A Causal Model on Sustainable Fisheries Management as Predicted by Fishing Practices, Community Support and Government Intervention

Fatma M. Idris., Alger P. Dura, DPA

University of Mindanao

DOI: https://dx.doi.org/10.47772/IJRISS.2025.914MG0090

Received: 29 April 2025; Accepted: 07 May 2025; Published: 09 June 2025

ABSTRACT

The establishment of a closed season from June to August for the conservation of small pelagic fishes in the Davao Gulf was observed for the eleventh year... The study aims to determine the best fit model of sustainable fisheries management with its three exogenous variables namely fishing practices, community support and government intervention. It aimed to assess the level of fishing practices, community support and government intervention. The study determined the significant relationship among the exogeneous variables with endogenous variable. All indices of exogenous variables have statistically significant positive relationships with sustainable fisheries management. The R value of 0.529 indicates that 52.9% of the variation in sustainable fisheries management was validated by three predictors: fishing practices (ß=0.501), government intervention (ß= 0.253), and community support (ß=0.052). This revealed the critical role of fishing practices in pursuit of sustainable fisheries management. The study used a Structural Equation Model, and 400 registered fisherfolks were selected through stratified random sampling. Generated Model 3 was found the Best Fit Model in Standard Solution from a Summary of Goodness of Fit Measures of the three generated models. These findings will serve as scientific recommendation to evolving policy in Davao Gulf closed fishing season.

Keywords: Sustainable Fisheries Management, Fishing Practices, Community Support, Government Intervention, Structural Equation Model, Stratified Random Sampling, Davao Gulf, Philippines

INTRODUCTION

Objectives of the Study

The study aims to determine the best fit model of the sustainable fisheries management with its three exogenous variables namely: fishing practices, community support, and government intervention. Specifically, this study has the following objectives: To attest the level of fishing practices in terms of legal, technological and educational, To assess the level of community support in terms of community integration, community participation and community organization, To analyze the level of government intervention in terms of enhanced law enforcement, increased fisheries regulation, protected area, alternative livelihoods, reduced demand for juvenile pelagic fishes and research, To assess the level of sustainable fisheries management in terms of ecological domain, social and economic domain, and governance domain. To determine the significant relationship between fishing practices and sustainable fisheries management, community support and sustainable fisheries management, and government intervention and sustainable fisheries management, To determine the significant influence of fishing practices, community support, and government intervention on sustainable fisheries management. Lastly, to determine the best fit model for sustainable fisheries management in Davao Gulf.

LITERATURE REVIEW

In order to guarantee the long-term survival of fish stocks and the communities that depend on them, sustainable fisheries management seeks to strike a balance between ecological, economic, and social goals (Food and Agriculture Organization,2020).

A foundation for comprehending the interactions between human activities, including fishing methods, and ecological systems is provided by theoretical frameworks as the Social-Ecological Systems (SES) framework (Ostrom, 2009) and Resilience Theory (Folke et al., 2021). The direct and indirect relationships between variables are examined by a causal model. Fish stocks and habitats are directly impacted by ways of fishing in this context, such as gear type and catch restrictions. Adaptive management and regulatory compliance are influenced by community support (engagement, traditional knowledge). The institutional context for sustainable activities is shaped by government intervention (policy, enforcement). Stakeholder theory (Freeman, 1984), which emphasizes the value of including communities in decision-making, and institutional theory (North, 1990), which stresses the influence of formal and informal institutions on behavior, both encourage the integration of these aspects. According to empirical research, sustainable fishing methods that minimize overfishing and bycatch include using selective gear and adhering to catch limits (Hilborn et al., 2020).

For instance, a study conducted in Southeast Asia showed that fish population recovery was enhanced by community-led gear restrictions (Tao et al., 2021). Unsustainable activities, like illegal, unreported, and unregulated (IUU) fishing, continue to be a significant problem, though (Food and Agriculture Organization, 2022). One important indicator of the success of sustainable fisheries management is community support. Co-management of fisheries, in which governments and people work together, has been shown to improve resource stewardship and compliance (Gutiérrez et al., 2021). Sustainable Fisheries Management depends on efficient government regulations and enforcement. Studies emphasize the significance of monitoring systems, science-based quotas, and sanctions for non-compliance (Costello et al., 2020). For instance, fish populations in the North Atlantic have been restored thanks to the European Union's Common Fisheries Policy (CFP) (Directorate-General for Environment, 2023). Nevertheless, these initiatives may be hampered by poor governance and corruption (Sumaila et al., 2021).

A systems-thinking approach that takes into consideration the intricate relationships between ecological processes, governance institutions, and human activity is necessary for sustainable fisheries management. A causal model aids in determining the ways in which particular elements—like fishing methods, community service, and governmental regulations—interact to affect sustainability results. Fishing practices: the main causes of fisheries depletion are bycatch, harmful fishing techniques (such as ring net and bag net operations), and overfishing. According to Hilborn et al. (2020), a causal model can show how particular behaviors contribute to ecological deterioration and how changing these behaviors might increase sustainability. Community Support: Local communities are essential to the management of fisheries.

A key component of sustainable fisheries management is community support. A causal model can clarify the ways in which community involvement affects regulatory compliance, the adoption of sustainable practices, and management effectiveness in general. According to research, more fair and successful fisheries management results from inclusive governance, in which local communities actively participate in decision-making (Bennett et al., 2021).

The socioeconomic elements that impact community support, such as reliance on fisheries for subsistence, cultural values, and availability of alternative revenue streams, can also be emphasized by a causal model (Cinner et al., 2020). Though their efficacy varies greatly, government initiatives are frequently created to combat overfishing and advance sustainability. A causal model can be used to evaluate the effects of various interventions and pinpoint implementation obstacles. For instance, research has demonstrated that well implemented MPAs can result in notable gains in fish biomass and biodiversity; nevertheless, their effectiveness is contingent upon other elements, including community support and sufficient financial resources (Gill et al., 2023). Likewise, subsidies for sustainable fishing methods might encourage good changes in behavior, but ill-conceived subsidies can make overfishing worse (Skerritt et al., 2021).

