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The Relationship Between Education Level and Environmental Awareness With the Implementation Sustainable Fishing in Gorontalo Bay

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Abstract

Abstract: Sustainable fisheries management in coastal areas is a challenge as well as a strategic opportunity in maintaining the sustainability of marine resources and the welfare of fishing communities. Bone Bolango Regency, which has quite large fisheries potential, especially in the Tomini Bay area, faces various challenges in its fisheries governance, ranging from low community participation, limited responsive policy support, to minimal cross-sector collaboration. This study aims to analyze sustainable fisheries management in Bone Bolango by emphasizing the role of fishing communities, government responsiveness, and multi-party partnerships. The method used in this study is a descriptive qualitative approach with data collection techniques through in-depth interviews, field observations, and documentation studies. Data were analyzed using the Business Model Canvas framework adapted to the Design Thinking approach to understand the dynamics of user needs, actor roles, and innovation in governance. The results of the study show that active participation of fishing communities has a significant influence on the legitimacy of policies and the success of marine conservation programs based on local wisdom. However, this involvement is still hampered by low environmental literacy and technical capacity. In addition, the level of responsiveness of local governments is still partial, focusing more on technical assistance than building equal dialogue mechanisms. Meanwhile, collaborative practices between fishing communities, government, and the private sector have not been optimal due to the weakness of existing partnership institutions. This finding strengthens the arguments of a number of previous studies that emphasize the importance of environmental education, integration of local knowledge, and inclusive partnerships in coastal resource management. The implications of this study indicate that the success of sustainable fisheries management is largely determined by an adaptive, community-based governance model supported by strategic cross-sector partnerships. Therefore, it is necessary to design policies and programs that are more responsive to the needs of coastal communities, strengthen community capacity, and build participatory and sustainable collaborative institutions.

Introduction

Gorontalo Bay is a coastal area that has high marine biodiversity and is the main source of livelihood for coastal communities, especially traditional fishermen, (Asruddin et al., 2021). However, pressure on marine resources in this area is increasing along with the intensity of environmentally unfriendly fishing activities, the use of destructive fishing gear, and climate change that affects the balance of the marine ecosystem. In facing these challenges, the concept of sustainable fishing is a very important approach to ensure the sustainability of marine resources and the welfare of coastal communities in the long term, (Yulisti et al., 2024). The implementation of sustainable fishing does not only depend on regulations and technology, but is also greatly influenced by socio-ecological factors, such as the level of education and environmental awareness of fisheries actors, (Elegbede et al., 2023). Adequate knowledge of the impacts of destructive fishing practices and an understanding of the importance of maintaining marine ecosystems are the basic capital in changing exploitation behavior into sustainable management. On the other hand, low levels of education are often associated with limited understanding of sustainability principles, while low environmental awareness leads to resistance to changes in more environmentally friendly fishing practices, (Al Amin et al., 2021). Previous studies have shown that successful interventions in fisheries conservation are often supported by individuals' capacity to understand and accept sustainability values.

A study by (Kasri et al., 2024) revealed that fishermen with higher levels of education tend to have a better understanding of the concept of sustainability and its impact on the sustainability of catches. Research by (Ghaisani, & Astuti 2019) showed that fishermen with good environmental awareness tend to have proactive behaviors, such as avoiding catching immature fish and complying with fishing area zoning regulations. However, low levels of education and environmental awareness are still significant challenges in implementing sustainable practices in various regions. Research by (Syamsuddin & Salam, 2023) found that in areas with limited access to education and information, fishermen are more likely to use destructive methods, such as fish bombing or the use of chemicals. This is exacerbated by economic pressures that force fishermen to prioritize short-term profits over long-term sustainability. This condition leads to the importance of evaluating the effectiveness of the implementation of sustainable fisheries management policies in the area. Although the government has issued various policies related to marine resource conservation and sustainable fisheries management, the weak internalization of sustainability values among fishermen and the lack of an education-based approach have made these policies not run optimally at the grassroots level. The minimal participation of fishermen in the preparation and implementation of policies also worsens the situation, because top-down regulations are often not in accordance with local social and economic realities.

Fishermen in the Goerontalo Bay area rely heavily on traditional activities, but face major challenges due to low levels of education and knowledge about marine ecosystems. Limited mindsets make fishermen tend to pursue short-term catches without considering resource sustainability, so that destructive practices such as the use of environmentally unfriendly fishing gear and over-exploitation are still common. Low environmental awareness worsens this condition, coupled with minimal education and conservation campaigns that result in very low compliance with sustainable marine management regulations. The impacts are beginning to be seen through declining fish stocks, habitat destruction such as coral reefs, and declining

coastal environmental quality, which ultimately threatens the economic sustainability of the community. This situation not only threatens the ecosystem, but also the economic stability of coastal communities, which are fully dependent on the fisheries sector as shown in (Table 1) below.

