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Article

Community Perceptions and Involvement in Coral Reef Ecosystem in Awaiama Village, Milne Bay Province: A Social-Ecological Perspective

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Abstract: This study examines community perceptions and involvement in coral reef conservation in Awaiama Village, Milne Bay Province, Papua New Guinea, through a social-ecological framework. Fieldwork in October 2024 integrated coral reef assessments with semi-structured interviews involving local stakeholders. Results indicate that coral reefs are important to livelihoods, food security, and cultural heritage. Despite this dependency, the reefs are increasingly threatened by overfishing, destructive fishing practices, and the impacts of climate change. The community exhibits limited ecological awareness and continues relying on unsustainable fishing methods. Although minor signs of reef recovery were recorded in some areas, community participation in formal conservation initiatives remains minimal. Traditional governance structures, such as clan meetings, play a more prominent role in local resource management. However, there is strong support for reef protection and recognition of the value in integrating traditional ecological knowledge with science-based management strategies. The findings highlight the need for co-management approaches tailored to local socio-economic contexts and emphasize education, sustainable practices, and collaborative governance to ensure long-term reef resilience.

Keywords: Awaiama; co-management; community participation; conservation; coral reefs

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1. Introduction

Coral reef ecosystems are one of the most diverse and valuable marine environments, providing numerous benefits to coastal communities. These ecosystems support food security, livelihoods, tourism, and coastal protection, making them crucial to the tropical regions, including Papua New Guinea (Kittinger *et al*., 2012). Coral reefs in Milne Bay Province contribute significantly to local fisheries, with reef-associated species serving as a primary food source for coastal communities (Cinner, 2014). Reefs serve as an economic backbone through small-scale fisheries and the harvesting of high-value marine products such as sea cucumbers and trochus shells (Butler *et al*., 2014). However, despite their significance, environmental changes and human activity pose a growing threat to these ecosystems.

The declining reef health globally is largely driven by overfishing, habitat destruction, climate change, and poor management practices. Unsustainable fishing practices, such as the overharvesting of sea cucumbers and reef fish, have led to declines in marine resources, with community members expressing concerns about diminishing fish stocks (Allen et al., 2003). Additionally, environmental stressors such as coral bleaching, caused by rising sea temperatures, exacerbate the vulnerability of these ecosystems (Chin *et al*., 2008). The impacts of these ecological degradation affect local livelihoods, food security, and cultural traditions that rely on the health of coral reef ecosystems (Kittinger *et al*., 2012). Addressing these challenges requires an understanding of community perceptions and participation in conservation efforts.

Community involvement plays a crucial role in the management and sustainability of coral reef ecosystems. In Milne Bay Province, traditional knowledge and community-based initiatives, such as Locally Managed Marine Areas (LMMAs), improved resource stewardship and promoted sustainable fishing practices (Allen *et al*., 2003). Similar patterns are observed across the Pacific, where LMMAs rooted in traditional governance have strengthened community stewardship and contributed to reef resilience (Bernard *et al*., 2025; Belade *et al*., 2025). However, effective conservation strategies must align with local socioeconomic conditions and cultural values to ensure long-term success (Mudge, 2018). This study aims to analyze information on the socio-ecological impact on coral reefs by assessing the community perspectives on reef health and management practices.

2. Materials and Methods

The research was conducted in Awaiama Village, located in Maramatana Rural LLG, Milne Bay Province, Papua New Guinea, at 10°12′31.9″S, 150°31′54.4″E (Figure 1). The village lies approximately 12 km from the nearest town and is accessible by both road and sea.