Policymakers can create more focused and efficient actions by simulating these processes. Prior research's implications have mostly concentrated on distinct elements (such as governance or fishing methods) without thoroughly examining how they interact (Smith et al., 2021). Research on how socioeconomic and cultural factors affect the efficacy of community support is scarce (Garcia et al., 2022). Adaptive management solutions are necessary due to the increasing complications brought about by globalization and climate change,

such as fluctuating fish stocks and pressures from international trade (Jones et al., 2023). The need for more robust governance and community engagement has been brought to light by the increase in illegal, unreported, and unregulated (IUU) fishing (Lee et al., 2023). Although they need more work, integrated models that blend top-down governance with bottom-up community interaction have showed promise (Nguyen et al., 2024). The long-term effects of financial incentives, such certification programs and subsidies for sustainable activities, must be assessed (Wang et al., 2025).

A study emphasizes that the effectiveness of fisheries governance in achieving greater sustainability is significantly influenced by the interactions between small-scale fisheries (SSF) and large-scale fisheries (LSF). It proposes that a deeper understanding and acknowledgment of this fundamental relational dynamic could lead to more successful governance outcomes (Fabinyi, 2024). The long-term sustainability of fisheries and the economic benefits they provide hinge on effective management. However, an exclusive focus on ecological sustainability risks overlooking broader well-being objectives, which necessitate more holistic social policies to ensure lasting outcomes (Nava et al, 2021).

Smith and Brown (2022) emphasized that there is a need for responsible management approach in establishing relationship between fishing practices and sustainable fisheries management. Another study has shown that an integrated approach to sustainable fisheries management is recommended to the socioeconomic and environmental effects by various fishing practices (Garcia & Le Cren, 2023). Thompson and White (2024) discussed on the innovations and adaptive management.

Bernnett and Fenton (2022) examined various studies where community engagement has led to successful sustainable fisheries management. Another study showed that sustainable fisheries management has been made possible by combining local understanding with a focus on community support (Gonzalez & Martinez, 2021). Thompson and Naylor (2023 highlights attention that gained much importance where community support has improved the efficacy of fisheries management systems and enhanced ecosystem resilience.

Sustainable Practices are techniques to regulate catch limits are effective sustainable fishing practices. These fishing practices help prevent overfishing, reduce bycatch, and protect marine habitats, ensuring the long-term viability of fish populations (ClimateSort, 2021). Community participation Improves compliance when local communities are actively engaged in fisheries management. This will result to improved adherence to regulations and the promotion of sustainable practices are fostered by community leadership (Hamelin et al., 2024). Government intervention in fisheries management is evident when transparency is crucial for effective policy implementation. It entails clear communication of regulations, community engagement, and accountability mechanisms to ensure compliance and sustainable resource use. (Skerritte, 2024). These three factors interact dynamically. For instance, government intervention can incentivize sustainable fishing practices, while community support can amplify the effectiveness of such interventions. Conversely, weak governance or lack of community engagement can undermine sustainability efforts (Hamelin, 2024).

Theoretical Framework

The anchor theory of Social Ecological System (SES) Framework was developed by Elinor Ostrom and colleagues, examines he interaction between human systems such as fishing communities, governance and ecological systems. The framework stresses the interdependence of social and ecological factors in attaining sustainability. It analyze how fishing practices (ecological) are influenced by community support (support) and government intervention (institutional). It can recognize feedback loops, trade-offs, and synergies among these variables. Similarly, C.S.Holling introduced the Resiliency Theory in 1973 after realizing that systems that have been disrupted beyond their ability to recover could change into different states. The application of the framework is to assess how fishing communities and ecosystems respond to external pressures (e.g. overfishing, climate change) and how government interventions can enhance or undermine resilience. Moreover, Governance Theory by Elinor Ostrom's work examines the process and structures through which decisions are made and implemented. This framework analyzes the roles of local, national and international actors in fisheries management and how their interactions influence sustainability results.

Conceptual Framework

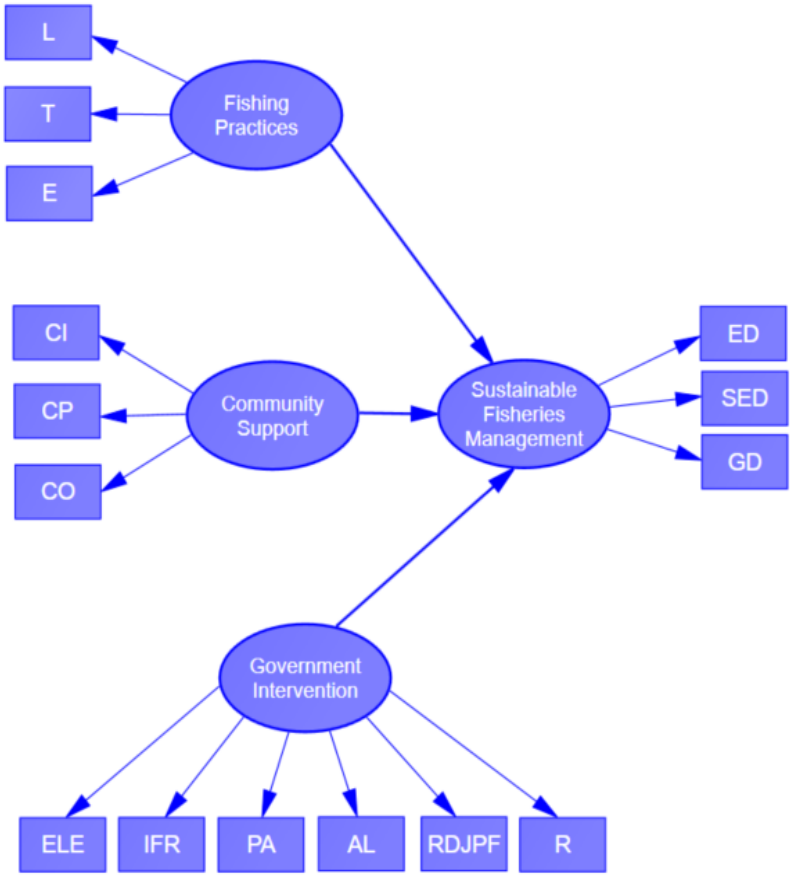


Figure 1. Conceptual Framework of the Study

Legend:

SFM – Sustainable Fisheries Management
ED- Ecological Domain
SED- Social and Economic Domain
GD- Governance Domain
FP - Fishing Practices
L- Legal
T- Technological
E- Educational

CS -Community Support
CI- Community Integration
CP- Community Participation
CO- Community Organization
GI- Government Intervention
ELE- Enhanced Law Enforcement
IFR- Increased Fisheries Regulation
PA- Protected Areas
AL- Alternative Livelihoods
RDJPF- Reduce Demand for Juvenile Pelagic fishes
R- Research

The study consisted of three exogenous variables: fishing practices, community support and government intervention. Figure 1 presents the study's conceptual framework, which shows the interrelationship between the exogenous variables fishing practices, community support and government intervention and sustainable fisheries management as endogenous variable:

The first exogenous variable of the study is fishing practices. It has the following indicators: legal, technological and educational (Ail et al.,2016). *Legal covers* laws, regulations, and policies that govern fishing activities to ensure sustainable practices by establishing catch limits, marine protective areas, closed fishing season and enforcing compliance. *Technological* involves instruments and innovations that enhance monitoring, control, and enforcement in fisheries to improve transparency and efficiency. *Educational* refers to training and capacity-building initiatives that inform fisherfolk about sustainable fishing practices, legal requirements, and government intervention.

The second exogenous variable is Community Support (Herrero & Gracia, 2007). It has three indicators: community integration, community participation and community organization. *Community integration* measures the sense of belongingness to a fishing community. *Community participation measures the degree which the fisherfolk is engaged in social activities of the coastal community.*

Community organization measures the degree of support the fisherfolk perceives from voluntary groups, government and non -government organizations.

The third exogenous variable is government intervention (Svolkinas et al., 2023).

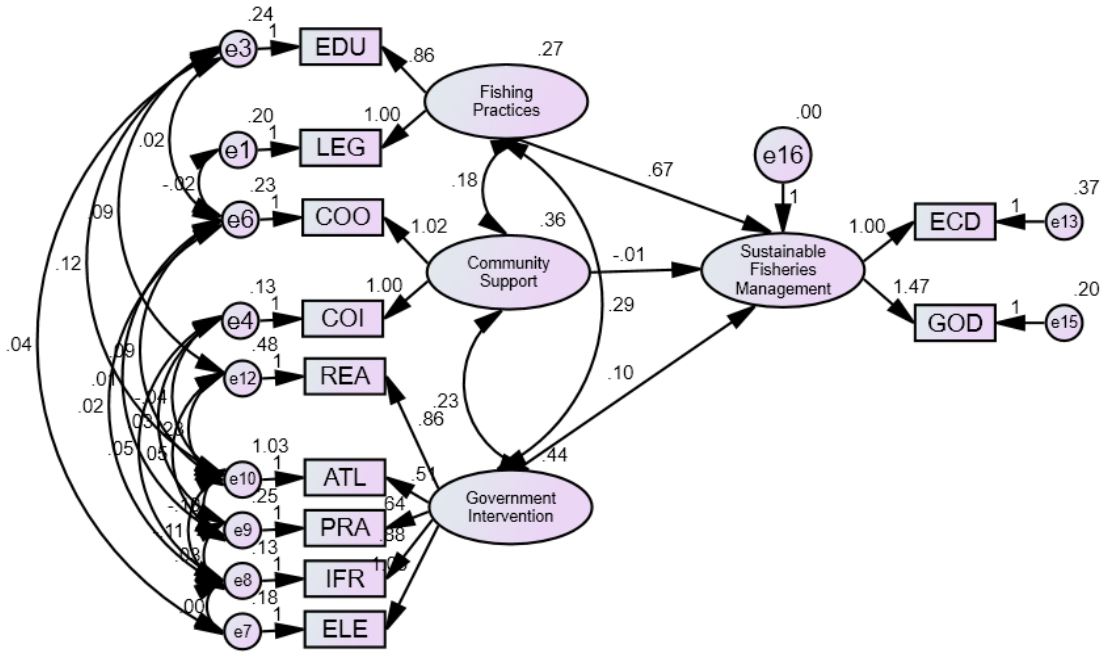
This variable has six indicators: enhanced law enforcement, increased fisheries regulation, protected areas, alternative livelihoods, reduce demand for juvenile pelagic fishes and research. *Enhanced law enforcement* includes regular monitoring, surveillance and market denial of pelagic species. Increased fisheries regulations define enforces of closed fishing season, gear restrictions and alternatives, inspection, apprehensions of illegal fishing activities, and participation to Fisheries and Aquatic Resources Management Council (FARMC) policy formulation and enforcement, collaboration with interagency for information dissemination about Davao Gulf. *Alternative livelihood* covers the financial incentives in mangrove planting, provision of aquaponic projects, and skills training with Bureau of Fisheries and Aquatic Resources, Department of Agriculture, Agriculture Training Institute, and Technical Education and Skills Development Authority. *Reduce Demand for Juvenile Pelagic fishes* are community actions and public awareness campaigns. *Research* are water assessments of Davao Gulf, reviews socio-economic effects of closed fishing season and reviews the scientific findings of National Stock Assessment Program as to lifting/adjustment of the period for the closed fishing season in Davao Gulf.