Table 1 Fisheries Production Data for Gorontalo Province in 2023

Regency/City	Marine Capture Fisheries Production	Production Value of Capture Fisheries in the Sea	Inland Public Water Fisheries Production	Inland Public Water Fisheries Production Value	Capture Fisheries Production	Capture Fisheries Production Value
	(Ton)	Ribu (Rp)	(Ton)	Ribu (Rp)	(Ton)	Ribu (Rp)
Boalemo	22.626	458.486.062	-	-	22.626	458.486.062
Gorontalo	20.450	624.757.385	1.760	48.968.839	22.210	673.726.224
Pohuwato	27.084	867.699.280	-	-	27.084	867.699.280
Bone Bolango	10.991	257.168.504	-	-	10.991	257.168.504
Gorontalo Utara	25.831	632.695.671	-	-	25.831	632.965.671
Kota Gorontalo	19.118	647.795.607	215	6.344.273	19.333	654.139.880

Data source: Badan Pusat Statistik Gorontalo Province in 2023

Based on the 2023 Gorontalo Province fisheries production data (Figure 1), it can be seen that Bone Bolango Regency has a relatively lower marine capture fisheries production volume compared to other regencies/cities, which is 10,991 tons with a production value of around IDR 257 billion. This amount is quite far from Pohuwato (27,084 tons) and Boalemo (22,626 tons), even lower than Gorontalo City which has a more limited sea area but recorded higher production. This fact indicates that there is marine fisheries potential that has not been optimized in Bone Bolango Regency. One of the suspected causes of low production is the still dominant unsustainable fishing practices, low adoption of environmentally friendly technology, and minimal knowledge and awareness of fishermen about the importance of maintaining marine ecosystems. However, until now there has not been much research that specifically examines how socio-ecological factors, such as the level of education and environmental awareness of fishermen, contribute to the low productivity and sustainability of fisheries practices in this region. Therefore, there is an important research gap to explain the relationship between the social characteristics of coastal communities and sustainable fishing practices, especially in Bone Bolango Regency. This research is relevant to fill the gap in literature while providing data-based input for the formulation of sustainable fisheries policies in the area.

Ansell and Gash (2008) in their study on collaborative governance emphasize the importance of three approaches in participatory policies, namely community involvement, government responsiveness, and the formation of networks that are relevant to sustainable fisheries management. In this context, the active involvement of fishermen in program planning and implementation is the key to success, because it allows them to voice local conditions and contextual solutions. On the other hand, government responsiveness to input from fishermen is very important to ensure inclusive and applicable policies. In addition, the formation of networks between the government, fishing communities, and the private sector can strengthen cross-actor synergy, expand access to resources and technology, and encourage environmentally friendly investment to support competitive and sustainable sustainable fishing practices.

The novelty value of the problem-solving approach in this article lies in the integration of the socio-ecological dimension and the collaborative governance approach in the local context of traditional fisheries in Gorontal Bay. Unlike previous studies that tend to emphasize the technical aspects of fisheries resource management or are limited to environmental education counseling, this article offers a new perspective by positioning fishermen not only as objects of policy recipients, but as active subjects in the process of formulating and implementing sustainable fisheries policies. The principles of community involvement, government responsiveness, and the formation of cross-sector networks, this study highlights the importance of synergy between actors to create policies that are not only based on ecological data, but also take into account the social, cultural, and educational dimensions of coastal communities. This approach is expected to be able to fill the gap in literature that has so far lacked integration of community participation and institutional collaboration in efforts to strengthen the implementation of sustainable fishing in Indonesia's tropical coastal areas.

Method

This study uses the Design Thinking approach as a methodological framework to understand, explore, and formulate contextual solutions to the low implementation of sustainable fishing among traditional fishermen in Bone Bolango Regency, Gorontalo Bay. Design Thinking was chosen because it is able to accommodate a human-centered, collaborative, and iterative approach in responding to complex problems involving social, educational, and environmental factors (Zupan & Nabergoj 2022). The Design Thinking approach offers a human-centered framework (human-centered design) and prioritizes empathy, collaboration, and literacy in designing solutions, through 4 stages including: 1) Empathize, which is to explore in-depth understanding of the experiences, challenges, and perspectives of fishermen through direct observation and exploratory interviews; 2) Define, which is to formulate the root of the problem based on empathetic findings to identify the main obstacles in the implementation of sustainable fishing; 3) Ideate, which is to gather innovative solution ideas through focus group discussions (FGD) with fishermen, local governments, and related parties; 4) Prototype, namely compiling an initial design for a collaborative or intervention model based on education and cross-sector partnerships, (Leary et al., 2022). This article also designs a collaborative business model based on the Business Model Canvas through a Design Thinking approach in the context of sustainable fisheries management in local fishing communities which is described as follows:

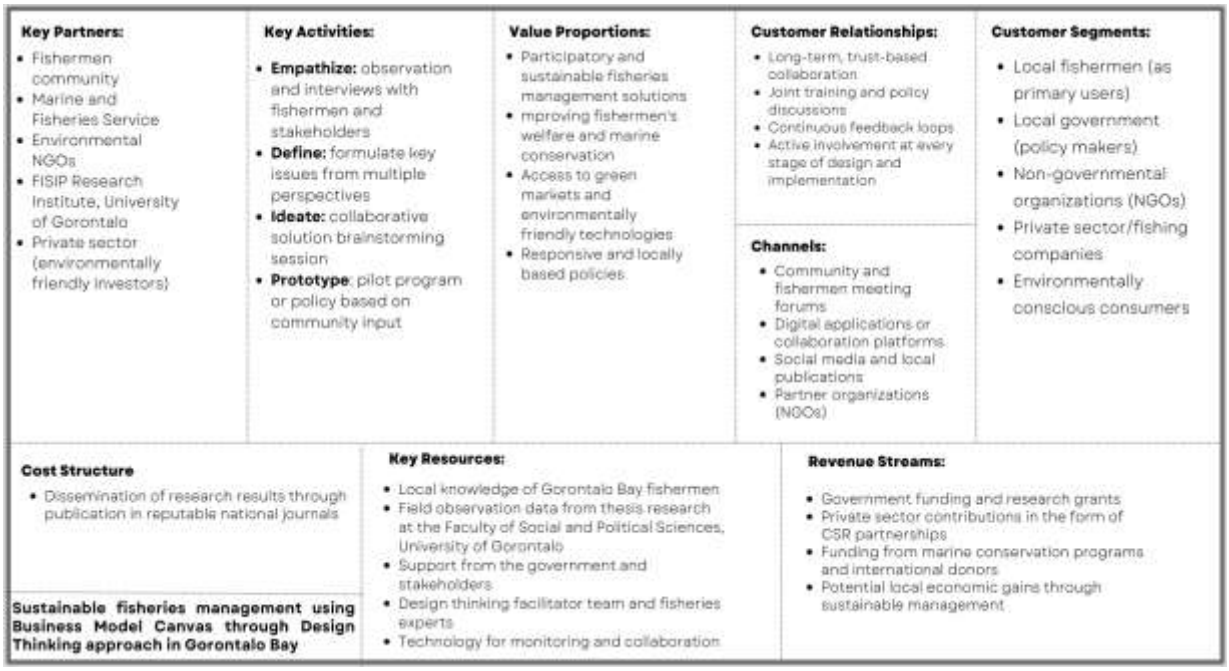

Figure 1: Business Model Canvas with Design Thinking approach

Headlines of the first analysis or discussion

The combination of adequate education levels and strong environmental awareness is an important foundation in realizing sustainable fisheries. However, in reality, in many coastal areas of Bone Bolango, education is still uneven and environmental awareness is still low. This is due to limited access to education, minimal environmental outreach activities, and weak integration of sustainability issues in regional development programs. Research on the relationship between education levels and environmental awareness with the implementation of sustainable fishing is very relevant and strategic in this context. The results of the study can provide a comprehensive picture of the extent to which these two factors influence the practices of coastal communities. This study highlights the importance of synergy between actors to create policies that are not only based on ecological data, but also take into account the social, cultural, and educational dimensions of coastal communities, which are reviewed in the following sub-chapters:

1. Community Involvement in Sustainable Fisheries Management Programs

The issue of sustainability in fisheries management is increasingly receiving widespread attention, along with increasing pressure on marine resources due to over-exploitation, climate change, and coastal ecosystem degradation. In this context, the involvement of local communities, especially fishing communities, is a crucial element in determining the success of sustainable fisheries management programs. As the main actors who interact directly with the sea, local communities are not only affected parties, but also have the capacity as agents of change who can maintain and manage resources responsibly.

This study was conducted to understand the extent to which local communities are involved in the planning and implementation process of sustainable fisheries management programs. The focus of the study was directed at efforts to explore community participation in various stages of policy, from problem identification, planning, to implementation and evaluation. This

study also assessed the extent to which community involvement influences the effectiveness of the management policies implemented.

Based on interviews with fishing communities in Modelomo Village, Kabila Bone District, Bone Bolango Regency, researchers revealed a slowly growing awareness of the importance of maintaining marine sustainability. Many fishermen expressed concerns about the decline in catches in recent years, which they associated with destructive fishing practices such as the use of fish bombs, poisons, and small-mesh nets.

> "… Fishermen here have been using the same approach for generations when they want to fish in the sea. Fishing rods or using trawl nets. But not all of them have received technical assistance or direct support from the government. If asked about using other alternatives, frankly we lack training. Personally, I want to be involved in marine conservation programs, as long as there is training, legal certainty, and access to alternative fishing gear. (Interview with fishermen/February 12, 2025)

From the Bone Bolango Regency Fisheries Service, the interview revealed that the local government already has a number of programs that support sustainable fisheries management, such as assistance with environmentally friendly vessels, marine cultivation training, and socialization of conservation areas.