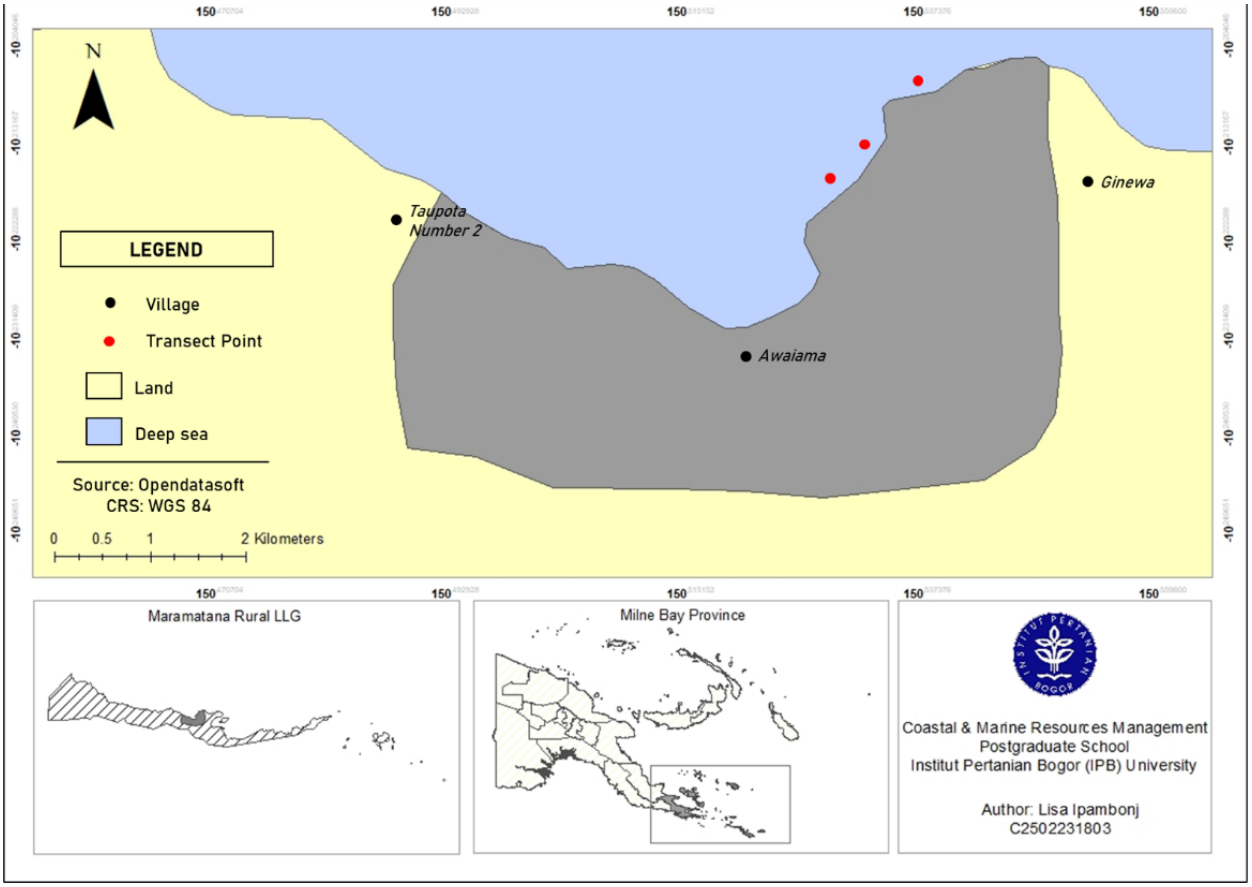


Figure 1. Geographic location of Awaiama Village in Milne Bay Province, Papua New Guinea, illustrating the study area and its relevance to community perceptions and involvement in the coral reef social–ecological system

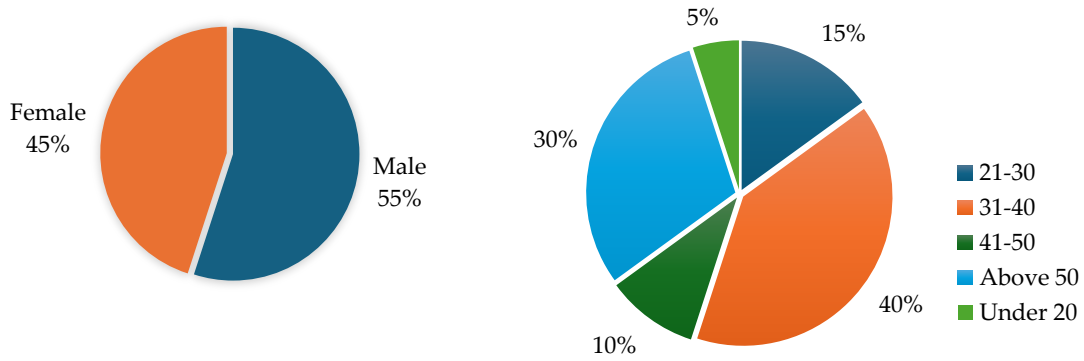
Data were collected through key informant interviews with local stakeholders, involving 20 participants. A combination of structured, semi-structured, and unstructured questions explored perceptions of reef health, dependence on reef resources, and participation in management activities. Purposive sampling was employed to target community leaders, youth, and fishers. Interview responses were transcribed and analysed using descriptive thematic analysis. Key themes were identified and supported by direct quotes from participants. Biodiversity and reef health data were collected using the Point Intercept Transect (PIT) method and the Underwater Visual Census (UVC) method. These data were used to calculate the coral cover and biodiversity metrics, including the Shannon Diversity Index and Evenness.

This study was limited to a single survey period and purposive sampling, which may not reflect seasonal variations or fully represent the wider community. The reliance on visual observations and community recall may also introduce bias; however, the approach provides an initial baseline for understanding the socio-ecological context of coral reef management in Awaiama Village.

3. Results

3.1. Respondent Details

All respondents were originally from Awaiama. The majority of participants were male compared to female (Figure 2a). The dominant age group among the participants ranged from 31 to 40 years (Figure 2b). This aligns with the 2021 National Population Estimate (National Statistical Office, 2021), which reported a total provincial population of 748,196, with a higher male population (395,458) compared to the female population (352,738).