The endogenous variable is sustainable fisheries management (Angel et al., 2019). It has three indicators: ecological domain, social and economic domain and governance domain. *Ecological domain* includes maximum sustainable yield, monitoring of water quality in the Davao Gulf by government, academe and interested institutions, and identification of physical and biological characteristics of the habitat in Davao Gulf.

Hypotheses

The following null hypotheses will be tested at 0.05 level of significance, there is no significant relationship between fishing practices and sustainable fisheries management, community support and sustainable fisheries management and government intervention and sustainable fisheries management. There is no significant influence of fishing practices, community support, and government intervention on the sustainable fisheries management and no best fit model for sustainable fisheries management in Davao Gulf.

Proposed Model for Structural Equation Model



Best Fit Model in Standard Solution (Model 3)

Limitations of the Current Study

There is little research has been done on fishing practices, community support and government intervention on sustainable fisheries management. Thus, it is vital to examine sustainable fisheries management more broadly. Hence, this study will respond to the prevailing issues on limited studies of sustainable fisheries management. Additionally, the study will be a superior one because it will cover four variables and structural equation modelling will be used. It is further hoped that a model for sustainable fisheries management produced out of this research can meaningfully contribute to new knowledge.

RESULTS AND DISCUSSION

In this section, the data collected and analyzed on fishing practices, community support, government intervention, and sustainable fisheries management is presented and discussed.

Fishing Practices

Shown in Table 1 is the level of fishing practices in terms of legal, technological, and educational. The obtained overall mean of 4.18, SD 0.59 signifies a high level. This indicates that the level of fishing practices is oftentimes manifested. On a per-indicator analysis, it was found out that the indicator, educational, has the highest mean of 4.30 or very high, with a standard deviation of 0.66, while the indicator technological has the lowest mean of 3.95 or high with a standard deviation of 0. 77.

The high level of implementation of the indicators in fishing practices in terms of legal, technological, and educational. awareness programs about responsible fishing practices are conducted, education and training measures making fishers aware of the provisions of the 1998 Philippine Fisheries Code (RA 8550) and other applicable environmental standards essential for a responsible fishery conducted, meetings are done to promote environmental and other standards essential for a responsible fishery and regular renewal of fishing permits is observed among fishermen. The high result is due to the high ratings of the respondents on awareness programs about responsible fishing practices are conducted, education and training measures making fishers aware of the provisions of 1998 Philippine Fisheries Code (RA 8550) and other applicable environmental standards essential for a responsible fishery conducted, meetings are done to promote environmental and other standards essential for a responsible fishery and regular renewal of fishing permits is observed among fishermen.

Table 1 Level of Fishing Practices

Indicators	**SD**	**Mean**	**Descriptive Level**
Legal	**0.68**	**4.29**	**Very High**
Technological	**0.77**	**3.95**	**High**
Educational	**0.66**	**4.30**	**Very High**
Overall	**0.59**	**4.18**	**High**

The high level of fishing practice in terms of educational is in line with the findings of Imbwae et al., (2022) guaranteeing sustainable use, every successful management intervention must then focus on controlling resource usage. Therefore, the management plans need to include a mix of socio-economic, ecological-economic, and socio-ecological approaches to fisheries governance. In addition, ensuring responsible fisheries on Lake Kariba will require strong institutional cooperation among the riparian nations' stakeholders, efficient enforcement of the law, and active community involvement in resource governance. Furthermore, more policy recommendations on the subject of study require actual studies on ecological experiments and other socio-cultural difficulties. This also aligns with the study of Asha and Bhuvaneswari (2024) who found that to improve the socioeconomic well-being of fishing communities and increase the resilience of fisheries resources, recommendations will be developed based on stakeholder consultations and scientific research. Support community-based management programs, encourage sustainable fishing methods, and fortify governance frameworks to help preserve marine biodiversity and empower coastal communities.

Community Support

Displayed in Table 2 is the level of community support in terms of community integration, community participation, and community organization. The level of community support attained an overall mean of 4.23 which is described as Very High. This means that the level of community support is always manifested. Two indicators of community support work recorded very high mean scores and the one has high. On per indicator analysis, the indicator community participation has the highest mean of 4.30 or Very High with a standard deviation of 0.73. The indicator, community organization, has the lowest mean score of 4.11 or High and with a standard deviation of 0.78.

Table 2 Level of Community Support

Indicators	**SD**	**Mean**	**Descriptive Level**
Community Integration	0.70	4.28	Very High
Community Participation	0.73	4.30	Very High
Community Organization	0.78	4.11	High
Overall	**0.65**	**4.23**	**Very High**

The high level of implementation of the indicators in community support manifested among fisherfolk in Davao Gulf in terms of community integration, community participation and community organization. The high result is due to the very high ratings of the respondents. I collaborate with organizations and associations in my community, I take part in social activities in my community, I respond to calls for support in my community and I take part in socio-recreational activities in my community.

The result is consistent with the findings of Franco-Meléndez et al. (2021) who asserts that in the context of conflicts, a majority of fishers acknowledge that enhancing social networks within their groups leads to improved communication. Also, this is aligned to the study of Fidler et al. (2022) who said that it's possible that local organizations offer a way for people to formally participate in management through stronger ties within the community, considering the strong correlation between local group membership and other significant participatory governance indicators (e.g., management rights and decision-making participation.