> "… So far, the central government and local government programs have supported the sustainable fishing program. But changing the mindset of the fishing community is the most difficultHowever, the service also admits that community involvement in the planning stage is still not optimal. The main challenges faced are budget constraints, lack of assistants, and low community literacy regarding fisheries regulations and technology. The agency emphasized that active participation from the community is needed so that the programs designed are not only administrative in nature, but truly answer the needs in the field. (Interview with the Head of Capture Fisheries Division of the Bone Bolango Regency Fisheries Service/March 3, 2025)

Interviews with other informants such as academics, environmental NGOs, and local traditional leaders provided additional perspectives. They highlighted the importance of integrating local wisdom with a scientific approach in managing marine resources.

> "… As an environmental activist, I think that the challenge currently faced by the community is that many fishermen still do not fully understand the concept of sustainability, not because of a lack of will, but because of limited information and a less than targeted delivery approach. The NGO has run several programs such as training in identifying target and non-target fish, preserving coral reefs, and strengthening fishermen groups. As a result, in several fostered villages, there has been a change in mindset and behavior in fishing practices. (Interview with Bone Bolango Regency fishermen activist/February 12, 2025)

2 Government Responsiveness to Sustainable Fish Management Programs

In facing the challenges of marine resource degradation and declining catches of traditional fishermen, the role of government in supporting sustainable fisheries management is becoming increasingly crucial. This research is motivated by the need to understand the extent to which local governments, especially in Bone Bolango Regency, are responsive to the dynamics and needs of coastal communities in implementing environmentally friendly fisheries programs. Government responsiveness in this context is not only measured by the existence of regulations and budget allocations, but also by its ability to adjust policies, strengthen cross-sector coordination, and actively assist fishing communities. The results of the study show that

although there are several policies that support the direction of sustainable fisheries management, such as environmentally friendly fishing gear training programs and empowerment of joint business groups (KUB), the government's response still tends to be reactive and short-term. Based on interviews with fishermen in Olele Village, Bone Bolango Regency, researchers said that:

> "… Compared to before, it has decreased significantly. In the past, we could only go out to sea for half a day and bring home a lot of fish. Now, sometimes we go out to sea from morning to evening, but the results are still lacking. Many spots that used to be mainstays now don't have many fish. Maybe because they are taken too often, there is no break. There are also those who use destructive fishing gear, such as bombs or fine nets. Sometimes there are also those from outside the village who come and take them at will. (Interview with fishermen in Olele Village/February 12, 2025)

Direct government involvement in coastal community dialogue forums is also still limited, so that local aspirations have not been fully accommodated in the policy planning and evaluation process. On the other hand, several progressive initiatives have emerged from technical units in the fisheries office that are actively partnering with NGOs and universities to strengthen community capacity. Based on the researcher's interview with fishermen in Huangobotu Village regarding whether there are programs from the government or other institutions that help fishermen here to fish in a more sustainable way, they said that:

> "… There have been several trainings from the agency, as well as assistance with fishing gear. But not all fishermen get it. Sometimes only those who are active in groups are prioritized. Furthermore, information about the program does not always reach all fishermen. The government should come and talk to us directly more often. Not only when there is a project. Furthermore, it is necessary to also invite traditional leaders and youth. And if possible, also help with equipment that we really need, not equipment that is difficult to use. (Interview with fishermen in Huangobotu Village/February 12, 2025)

This study also highlights that the success rate of sustainable fisheries management programs is highly correlated with the extent to which the government is present as a responsive and adaptive facilitator. When the government is able to read changes in the situation in the field including climate change, fish migration patterns, and economic pressures on the community and adjust its interventions quickly and appropriately, the chances of the program's success will be much greater. On the other hand, delayed response and weak monitoring and evaluation are often the main obstacles in maintaining program continuity. Based on the results of the researcher's interview with a fisherman's wife in Botubarani Village, she said:

> "… I support it if there are rules to protect the sea. But the rules must be fair. Sometimes we feel that small fishermen are being oppressed, while large ships can freely catch fish outside. If my husband comes home from fishing with little results, we have to go into debt. We want to be taught better ways, maybe training or other business assistance too. So that we don't just depend on fish. When asked whether the government is involved, never. Usually only the head of the group is invited. Mothers like me are rarely involved, even though we also know how hard life is if the sea no longer produces results. (Interview with a fisherman's wife in Botubarani Village/February 12, 2025)

In an effort to enrich perspectives, interviews were also conducted with a number of other key informants, such as academics from local universities, traditional leaders, and small-scale

fisheries business actors operating in the coastal areas of Bone Bolango Regency. An academic from the marine department revealed that the local government's policy approach is still not fully based on marine ecosystem data and the socio-economics of fishing communities.

> "... Sometimes the interventions carried out are still general, not considering the specific characteristics of each coastal area. In fact, the data is already available and can be used as a basis for planning. Several customary practices such as sea sasi or fishing bans in certain seasons have been proven to maintain eco-sustainability. coastal systems for years. However, he complained that the government rarely invited them to dialogue or involved indigenous communities in the policy-making process. "The government should come down to listen more often. Not only come during socialization or aid distribution," (Interview with a fisheries lecturer at Gorontalo State University/March 22, 2025)

Several statements from informants from small-scale fisheries business actors conveyed that several government regulations are still difficult to implement due to the lack of supporting facilities. For example, the appeal to use environmentally friendly fishing gear is often not accompanied by assistance with equipment or technical training.