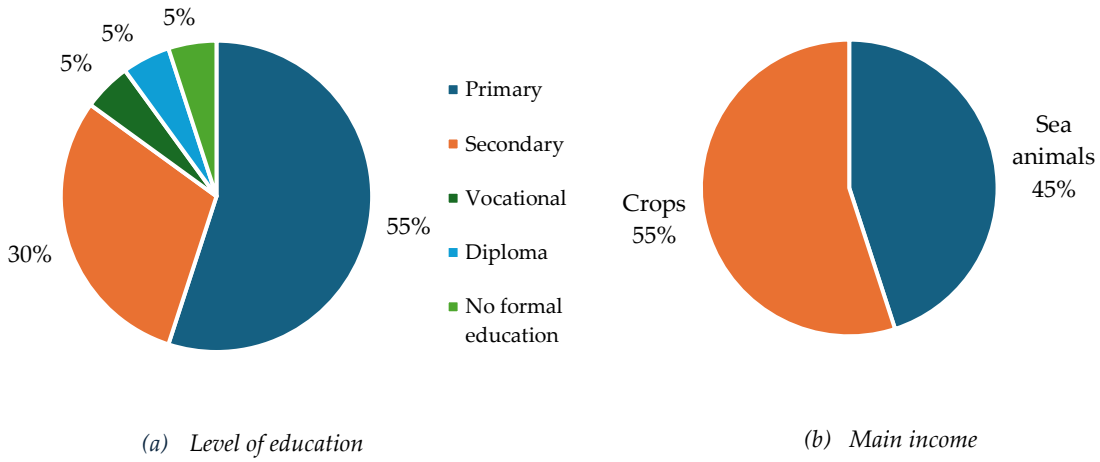
(a) Gender in percentage

(b) Age of the participants grouped in percentages

Figure 2. Gender (**a**) and age (**b**) composition of respondents in Awaiama Village, Milne Bay Province, illustrating demographic structure in relation to educational attainment and subsistence-based livelihoods

According to the National Population Statistics (National Statistical Office, 2014) the provincial literacy rate was 82.2% as of 2011, with 69.1% of the population aged five and over having attended school. Although the majority of respondents were educated, with primary education being the highest level attained, some local individuals had not undergone formal education. As noted by Harahap *et al.* (2020) and Idris *et al.* (2025) educational limitations arise from regional disparities that restrict access for children in remote areas, along with inadequate infrastructure, unequal resource distribution, and weak institutional management, all of which contribute to ongoing educational inequalities (Figure 3a).

Additionally, the National Population Statistics (National Statistical Office, 2014) indicate that Milne Bay Province has the highest proportion of individuals engaged in subsistence employment (gardening and/or fishing for own use), accounting for 81% of the population, compared to the national average of 58.3%. This suggests that a significant portion of the population produces goods and services primarily for personal use. These findings align with the study, which indicates that the main sources of income are the sale of crops and marine resources (Figure 3b). The main crops planted, harvested, and sold include bananas, yams, coconuts, cassava, taro, and sweet potatoes, while the primary marine resources harvested are fish, shellfish, sea grapes, and seaweed.

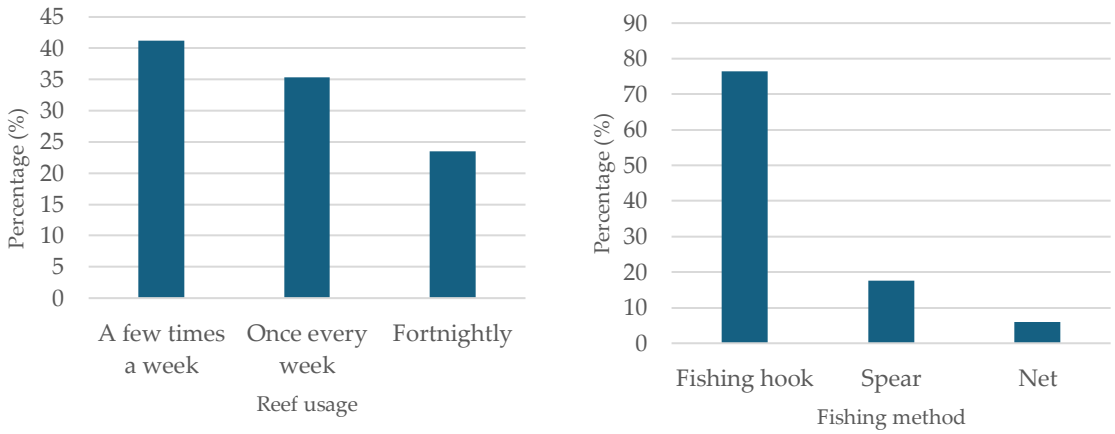


(a) Level of education *(b) Main income*

Figure 3. Distribution of respondents by (**a**) highest level of education and (**b**) main sources of household income in Awaiama Village, Milne Bay Province

3.2 Community Perception on coral reef activities.

Local families utilize the reef several times a week for fishing, primarily using handlines, a common practice among coastal communities. Spearfishing is predominantly conducted at night with the aid of a torch, while net fishing is practiced sporadically. Dugout canoes are the preferred vessels for nearshore fishing, whereas small-scale fishers mainly use motorized boats to access deeper fishing grounds. This fishing practice aligns with broader national trends in small-scale fisheries (Simard, 2024).