Government Intervention

Depicted in Table 3 is the level of government intervention which is measured in terms of enforced law enforcement, increased fishery regulation, protected areas, alternative livelihoods, reduced demand for juvenile pelagic fishes and research. It obtained an overall mean of 4.11 which is described as High. This means the level of government intervention is oftentimes manifested and overall standard deviation of 0.63. The indicator with the highest mean is protected areas at 4.49 or Very High with a standard deviation of 0.66. Alternative livelihoods obtained the lowest mean at 3.74 which is described as High and a standard deviation of 1.07.

The high descriptive levels on every indicator of government intervention is due to the very high rating on protected areas, increased fisheries regulation and enhanced law enforcement. Such high rating on protected areas is contributed by establishing municipal/city ordinances for Marine Protected Areas or Fish Sanctuary, establishing closed fishing season in Davao Gulf, and inspecting fishing boats not using fine mesh nets. This implies that government employees' workplace resilience is oftentimes manifested.

Table 3 Level of Government Intervention

Indicators	**SD**	**Mean**	**Descriptive Level**
Enhanced Law Enforcement	0.79	4.23	Very High
Increased Fisheries Regulation	0.69	4.34	Very High
Protected Areas	0.66	4.49	Very High
Alternative Livelihoods	1.07	3.74	High
Reduce Demand for Juvenile Pelagic Fishes	1.18	3.86	High
Research	0.91	4.03	High
Overall	**0.63**	**4.11**	**High**

This finding is similar to Umar and Iskandar (2023) who said external parties, particularly the state or government, highly support the Sasisen practice due to its impact on the conservation of coastal ecosystems. This finding corroborates the study of Li et al., (2024) that protecting ecosystems and fish populations requires the employment of climate-smart fisheries management strategies in conjunction with marine protected areas (MPAs) and other area-based conservation initiatives. However, because they have different legislative procedures, management agendas, and administering agencies, spatial management approaches are frequently applied independently from non-spatial management interventions.

Furthermore, the high level of protected areas affirmed the impressions of Chen et al. (2022) that Protected area (PA) quality and quantity must be improved for sustainable development. The effectiveness of PAs includes: (1) evaluation based on a theory of change that explains how and why an intervention is supposed to work; (2) counterfactual evaluation using a baseline of the treatment group or a random or constructed control group as the counterfactual; (3) economic evaluation that evaluates the costs and benefits of interventions; (4) consultation; (5) case studies; (6) rapid assessments based on easily accessible evaluation sheets (e.g., scorecards); and (7) approaches that concentrate on a particular aspect of PAs (e.g., ecological integrity, representativeness, and threats).

Sustainable Fisheries Management

Presented in Table 4 is the level of sustainable fisheries management measured by ecological domain, social and economic domain, and governance domain. An overall mean of 4.06, SD 0.61 was obtained which is described as high. This means that the level of sustainable fisheries management is oftentimes manifested. Analyzing the result in the computation of all indicators of sustainable fisheries management, the governance domain has the highest mean of 4.16 or high, with a standard deviation of 0.75 while the social and economic domain has the lowest mean of 3.93 or high with a standard deviation of 0.74. The high descriptive levels on every indicator of sustainable fisheries management are due to the high rating on all stakeholders: government, non-government, civil society organizations, academe, fisherfolk organizations, and FARMCs at all levels are involved in the planning, implementation, and evaluation process in the management of Davao Gulf. Another reason is there is a conscientious agreement among the stakeholders in Davao Gulf to establish a closed fishing season. This implies that sustainable fisheries management is oftentimes manifested.

Table 4 Level of Sustainable Fisheries Management

Indicators	SD	Mean	Descriptive Level
Ecological Domain	0.73	4.08	High
Social and Economic Domain	0.74	3.93	High
Governance Domain	0.75	4.16	High
Overall	**0.61**	**4.06**	**High**

The result on the high level of sustainable fisheries management is coherent with the findings of Guggisberg et al. (2022) that potential enhancements to the way transparency might be applied to support sustainable fisheries management. There are a few restrictions, though. First, the benefits of transparency should not be acknowledged without a careful analysis of how it is actually applied. Second, substantive transparency requires more than just data availability; it also requires high-quality information that is easy for particular stakeholders to use. This also parallels the study of Garlock et al. (2022) that the investigation, management strategies are cross-cutting and, to differing degrees, support several sustainability criteria. Crucially, external influences can have an equal impact on fisheries management as fisheries management itself, indicating that cooperation between fisheries institutions and other public and commercial institutions is essential for the development of sustainable fisheries.

Significance of the Relationship between Fishing Practices and Sustainable Fisheries Management

Shown in Table 5 are the results of the test of the relationship between fishing practices and sustainable fisheries management. As displayed in the hypothesis, the relationship was tested at 0.05 level of significance. It means that there is a significant relationship between fishing practices and sustainable fisheries management.

More specifically, the results show that all the indices of fishing practices have a significant relationship with sustainable fisheries management, as the p-values are less than .05.

Table 5 Significance of the Relationship between Fishing Practices and Sustainable Fisheries Management

Fishing Practices	**Sustainable Fisheries Management**			
	Ecological Domain	Social and Economic Domain	Governance Domain	**Overall**
Legal	.411** .000	.520** .000	.629** .000	**.628** .000**
Technological	.415** .000	.553** .000	.478** .000	**.582** .000**
Educational	.381** .000	.444** .000	.486** .000	**.528** .000**
Overall	**.486** .000**	**.612** .000**	**.638** .000**	**.699** .000**

The total r-value of 0.699 with a p-value of less than .05 indicated that the null hypothesis was rejected. It demonstrates that there is a strong link between fishing practices and sustainable fisheries management. The correlation coefficient r =.699 signifies a strong association between fishing practices and sustainable fisheries management. More specifically, the results show that all the indices of fishing practices have a significant relationship with sustainable fisheries management, as the p-values are less than .05.

This suggests that increasing fishing practices namely legal, technological and educational can in turn result in enhancing their ability to enhance the ecological domain, social and economic domain and governance domain. Sustainable fisheries management plays a significant role in enhancing and delivering fishing practices.