> "... We support it, but the reality is that fishing gear is expensive and sometimes not available here. We need real solutions, not just regulations," he explained. This interview reinforces the finding that government responsiveness is not only about the speed of response, but also about accuracy and completeness in supporting real needs in the field. (Interview with fishing boat owner/February 12, 2025)

3 Establishment of a Cooperation Network Between Government, Fishermen Communities, and the Private Sector in Sustainable Fisheries Management

Sustainable fisheries management can no longer be implemented sectorally and separately, but requires a collaborative approach involving all stakeholders. The complexity of fisheries problems ranging from over-exploitation, damage to marine ecosystems, to inequality of access and economic benefits requires synergy between key actors involved in the production system and management of fisheries resources. In this context, the formation of a network of cooperation between the government, fishing communities, and the private sector is an important pillar to ensure the sustainability of marine ecology as well as the welfare of coastal communities.

The government, as a policy maker and system regulator, has a vital role in creating regulations that support multi-party collaboration. However, regulations alone are not enough. This is based on the results of the researcher's interview with the Head of the Bone Bolango Regency Fisheries Service who emphasized that:

> "… If we look at it, cooperation between the government, fishermen, and the private sector is very important, especially in the context of Bone Bolango which has great marine potential but also many challenges. We from the government cannot work alone. For example, to improve the quality of catches or market access, we need technological support and investment from the private sector, and fishermen must be empowered so that they can actively participate, not just be beneficiaries. (Interview with the Head of the Fisheries Service/March 22, 2025)

Active efforts are needed to build partnerships, facilitate cross-sector communication, and provide participatory space for fishing communities to be involved in the decision-making process. In several case studies, such as community-based conservation area management, collaboration facilitated by the government has been shown to increase compliance,

effectiveness of supervision, and achievement of conservation goals. Regarding whether the fishermen's group has ever been involved in collaborative programs with the government or the private sector, Fishermen in Olele Village emphasized that:

> "… Yes, there are several programs that involve us, such as training in environmentally friendly fishing gear and our involvement in the formation of conservation areas. But to be honest, sometimes fishermen feel that they have not been fully involved in the planning. We need to be involved from the start, not just during implementation. If there is better communication, I am sure that cooperation can be stronger. (Interview with fishermen/February 12, 2025)

The fishermen's community itself plays a strategic role as the main actor in the field. Local experience, traditional wisdom, and direct dependence on fishery resources make them the main guardians of marine sustainability. However, their involvement is often hampered by limited access to information, technology, and capital. Based on the researcher's interview with a business actor who owns a ship in Huangobotu Village, he said that:

> "… We have established partnerships with several fishermen's groups, especially in ensuring the quality and sustainability of marine products. But not all fishermen are ready. We need assistance from the government, so that there is standardization and education. We are very open to cooperation, as long as there is a clear and mutually beneficial framework. (Interview with business actors/March 25, 2025)

Result and Discussion

The results of this study underline that the success of sustainable fisheries management in Bone Bolango Regency is greatly influenced by three main factors, namely the active involvement of local communities, government responsiveness, and the formation of synergistic multi-party partnerships. These three findings do not stand alone, but are interrelated and strengthen each other in creating adaptive, inclusive, and sustainable fisheries governance. The involvement of fishing communities in the decision-making process, program implementation, and monitoring of marine resources shows that local knowledge-based participation has an important role in creating policy legitimacy. On the other hand, the role of the government as a party that is responsive to the real needs of fishermen and a facilitator of cross-sector collaboration is an absolute prerequisite for policy effectiveness. In line with various previous studies, these findings emphasize the importance of a collaborative approach that prioritizes two-way communication, community empowerment, and the creation of sustainable participatory spaces. Therefore, the following discussion will explore the relationship between these findings and the theoretical framework and previous studies, as well as explore practical implications that can strengthen the sustainable fisheries management model in coastal areas such as Gorontalo Bay. The sub-topic on community involvement in sustainable fisheries management programs shows that community involvement not only contributes to policy legitimacy but also increases a sense of ownership of the programs being implemented.

Active community participation encourages transparency, strengthens social oversight of fishing practices, and gives rise to local innovations that are relevant to local socio-ecological conditions. This involvement also opens up space for dialogue between the government, NGOs, and business actors, thereby creating synergy in marine resource governance. However, this study also reveals structural and cultural barriers that limit full community participation. Lack of access to information, limited technical capacity, and the dominance of top-down

approaches in decision-making are the main challenges. In some cases, communities are only involved symbolically without meaningful consultation mechanisms, so their contribution to the substance of the policy is limited. Research by (Sukomardojo et al., 2023) emphasizes that local communities are an important element in effective fisheries management. Local knowledge possessed by fishermen, such as an understanding of fishing seasons and fish spawning locations, can enrich the decision-making process in marine resource management. Integrating this knowledge with a scientific approach can improve the effectiveness of conservation programs and sustainable fisheries management. A study by (Najmi et al., 2020) showed that active community participation in marine conservation area management can increase a sense of ownership and support for conservation policies. This involvement can also reduce conflicts between communities and conservation area managers, and encourage compliance with established regulations.