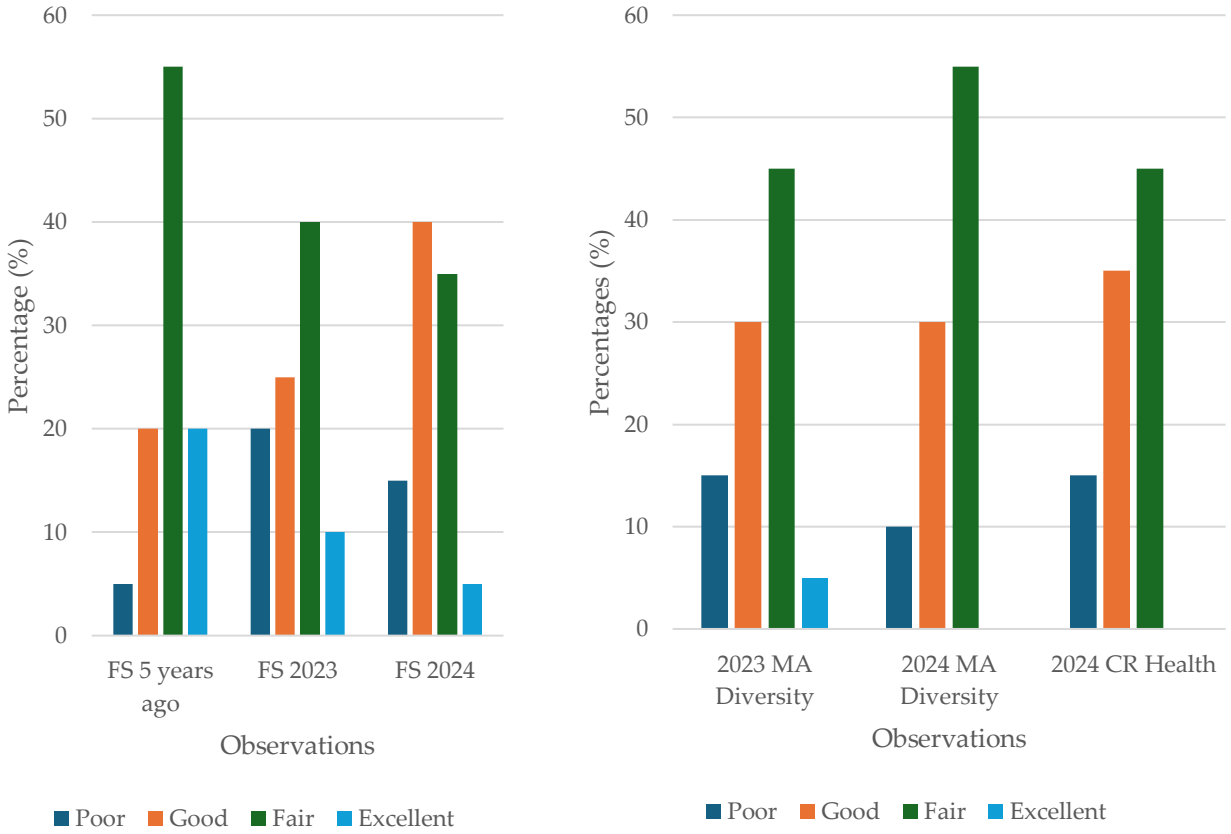


(a) Frequency of Coral Reef Use *(b) Fishing method frequently employed*

Figure 4. (**a**) Community perceptions of coral reef use frequency and (**b**) the types of fishing gear used by respondents in Awaiama Village, Milne Bay Province

Respondents have reported a decline in fish stocks within coral reef areas over the years, with both fish diversity and average fish size decreasing, raising concerns about resource availability. While current fish populations are considered moderately stable, fishers must now venture into deeper waters to find a greater variety of species and larger fish (Figure 5a). The most favourable fishing times are early mornings and late afternoons, aligning with fish migration patterns. In addition to declining fish stocks, residents have observed a reduction in other marine animal populations, which are now more difficult to catch (Figure 5b).

A preliminary assessment of coral reefs in the main fishing areas of Awaiama Village (Table 1) shows moderate hard coral cover and generally fair reef condition. Field observations reveal signs of ecological stress, including coral discoloration, coral rubble, and dead coral colonies. These findings are similar to those reported by Rasdiana *et al*. (2010) in Biawak Island, where declining coral cover and low fish biomass indicated reef ecosystem stress. The observed degradation may be limiting the diversity and complexity of the reef community.