This result is supported by the findings of De la Puente et al. (2022) that Peruvian fishermen's well-being was evaluated using the Sustainable Livelihoods Approach. Peruvian small-scale fishermen fall into a social-ecological trap. The majority of fishermen employ selective fishing gear, yet their livelihoods are not sustainable. Expanding the scope of fisheries research is necessary to improve the wellness of fishermen.

Also, the findings align with the study of Farid et al. (2024) that using attributes and scores, the rapfish (Rapid Appraisal for Fisheries) technique was used to assess the sustainability of fisheries in a multidisciplinary way and to ascertain the state of fisheries in an integrated manner. Data processing's sustainability index value ranged from 0 (poor) to 100 (excellent). The study's findings demonstrated that, with a value of 76.9, the flying fish management sustainability index in the technological dimension belonged to the sustainable category. category of sustainability. The multidimensional system's flying fish management was classified as highly sustainable with a score of 70.56 on the sustainability index derived from the rapfish analysis.

Relationship between Community Support and Sustainable Fisheries Management

Displayed in Table 6 are the results of the assessment on the relationship between fishing practices and government intervention As displayed in the hypothesis, the relationship was tested at a 0.05 level of significance. The overall r-value of 0.415 with a p-value less than .05 indicates that the null hypothesis was rejected. It can be deduced that there is a strong relationship between community support and sustainable fisheries management. Individually, all indicators of community support correlate positively with sustainable fisheries management on having a p-value less than .05. As a result, there is a significant relationship between community support and sustainable fisheries management. Community Support has a crucial role in enhancing sustainable fisheries management.

Table 6 Significance of the Relationship between Community Support and Sustainable Fisheries Management

Community Support	Sustainable Fisheries Management			
	Ecological Domain	Social and Economic Domain	Governance Domain	**Overall**
Community Integration	.251** .000	.362** .000	.395** .000	**.406** .000**
Community Participation	.202** .000	.278** .000	.279** .000	**.305** .000**
Community Organization	.235** .000	.370** .000	.352** .000	**.385** .000**
Overall	**.260** .000**	**.383** .000**	**.388** .000**	**.415** .000**

The finding is supported by McDonald et al. (2020) who found that in Brazil, Indonesia, and Philippines, positive impacts on all community-support indicators suggested that the Fish Forever intervention created the social conditions needed for shifting behavior toward more sustainable fishing practices.

Also, this is aligned with the study of Hamelin et al. (2024) shared the findings of their study that the results supported in strengthening the evidence base while pursuing reconciliation, credibility, and legitimacy, for fisheries management decision-making in Canada.

Relationship between Government Intervention and Sustainable Fisheries Management

Depicted in Table 7 are the results of the test of the relationship between government intervention and sustainable fisheries management Data showed an overall correlation coefficient of .621 at 0.05 level of significance. It means that there is a significant relationship between government intervention and sustainable fisheries management. More specifically, the results show that all the indices of government intervention have a significant relationship with sustainable fisheries management, as the p-values are less than 0.05.

Table 7 Significance of the Relationship between Government Intervention and Sustainable Fisheries Management

Government Intervention	***Sustainable Fisheries Management***			
	Ecological Domain	*Social and Economic Domain*	*Governance Domain*	***Overall***
Enhanced Law Enforcement	.389** .000	.506** .000	.590** .000	**.598** .000**
Increased Fisheries Regulation	.417** .000	.495** .000	.599** .000	**.608** .000**
Protected Areas	.297** .000	.371** .000	.450** .000	**.450** .000**
Alternative Livelihoods	.237** .000	.380** .000	.168** .001	**.315** .000**
Reduce Demand for Juvenile Pelagic Fishes	.232** .000	.249** .000	.257** .000	**.297** .000**
Research	.383** .000	.481** .000	.400** .000	**.508** .000**
Overall	**.442** .000**	**.564** .000**	**.538** .000**	**.621** .000**

The findings of the study are parallel to the study conducted by Jiayu and Yuting (2024) that member states' desire to comply may be impacted by the practical difficulties in implementing SDT. Stressing the importance of SDT for the shared interests of WTO members in marine fisheries law is essential to overcoming the

challenges, such as ambiguity and inefficiency, that stand in the way of the legalization process of sustainable global marine fishery governance. In the near term, this will help emerging nations, particularly small island developing states; in the long run, it will serve the interests of both developed and developing nations. This is supported by Fabinyi (2024) who claimed that it becomes crucial to comprehend how any governance action may change these pre-existing linkages in order to better grasp the effects of environmental policy and planning.

Influence of Fishing Practices, Community Support and Government Intervention on Sustainable Fisheries Management

Presented in Table 8 is the influence of fishing practices, community support and government intervention on sustainable fisheries management. Further, as indicated by the F-value of 148.336 with a corresponding p-value of 0.000, the regression model is therefore significant. Hence, it leads to the rejection of the null hypothesis. It could be stated that there is a variable that can predict sustainable fisheries management.

In addition, the R2 of .529 signifies that 52.9 percent of the variation in sustainable fisheries management is explained by the predictor variables, fishing practices, community support, and government intervention. This means 47.1 percent of the variation could be attributed to other factors aside from these three variables. The presentation revealed that the standard coefficient of fishing practice has the highest beta of .501. It indicates that fishing practices have the greatest influence on sustainable fisheries management compared to government intervention with .253 and community support with .052, respectively.