Community participation also opens up opportunities for livelihood diversification, such as ecotourism and recreational fishing, which can improve the welfare of coastal communities. Despite the many benefits of community participation, several studies have shown challenges in its implementation. For example, a study by (Fauziah, M., & Rahmah, Y. F. 2018) found that the level of community participation in fisheries management in Banjar, South Kalimantan, was still low. This is due to the lack of community understanding of the importance of conservation, limited access to information, and minimal training provided to fishermen. Environmental education and awareness play an important role in encouraging community participation in sustainable fisheries management. Research by (Sagala, et al., 2024) shows that integrating conservation materials into the education curriculum can improve students' understanding and concern for the environment. This has the potential to create a younger generation that is more aware of the importance of preserving marine resources.

Based on the results of this study and reinforced by a number of previous studies, the researchers concluded that local community involvement is a key factor in the success of sustainable fisheries management in Bone Bolango Regency. The active participation of fishing communities, although still facing structural challenges such as low environmental literacy, access to information, and technical capacity, has been proven to be able to encourage policy legitimacy, strengthen social supervision, and create local innovations based on traditional knowledge. This involvement not only strengthens the sense of ownership of towards the program, but also opens up space for cross-actor dialogue between the government, NGOs, and communities. This finding is in line with the theory and findings of Sukomardojo et al. (2023), Najmi et al. (2020), and Sagala et al. (2024) which emphasize the importance of integrating local knowledge, environmental education, and community participation in marine resource management. Therefore, sustainable fisheries management strategies in the future must be based on community empowerment through collaborative approaches, contextual education, and institutional strengthening.

The sub-topic on government responsiveness involvement in sustainable fish management programs shows that in sustainable fisheries management, the Community-Based Natural Resource Management (CBNRM) approach (Arifianto, A., Yudanto, M. I., & Sutriadi, R. 2023) emphasizes that the success of natural resource management is greatly influenced by the active involvement of local communities who have traditional knowledge, cultural values, and direct interests in ecosystem sustainability. This is in line with the statements of fishermen in Olele Village and its surroundings who want direct involvement in the planning and evaluation

process of marine management policies. When the community feels owned and involved, compliance with the rules and a sense of collective responsibility increases. Empirical support for this approach is also found in a study (Zulaika, et al., 2024) which states that community-based fisheries management initiatives show higher success in terms of sustainability, especially in coastal areas of Southeast Asia. This study shows that programs that directly involve fishermen in monitoring fishing areas, training, and decision-making are better able to reduce destructive fishing practices and increase long-term catches. This condition supports the complaints of Bone Bolango fishermen who feel they are not fully involved in the policy process.

Another study by (Kasperson et al., 2022) in the journal Global Environmental Change highlighted that social, economic, and institutional support are important factors in motivating coastal communities to maintain marine sustainability. In interviews, fishermen stated that they support the concept of sustainable fisheries, but the lack of access to environmentally friendly fishing gear, technical training, and inequality in the distribution of aid are obstacles. This strengthens the argument that sustainability cannot be achieved through regulation alone, but must be accompanied by empowerment and fair distribution of resources.

Furthermore, the theory of Environmental Governance (Kasperson, et al., 2022) emphasizes the importance of collaboration between government, communities, and non-state actors such as NGOs in ensuring the effectiveness of environmental policies. The inequality of information, the dominance of elites in fishing groups, and the lack of communication between the government and the community as complained about by female fishermen and traditional leaders in interviews indicate gaps in the local governance system that need to be fixed. Therefore, synergy between institutional support and strengthening community capacity is key to achieving sustainable fisheries management that is not only technical, but also socially just. Research by (Lyster, O., & Ashley, S. 2022) from the International Institute for Sustainable Development (IISD) revealed that central and provincial government support for marine fisheries in Indonesia, such as fuel subsidies and equipment assistance, is often ineffective in achieving the expected socio-economic impacts and can encourage overfishing. This study emphasizes the need for an in-depth evaluation of the social, economic, and environmental impacts of such support to ensure the sustainability of the fisheries sector.