(a) Fish Stock (FS)

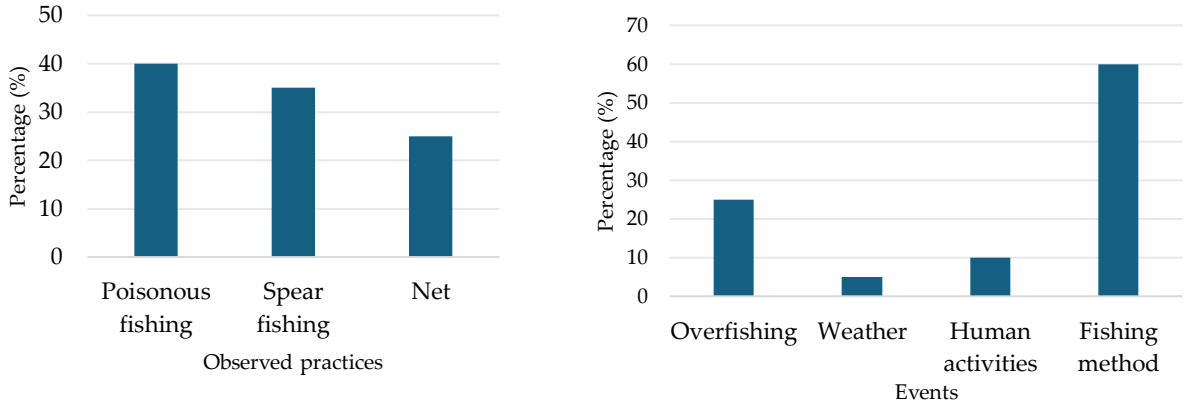
(b) Marine Animal (MA) Diversity and Coral Reef (CR) Health

Figure 5. Respondents' general observations of (**a**) changes in coral reef fish stocks and fishing depth and (**b**) declining availability of other marine animals in Awaiama Village

Table 1. Summary of coral and fish community structure at Awaiama Village, showing taxonomic richness (genera and families), coral cover and condition, and biodiversity indices (Shannon Diversity and Evenness). Results indicate moderate coral cover with fair condition, and similar levels of diversity and evenness between coral and fish communities

Corals	
Family	Acroporidae, Merulinidae, Pocilloporidae, Poritidae, Fungiidae, Caryophylliidae, Dendrophylliidae, Diploastreidae
Genus	Acropora, Isopora, Montipora, Favites, Platygyra, Leptoria, Seriatopora, Stylophora, Porites, Fungia, Cladocora, Turbinaria, Diploastrea
Coral Cover	32%
Coral Condition	Fair
Shannon Diversity Index (H)	1.92
Shannon Diversity Evenness (E_H)	0.75
Fish	
Family	Pomacentridae, Labridae, Blenniidae, Holocentridae, Apogonidae
Genus	Abudefduf, Neoglyphidodon, Stegastes, Pomacentrus, Chromis, Chrysiptera, Neopomacentrus, Dischistodus, Halichoeres, Salarias, Myripristis, Apogon
Shannon Diversity Index (H)	1.92
Shannon Diversity Evenness (E_H)	0.77

Historically, one of the most destructive fishing methods was poisonous fishing, which involved using the roots of the pandanus plant. Although this practice was discontinued years ago, it had a significant impact on fish populations. In the past, fishermen combined net fishing with pandanus root extract (commonly called "poison rope") during the flood tide to catch large quantities of fish. The local community believes that wave movement plays a role in dispersing the toxin through dilution, clearing it from the area where fish were caught, which made this method particularly effective during high tide when the currents were stronger. Today, the primary destructive fishing methods are spearfishing and net fishing, with spearfishing being preferred for its higher accuracy and effectiveness (Figure 6a). Respondents believe that fishing practices have a greater impact on fish populations than other environmental factors (Figure 6b). This issue is not only a concern for this village but for the entire country. According to Kuman (2023) reported in The National newspaper, fishing is an important part of Papua New Guinean culture, however, the ongoing practices of destructive fishing, combined with excessive fishing, is disrupting the marine ecosystem, leading to biodiversity loss and negatively affecting coastal communities.