Table 8 Significance of the Influence of Fishing Practices, Community Support and Government Intervention on Sustainable Fisheries Management

Sustainable Fisheries Management					
(Variables)		*B*	β	*t*	*Sig.*
Constant		.631		3.652	.000
Fishing Practices		.525	.501	10.358	.000
Community Support		.049	.052	1.281	.201
Government Intervention		.248	.253	5.157	.000
R	.727				
R^2	.529				
ΔR	.526				
F	148.336				
ρ	.000				

This result is in alignment with the results of Stacey et al. (2021) that numerous livelihood interventions have been tried to help coastal communities and households that depend on fishing. Insufficient post-project impact evaluation has been conducted for livelihood-focused interventions aimed at small-scale fisheries (SSF). The most effective interventions seem to be those that involve communities in collaboration with governmental and non-governmental organizations. Finally, a study supported by the findings was conducted by Sun et al. (2024) offered a perspective on an urgent issue that needs to be resolved is figuring out how to effectively encourage local governments and fishermen to work together to restore the environment through fishing bans, enabling fishermen to access alternative sources of income or compensatory measures while forgoing their fishing income.

Best Fit Model of Sustainable Fisheries Management

This part analyzes the interrelationships among the variables in the study. Three models were generated to obtain the best-fit model of sustainable fisheries management. The models were assessed against the given fit indices and served as a basis to accept or reject the model.

Revealed in Table 9 is the result of the goodness of fit measures, of Generated Model 3. As can be seen in the results, all model fit values have successfully met the criteria set by each index; CMIN/DF < 2, GFI, CFI, NFI, TLI 0. >95, and RMSEA <0.05 with a P- Close >0.05. The result is in alignment with the criteria set by Arbuckle and Wothke (1999) emphasizing the CMIN/DF should be less than 2, and The Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Normed Fit Index (NFI), and Goodness of Fit Index (GFI) should be more than 0.95. Moreover, the RMEA and PCLOSE values are supported by Browne and Sugawara (1996) indicating 0.01, 0.05, and 0.08 as excellent, good, and mediocre fit respectively, with a P-Close that is greater than 0.0.

Table 9 Summary of Goodness of Fit Measures of the Three Generated Models

Model	***P-value (>0.05)***	***CMIN / DF (0<value)***	***GFI (>0.9)***	***CFI (>0.95)***	***NFI (>0.95)***	***TLI (>0.95)***	***RMSEA (<0.05)***	***P-close (>0.05)***
1	*.000*	*10.262*	*.768*	*.740*	*.722*	*.686*	*.152*	*.000*
2	*.000*	*8.829*	*.808*	*.785*	*.766*	*.735*	*.140*	*.000*
3	*.058*	*1.524*	*.986*	*.994*	*.984*	*.986*	*.036*	*.809*

Legend: CMIN/DF – Chi Square/Degrees of Freedom NFI –Normed Fit Index

GFI – Goodness of Fit Index TLI -Tucker-Lewis Index

RMSEA – Root Mean Square of Error Approximation CFI – Comparative Fit Index

As shown in the Table, Model 3 obtained a p-value of .058, CMIN/DF of 1.524, goodness of fit index of .986, comparative fit index of .994, normed fit index of .984, Tucker-Lewis index of .986, RMSEA of .036 and finally p-close of .809. All exogenous variables are fitted to be part of the best-fit model for sustainable fisheries management in Davao Gulf.

Generated Structural Model 1 presented the direct relationship between the endogenous and exogenous variables. As shown in Table 10.1, fishing practices are strongly represented by their factors which are strongly represented by their factors, with the highest beta values (beta=.454) followed by government intervention (beta = .286) and community support (beta = .033). Table 10.1 shows that exogenous variables, fishing practices, government intervention, and community support do not predict sustainable fisheries management having a P-value of > 0.05. Also, revealed in the goodness of fit results that the model fit values were not within the range of the indices criteria as shown by CMIN/DF > 2, GFI, CFI, NFI, TLI < 0.95, and RMSEA > 0.05 with a P- Close < 0.05. This means that the model does not fit with the data.

Generated Structural Model 2 displayed the interrelationships between the exogenous variables fishing practices and community support and government intervention with its direct relationship to the endogenous variable which is sustainable fisheries management. As shown in Table 10.1, fishing practices are strongly represented by their factors, with the highest beta values (beta=.480) followed by government intervention (beta = .316) and community support (beta = -.032). Also, the goodness of fit results revealed that the values were not within the range of the indices criteria as shown by CMIN/DF > 2, GFI, CFI, NFI, TLI < 0.95, and RMSEA > 0.05 with a P- Close < 0.05. This means that the model shows a very poor fit.

Table 10.1 Regression Weights of the 3 Generated Models

	Exogenous Variables to Endogenous Variable		
Model	**Fishing Practices**	**Community Support**	**Government Intervention**
1	.454***	$.033^{NS}$	.286***
2	.480***	$-.032^{NS}$	$.316^{***}$
3	$.672^{***}$	$-.010^{NS}$	$.100^{NS}$

* p<0.05, ** p<0.01, *** p=0.000

Table 10.2 Covariances: (Group number 1 – Best Fit Model)

Variables			Estimates	S.E.	P-value
Fishing Practices	<-->	Community Support	.176	.024	***
Community Support	<-->	Government Intervention	.228	.029	***
Fishing Practices	<-->	Government Intervention	.288	.029	***

Reflected in Figure 2 is the standard estimate of Generated Model 3. As can be gleaned in Model 3, the best-fit model, fishing practices, community support, and government intervention are exogenous variables that have a direct causal relationship with sustainable fisheries management. The model also revealed the interconnectedness of these three exogenous variables namely, fishing practices, community support and government intervention fishing practices had a direct relationship with sustainable fisheries management, community support with sustainable fisheries management and government intervention with sustainable fisheries management.