(Widyaningtyas, R. S. 2019) highlighted that the application of good governance principles in fisheries management regulations in Indonesia is still not optimal. This study recommends a co-management model that involves community empowerment and participation of all stakeholders as an ideal approach to sustainable fisheries management. (Akbar, D., Pratama et al., 2022) in their study on the readiness of Indonesian fisheries governance to achieve the Sustainable Development Goals (SDGs) found that multi-stakeholder engagement is essential. The lack of readiness and engagement from business actors and practitioners is an obstacle to the implementation of sustainable fisheries policies, indicating the need for an active role for the government in coordinating and facilitating the participation of all relevant parties. In addition, (Astriana, S., & Khoirunurrofik, K. 2024) in their dissertation highlighted that decentralization in fisheries governance in Indonesia has created new challenges, such as the issue of re-licensing for small-scale fishing vessels and the inconsistency of existing laws. This study recommends strengthening the legal basis for the establishment of the Fisheries Management Commission in the Indonesian Fisheries Management Area (WPPNRI) and increasing the involvement of non-government stakeholders in the commission. These findings

underline that high government responsiveness, through continuous policy evaluation, application of good governance principles, and active involvement of all stakeholders u interests, is very important for the success of sustainable fisheries management programs in Indonesia.

Based on the results of this study and reinforced by a number of previous studies, the researcher concluded that the success of the sustainable fisheries management program in Bone Bolango Regency is highly dependent on the level of government responsiveness in understanding the real needs of fishermen, building inclusive two-way communication, and creating collaboration space between local communities, NGOs, and other stakeholders. This responsiveness is not enough just in the form of technical assistance or subsidies, but also includes openness to community input, regular regulatory evaluations, and encouragement of collaborative governance models that strengthen the position of fishermen as the main actors in the conservation of marine resources. Without this responsiveness, various policies have the potential to be off-target and fail to answer challenges.

In the sub-topic on the involvement of government responsiveness to sustainable fisheries management programs, it shows that the co-management approach has long been recognized in the literature as one of the effective strategies in overcoming the weaknesses of the top-down model in natural resource management, including the fisheries sector. This theory emphasizes the importance of sharing responsibility and authority between the government and local communities, including private actors, to achieve sustainable results (Fauziah & Rahmah 2018). The results of interviews with the fisheries office and NGOs indicate that the involvement of all actors in planning and decision-making is the key to successful fisheries management. This is in line with the view of co-management theory which emphasizes dialogue, negotiation, and mutual trust in managing shared resources. Research by (Soemarmi et al., 2019) strengthens this finding by showing that fisheries management will be more effective if it involves fishermen as the main stakeholders who understand local conditions directly. In the context of Gorontalo Bay, interviews with the head of the fishermen group showed the need to be involved from the early stages of program planning. This is consistent with the finding that the success of a sustainable fisheries program is highly dependent on the legitimacy of the process and the sense of ownership built together with fishermen. In addition, the involvement of the private sector in fisheries management also receives theoretical support from the Public-Private Partnerships (PPPs) approach in sustainable development.

According to (Riswanto et al., 2024) the private sector has the potential to provide the resources, technology, and market networks needed to improve the efficiency and sustainability of natural resource-based economic activities. This can be seen from the statements of representatives of seafood processing companies in interviews, who conveyed the importance of institutional support so that their partnerships with fishermen can run optimally and not be unequal in power. According to the theory of Collaborative Governance (Ansell & Gash, 2007), a collaborative form of governance requires a neutral leader, a fair facilitation process, and a deliberative forum that encourages open communication and joint problem solving. Interviews with NGOs underline the need for a space for dialogue and facilitators who are able to bridge the interests of the government, fishermen, and the private sector. This finding reinforces the urgency of strengthening institutional structures that are able to orchestrate multi-party cooperation networks in a sustainable and fair manner. Research by (Raazy 2023) shows that a co-management approach involving the government,

community, NGOs, and the private sector can increase the effectiveness of capture fisheries management. This study emphasizes the importance of developing human resources through technical assistance and prioritizing fishermen's independent capital. Periodic evaluation of co-management performance is also recommended to improve fishermen's welfare and the sustainability of fishery resources.

(Rani 2020) studied the implementation of co-management in the Karimunjawa Islands by involving business actors, government, communities, and academics. The results of the analysis indicate that cooperation between all stakeholders is needed for sustainable coastal resource management. An average score of 3.17 in the co-management analysis indicates a sufficient partnership condition, but still requires increased participation and coordination between parties (Widyaningtyas, R. S. 2019) recommends a co-management model for small-scale grouper fisheries in South Sulawesi. This study highlights the importance of industry involvement in the supply chain and small-scale fishermen within the co-management framework to support the Fisheries Improvement Project. This approach includes optimizing the role of the market, synergizing the role of government, strengthening fishermen's institutions, and multi-government collaboration. stakeholders, (Podungge & Solihin 2025).

Based on the results of this study and reinforced by a number of previous studies, the researchers concluded that the researchers concluded that the formation of a close cooperation network between the government, fishing communities, and the private sector is a crucial foundation in efforts to manage sustainable fisheries. This collaboration not only increases the effectiveness of the implementation of marine and fisheries programs, but also encourages a sense of ownership and shared responsibility for the sustainability of marine resources. The direct involvement of fishermen in planning and decision-making has been shown to strengthen policy legitimacy, while the private sector contributes through capital, technology, and wider market access. The government acts as a facilitator and regulator that creates a policy climate that supports cross-sector synergy. The success of fisheries programs involving many stakeholders is highly dependent on the existence of active, transparent partnership institutions that have a clear division of tasks. The government's responsiveness in encouraging and facilitating multi-party partnerships is an irreplaceable key in creating adaptive and sustainable fisheries resource governance. Thus, this partnership-based management strategy is very relevant to be applied more widely, especially in coastal areas with great fisheries potential such as Gorontalo Bay.

