemic in South Sulawesi, Indonesia. *Forest and Society, 5 (1), 136-158*.

Samah, A.A., Shaffril, H.A.M., Hamzah, A. & Samah, B.A. (2019). Factors affecting small-scale fishermen's adaptation toward the impacts of climate change: Reflections from Malaysian fishers. *SAGE Open, 9*(3), 1–11. 2158244019864204

Samah, A.A., Maruf, A., Ahmad, N. & Hamsan, H. (2024). Understanding local perceptions of impacts of climate change among small-scale Sama-Bajau fishers and their patrons in Wakatobi National Park, Indonesia. *Shima*, *18*(1), 161–180.

Sather, C. (1997). *The Bajau Laut: Adaptation, history, and fate in a maritime fishing society of south-eastern Sabah.* Oxford University Press.

Schleussner, C., Deryng, D., D'haen, S., et al. (2018). 1.5°C hotspots: climate hazards, vulnerabilities, and impacts. *Annual Review of Environment and Resources*, *43*(1), 135–163.

Smith, J.W., Anderson, D.H & Moore. R. (2012). Social capital, place meanings, and perceived resilience to climate change. *Rural Sociology 77*, 380–407.

Smith, K. & Lawrence, G. (2014). Flooding and food security: A case study of community resilience in Rockhampton. *Rural Society,* 23(3), 216–228.

Stacey, N., Steenbergen, D.J., Clifton, J. & Acciaioli, G. (2017). Understanding social wellbeing and values of small-scale fisheries amongst the Sama-Bajau of archipelagic Southeast Asia. In D.S. Johnson, T.G. Acott, N. Stacey & Urquhart, J. (Eds.) *Social wellbeing and the values of small-scale fisheries* (pp. 97-123). Springer.

UNISDR. (2009). *2009 UNISDR Terminology on disaster risk reduction*. United Nations International Strategy for Disaster Reduction (UNISDR).

Waitt, G. (2010). Doing Foucauldian discourse analysis: Revealing social realities. In Hay, I. (Ed.) *Qualitative methods in human geography*, pp. 217-240. Oxford University Press.

Wardhani, A.A., Susilowati, I. & Nugroho, S.B.M. (2023). Empowerment of gender-based small-scale fishers to strengthen the coastal economy: Case study Batang Regency. *Jurnal Ilmu Sosial dan Humaniora, 12*(3), 575-581.

Wilson, C. & Linkie, M. (2012). The Panglima Laot of Aceh: a case study in large-scale community-based marine management after the 2004 Indian Ocean tsunami. *Oryx*, *46*(4), 495–500.

Yin, R.K. (2009). *Case study research: Design and methods (*5th Ed). Sage

Zainuddin, M.F. (2023). When tradition meets modernity: The adaptation of Bajau community in Malaysia amidst sociocultural transformation. *Journal of Contemporary Rituals and Traditions, 1*(1), 1–10.