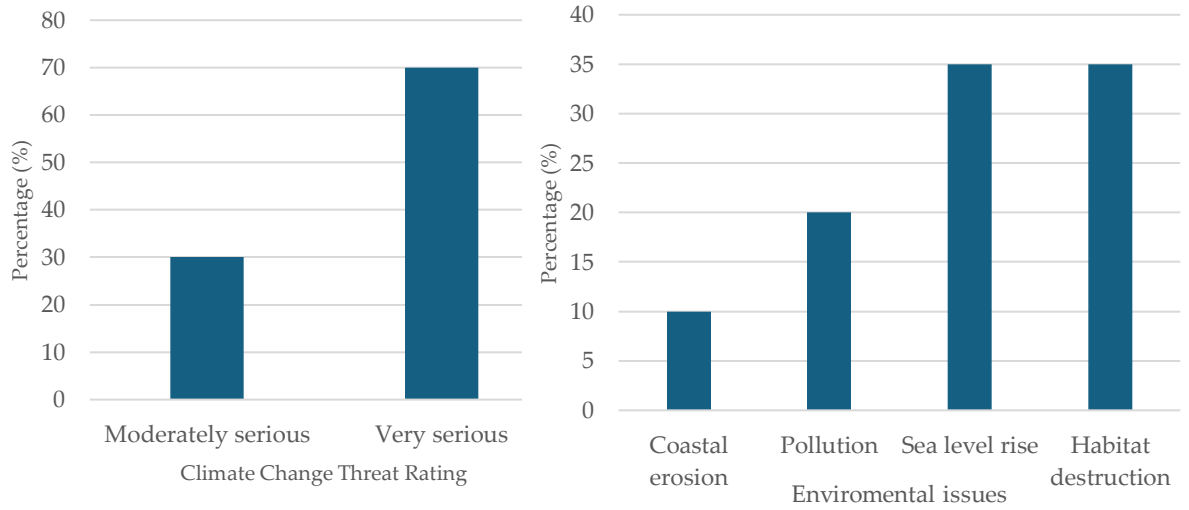


(a) Destructive Fishing Practices observed

(b) Observable events affecting fish population

Figure 6. Percentage distribution of respondents' perceptions of factors influencing fish population growth in Awaiama Village: (**a**) destructive fishing practices and (**b**) observable environmental events

Climate change is not a new issue to the community, as respondents have observed its effects over the years and consider it a serious issue (Figure 7a). One of the most significant impacts they reported was the 2018 king tide, which caused coastal erosion and saltwater intrusion in some parts of the village. Over time, rising sea levels, combined with wave action and seasonal winds, have contributed to ongoing beach erosion (Figure 7b). It was also observed that mangrove coverage along the coastline was minimal or absent, reducing the natural protection of the communities against natural disasters.



(a) Perceived Seriousness of Climate Change

(b) Environmental issues affecting the village

Figure 7. Respondents' perceptions of climate change impacts in Awaiama Village with (**a**) the perceived seriousness of climate change threats and (**b**) environmental issues affecting the village

Awaiama follows a matrilineal system, in which females are responsible for kinship and inheritance. The village is organized into several clans, with leaders elected from both genders. Within the community, various groups exist, including church groups, women's groups, and youth groups, whose leaders also participate in clan meetings and decision-making processes. Figure 8 illustrates the level of community participation, with the majority of the respondents reporting not being part of the committee, not holding leadership roles, and not having held leadership roles in the past. However, participation in clan meetings was higher, with 55% of the participants actively taking part in the discussion and decision-making. It was reported that due to the growing population, traditional regulations have become lenient, and leaders are less strict than before in controlling the extraction of coastal resources.