Based on the research results formulated into a matrix of findings, implications, and recommendations with the Business Model Canvas and Design Thinking approaches, it can be concluded that sustainable fisheries management in Bone Bolango Regency is greatly influenced by three main pillars, namely: active participation of fishing communities, government responsiveness in formulating inclusive policies, and structured multi-party partnerships between government, communities, and the private sector. Each finding reflects strategic challenges and potentials that, if optimized through an innovative and collaborative approach, can strengthen adaptive and sustainable fisheries governance in coastal areas.

Table 2. Research Implication Matrix

Business Model Canvas Elements	Research Findings	Implications	Strategic Recommendations
Customer Segments	Local fishing communities are key actors but are still marginalized.	Empathize: Understand the real needs of fishermen as the main users of marine resources..	More detailed segmentation of fishermen based on needs (e.g.: traditional fishermen, female fishermen, young fishermen).
Value Propositions	Community engagement drives legitimacy and innovation	Define: Sustainability values must be built from local participation and knowledge.	Create programs that position fishermen as co-creators of fisheries policies and innovations.
Channels	Communication channels between the government and fishermen are still top-down	Ideate: Build inclusive, community-based two-way communication channels.	Use local media, community forums, and participatory digital platforms as channels for distributing information and education.
Customer Relationships	Low responsiveness and trust in the government.	Empathize + Prototype: Relationships must be built on transparency and real collaboration.	Form a community feedback system for the program, for example through regular village meetings or a fisherman reporting application.
Revenue Streams	Market access is still limited, relying on third parties.	Ideate: Fishermen's income can be increased through fair partnerships and direct market access.	Promote community-based fisheries enterprise models, local e-commerce, and the involvement of BUMDes or fishermen's cooperatives.
Key Resources	Local knowledge, community solidarity, abundant marine potential.	Empathize: Treat communities as strategic resources, not just beneficiaries.	Document traditional knowledge and train young generations for locally-based conservation and management.
Key Activities	Government programs have not maximally involved communities in the planning and evaluation stages..	Prototype: Key activities need to be based on collaboration, active engagement, and capacity building.	Develop participatory training, conservation field schools, and community involvement in resource monitoring.
Key Partnerships	Multi-party collaboration between the government, NGOs, fishermen and the private sector is still sporadic and not yet institutionalized.	Ideate + Test: Partnerships must have shared goals, clear work structures, and high accountability.	Establish a Fisheries Partnership Council at the local level as a formal, decentralized and transparent collaboration forum.
Cost Structure	Community-based management is more cost-effective but requires long-term investment in education, communication, and institutional strengthening.	Define: Initial investment is important for long-term efficiency and socio-ecological impact.	Reallocate government budget to fishermen's eco-boarding school education programs, fisheries entrepreneurship training, and digitalization of fisheries information systems.

Conclusion

This study confirms that the success of sustainable fisheries management in Bone Bolango Regency is greatly influenced by three main pillars: active involvement of fishing communities, the level of government responsiveness, and the strength of multi-stakeholder partnership

networks. Although there are still structural challenges such as low environmental literacy, limited access to information, and minimal technical and institutional capacity, community involvement has been shown to provide a real contribution to policy legitimacy, the effectiveness of social supervision, and local innovation based on traditional knowledge. On the other hand, the role of a responsive government that is able to build two-way communication is the main determinant in creating a space for dialogue and relevant and inclusive policies. In addition, the partnerships built between the government, fishermen, NGOs, and the private sector have been shown to strengthen synergies in adaptive and sustainable marine resource management. Overall, these findings indicate the importance of a paradigm shift from a technocratic approach to a collaborative and participatory approach in marine governance.

Based on the findings of this study, it is recommended that local governments together with NGOs and academics actively develop contextual community-based empowerment programs, such as conservation field schools and leadership training for young fishermen, in order to improve environmental literacy, technical capacity, and community involvement in decision-making. In addition, government responsiveness needs to be improved through more inclusive two-way communication mechanisms, for example through the establishment of village fishermen forums or the use of feedback-based digital applications to ensure policies that are adaptive to the real needs of the community. Strengthening multi-party partnerships is also crucial, so it is necessary to form formal collaborative institutions such as the Fisheries Partnership Council that involve the government, fishing communities, NGOs, and the private sector, with a transparent structure and a focus on socio-ecological sustainability. On the other hand, support is needed for community-based business model innovations, such as fisheries cooperatives, local seafood e-commerce platforms, and social entrepreneurs that encourage conservation while strengthening the coastal economy. These collaborative strategies are considered relevant to be replicated in other coastal areas in Indonesia, especially in areas with high fisheries potential such as Gorontalo Bay, while still considering the local characteristics of each region.

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