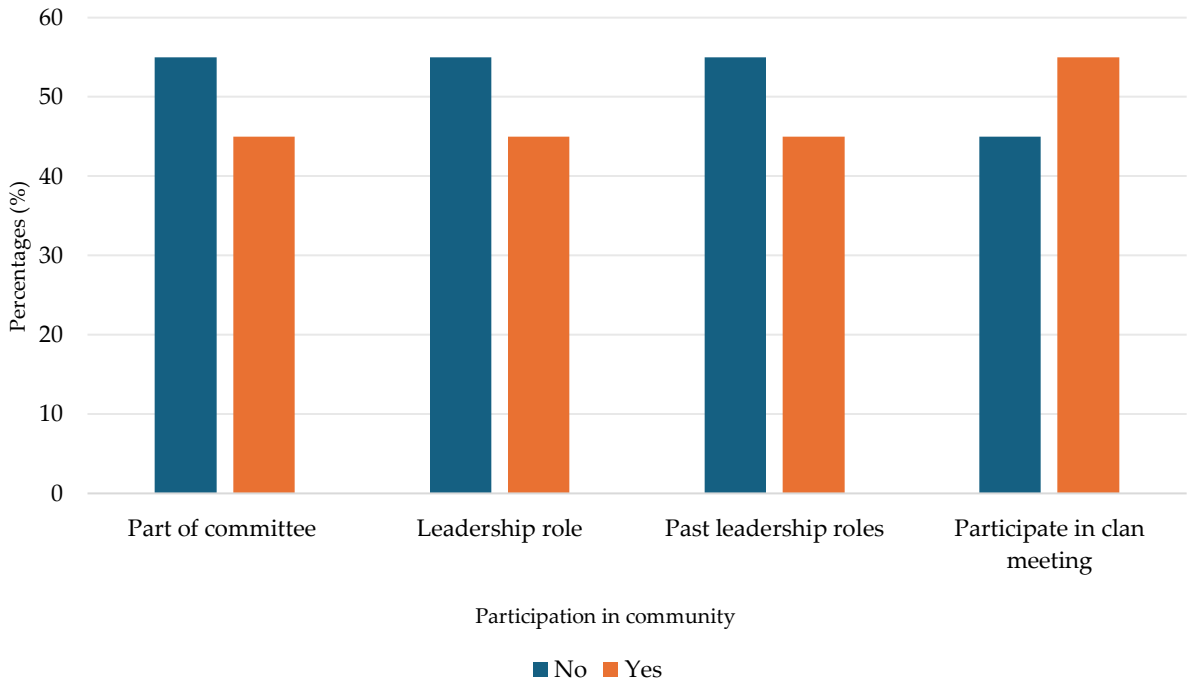


Figure 8. Respondents' percentage distribution showing participation and non-participation in community leadership roles and clan decision-making in Awaiama Village

3.2. Challenges Identified by the Community

The majority of respondents are beginning to recognize the importance of a healthy reef ecosystem and its benefits to their livelihood, culture, environment, and economy. They acknowledge that continuous fishing pressure could lead to a decline in protein availability, reduced income, and diminished village appeal. While most respondents are aware of the rules and regulations regarding coral protection, some remain unaware but express a willingness to learn and participate in conservation efforts. Furthermore, many agree that traditional knowledge and practices played a crucial role in maintaining sustainability in the past. To ensure long-term resource conservation, they believe that stronger regulations should be established and enforced (Table 2).

Table 2. Respondents' attitudes toward coral reef conservation and resource management practices in Awaiama Village

Variables	Categories	Percentages
Coral reefs are important to a community's livelihood and culture	Agree	65
	Strongly agree	35
The health of coral reefs directly impacts the livelihood (e.g. fishing, tourism)	Disagree	5
	Neutral	15
	Agree	80
Aware of the benefits of coral reefs to the environment and economy	Agree	60
	Strongly agree	40
Aware of the rules and regulations regarding the protection of coral reefs	Disagree	5
	Neutral	5
	Agree	65
	Strongly agree	25
Willingness to participate in coral reef protection activities	Agree	60
	Strongly agree	40
Traditional knowledge and practices contribute to the sustainable management of coral reefs	Strongly disagree	5
	Neutral	15
	Agree	70
	Strongly agree	10

4. Discussion

Contextual information gathered from this study contributes to identifying the community's perspectives on coastal resources, particularly coral reefs. Awaiama village, situated within the Maramatana Rural LLG, has an estimated population of 575, comprising 109 households, according to the National Population Statistics (National Statistical Office, 2014b). The geographical location of Awaiama restricts formal employment opportunities, resulting in the local people relying on subsistence livelihoods. As the population grows, fishing pressure increases, leading to higher extraction rates from coral reefs. The high dependence emphasizes the socio-economic significance of coral reefs to the community, aligning with global observations that coral reefs support the livelihoods of millions of people, particularly in coastal regions (Cinner, 2014).

Moreover, various types of fishing gear and methods contribute to the destruction of coral reefs. Although fishing hooks are frequently used, spears and nets are prevalent. Night spearfishing increases catch efficiency by targeting vulnerable, resting reef fishes such as parrotfishes, but it can also pose risks to coral habitats through frequent physical contact by spearfishers (Lucena *et al*., 2024; Sbragaglia *et al*., 2023). Similarly, 64% of fish consumption in PNG is obtained from subsistence fishing, and 36% was purchased, whereas in Milne Bay Province alone, the marine ecosystem contributes to human well-being by providing 57% of necessary goods and services (Bell *et al*., 2009; Butler *et al*., 2014).

Furthermore, the declining condition of the reef raises concerns about the sustainability of the community in the long term. The fish stock, marine animal diversity, and coral reef health displayed in Figure 5 have shifted over time. Data for 2024 show a decline in fish stock classified as "Fair," while the "Good" category has increased, suggesting improvements in fishery management practices. However, the persistence of "Poor" fishing stock highlights ongoing challenges in achieving sustainable fishing. Declining reef conditions, reflected in lower fish yields, have been strongly linked to destructive fishing practices (Mendes, 2024), while pollution and climate change have further intensified coral degradation and structural damage, reducing fish populations and increasing reef vulnerability (Arora and Choudhary, 2025). Marine animal diversity and coral reef health data from 2023 and 2024 indicate that the "Fair" category remained predominant, particularly in 2024. Notably, the increase in "Good" ratings for marine animal diversity and coral reef health suggests partial ecosystem recovery. Despite this, the continued presence of "Poor" fish stock and diversity levels underscores enduring threats from overfishing and habitat degradation (FAO, 2022).

Additionally, fluctuations in the coral reef ecosystem are reflected in both coral and fish communities. Findings from Table 1 indicate a moderately healthy coral community with high diversity (H = 1.92) and evenness (E_H = 0.75). Recent studies similarly report moderately healthy coral with measurable diversity and evenness, suggesting potential resilience (Vito *et al*., 2025; Samoilys *et al*., 2025). Fish communities show comparable diversity (H = 1.92) and slightly higher evenness (E_H = 0.77), largely dominated by disturbance-tolerant species such as damselfishes, which can replace more sensitive species and reduce functional diversity. These patterns may result from external stressors, such as sedimentation, pollution, or human disturbance, which can limit overall species richness (Drew *et al*., 2015).

Fishing practices including poisonous fishing, spearfishing, and net fishing contribute to habitat degradation and biodiversity loss, ultimately affecting fish populations. Widely recognized in the literature as “destructive fishing” (Willer *et al*., 2022), these methods degrade reef structures and reduce reef resilience, leading to declines in fish communities (Najeeb *et al*., 2025). The continued use reflects limited awareness or enforcement of sustainable fishing practices, a common challenge in coastal communities.

Correspondingly, fishing methods and overfishing are identified as the primary factors affecting fish populations, while human activities and weather play lesser roles. These findings align with research showing that destructive fishing and overexploitation significantly reduce reef resilience by altering species composition and ecosystem services *(Drew et al., 2015; Keller et al*., 2009). Sediments, toxins, and debris entering the water from land or marine vessels further disrupt the ecosystem by reducing water quality, smothering corals, and harming marine animals (Najeeb *et al*., 2025; Thushari and Senevirathna, 2020).

The respondents view climate change as either moderately serious to very serious indicating a general awareness of its impacts. Climate change presents significant environmental challenges, including ocean warming, sea level rise, and increased frequency of extreme weather events, all of which are threats to the resilience of coral reef ecosystems (Hoegh-Guldberg *et al*., 2017). Among the identified environmental threats sea level rise and habitat destruction were regarded as the most severe, while pollution and coastal erosion gradually increasing. Climate change contribute to coastal erosion and saltwater intrusion, leading to habitat degradation and reduced freshwater availability for coastal communities (Dong *et al*., 2024).

Furthermore, Figure 8 illustrates community participation in leadership and decision-making roles related to coastal resource management. The majority of the respondents reported not being part of the committees, holding leadership roles, or having past leadership experience. However, participation in clan meetings had a higher percentage of "Yes", suggesting a stronger engagement in traditional decision-making. According to Scott (2013), participation of local communities in government structures, such as committees and leadership roles, is important for achieving sustainable resource management. Lower engagement in leadership roles indicates limitations such as lack of capacity, exclusion from the decision-making process, or strong power that hinders broader participation.

The absence of formal environmental control mechanisms or customary rules to support coral conservation is a primary hindrance to addressing reef degradation. While there has been a recent closure to a degraded section of the reef by community leaders, this ad hoc action is insufficient to ensure reef health over the long term. The lack of systematic conservation efforts is a common feature for most developing regions, where resource management systems are weak or absent (Hughes *et al*., 2005). However, the receptivity of the community to participate in and adhere to conservation efforts, as demonstrated in Table 2, presents an opportunity for the development of co-management frameworks embracing local knowledge and practices with scientific approaches (Keppel *et al*., 2012). The willingness to participate in conservation efforts reflects the potential for community-led initiatives (Scott, 2013). While traditional knowledge is recognized, some remain uncertain about its role, highlighting the need for integrated management approaches (Paeniu *et al*., 2015).

Overall, findings suggest that an integrated approach will be needed to address reef decline in this community. To begin with, responsible fishing methods must be promoted by education and enforcement of the law. Community management schemes, such as the establishment of marine protected areas (MPAs) or seasonal fishing bans, could relieve pressure on the reef system (Govan *et al*. 2008). Similarly, to mitigate pollution, awareness of land and sea waste management must be done regularly by local leaders. Lastly, climate change adaptation strategies, such as mangrove forest restoration to serve as a buffer for coastal erosion and storm surges can enhance the resilience of reefs and communities (Guannel *et al*., 2016).

5. Conclusions

This study highlights the connections between human activities and ecological conditions in Awaiama Village, where community livelihoods are closely tied to the health of coral reef ecosystem. The findings reveal that fishing pressure, limited awareness of sustainable practices, and weak enforcement of community regulations have contributed to habitat pressure, affecting fish populations and coral health. However, the local community demonstrates a strong willingness to engage in conservation efforts and recognizes the cultural, economic, and environmental value of reef ecosystem.

Moreover, the analysis of community characteristics shows a predominantly subsistence-based lifestyle, strong clan structures, and emerging participation in traditional decision-making forums. Despite the limited involvement in formal coastal management organizations, there is potential for increased local engagement through co-management frameworks that integrate traditional knowledge with scientific strategies.

To address the socio-ecological challenges, future management efforts must prioritize community involvement, strengthen local leadership, and promote education on sustainable

fishing practices. A collaborative approach between local stakeholders, government agencies, and non-government organizations (NGOs) will be vital for the sustainability of the ecosystem and livelihood.

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