Moreover, as shown in Figure 2, two out of three indicators of fishing practices, namely, educational and legal, remain significant predictors of sustainable fisheries management. While community support had two out of three indicators, namely community organizing, and community integration were found to affect sustainable fisheries management. On the other hand, the government intervention had five out of six indicators namely, alternative livelihood, protected areas, increased fisheries regulation, enhanced law enforcement and research were found to affect sustainable fisheries management. Moreover, sustainable fisheries management had two out of three indicators, namely, economic domain and governance domain. Based on the result, it can be deduced that sustainable fisheries management was best anchored on fishing practices in terms of educational and legal; community support in terms of community organization and community Integration; government intervention in terms of alternative livelihood, protected area, increased fisheries regulations, enhanced law enforcement and research.

Furthermore, the endogenous variable sustainable fisheries management is measured in terms of economic domain, governance domain, educational, legal, community organization, community integration, research, alternative livelihood, protected area, increased fisheries regulations, and enhanced law enforcement.

The direct causal link of fishing practices, community support and government intervention towards sustainable fisheries management corroborates the research outcomes revealed Smallhorn-West et al. (2020), Oostdijk and Carpenter (2022) that found the direct effect of fishing practices, community support and government intervention on sustainable fisheries management.

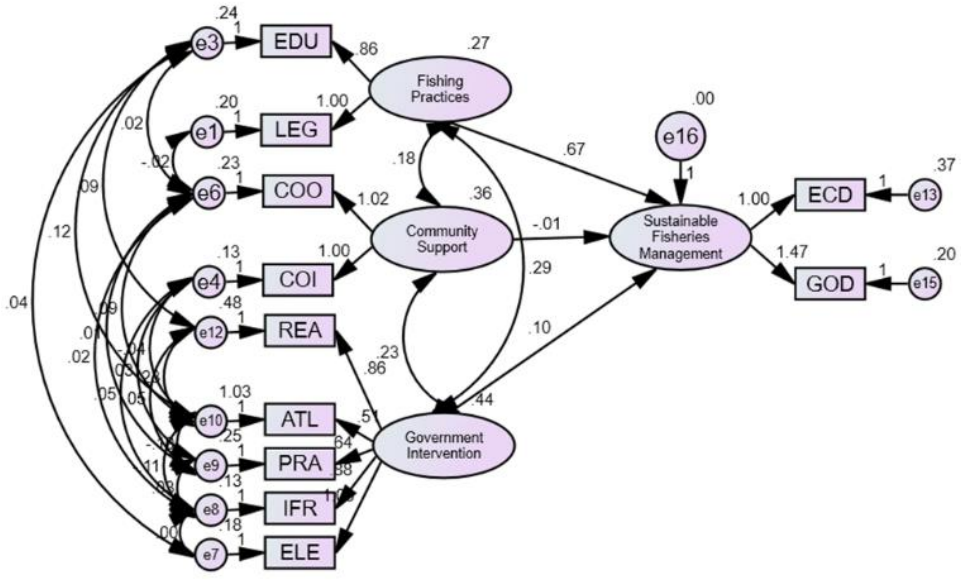


Figure 2- Best Fit Model in Standard Solution (Model 3)

Figure 2 – Model 3

Legend:

GOD-Governance Domain	COP- Community Participation
SED-Social and Economic Domain	COI – Community Integration
ECD-Ecological Domain	ELE -Enhanced Law Enforcement
EDU – Educational	PRA -Protected Areas
LEG- Legal	RJF – Reduce Demand for Juvenile Pelagic Fishes
COO – Community Organization	IFR – Increased Fisheries Regulation
ATL- Alternative Livelihood	TEC- Technological
REA- Research	

CONCLUSION AND RECOMMENDATION

Sustainable fisheries management is influenced by fishing practices, community support, and government intervention, collectively accounting for 52.9% of the variation. Among these, fishing practices play the most critical role. However, 47.1% of the variation remains unexplained, indicating the need to explore additional variables to enhance understanding and effectiveness.

The causal model on sustainable fisheries management resonates deeply by fostering sustainability, resilience, and interdisciplinary excellence. It not only addresses critical environmental and socio-economic issues but also serves as a template for integrating cutting-edge research into educational frameworks, empowering future generations to thrive in a rapidly transforming world.

The study reflects the growing focus on sustainability in research and education, directly supporting global efforts like the United Nations Sustainable Development Goal (SDG) 14: Life Below Water, which aims to conserve marine ecosystems. By highlighting the interplay of fishing practices, community support, and government intervention, the research provides a framework that can be integrated into academic programs focusing on sustainability, marine sciences, and policy development. The model emphasizes empowering communities through sustainable practices and active involvement in fisheries management. This fosters resilience by preparing communities to adapt to socio-economic challenges and environmental changes, such as climate impacts on marine resources. By combining ecological, socio-economic, and governance factors, the study demonstrates innovative approaches to interdisciplinary research, addressing complex, real-world problems with excellence and practical outcomes sustainability.

It is crucial to upgrade landing and berthing facilities in harbors and fishing hubs, fill infrastructure deficiencies (mean = 3.74), and promote sustainable ways in order to improve technological fishing practices and increase the sustainability and efficacy of the fishing business. Enhancing community support through training in self-reliance and skill development can improve the livelihood satisfaction and income diversification of fishermen (mean = 3.95). Sustainable income opportunities can be created by expanding government interventions by giving priority to alternative livelihood projects like aquaponics projects, especially in response to the lowest mean score (3.31).

REFERENCES

1. Asha and Dr. S. Bhuvaneswari (2024). Sustainable management and socio-economic impacts of fisheries in Kanniyakumari District, Tamil Nadu: A comprehensive study. Educational Administration: Theory and Practice, 30(4), 5710–5722. https://doi.org/10.53555/kuey.v30i4.2275
2. Awaliyah Umar, A.P. and Iskandar, D.A. (2023). Sustainable fishery management: Learning from the indigenous community of Biak. Jurnal Scientia, 12(04), 297–305. https://doi.org/10.58471/scientia.v12i04.1961
3. Barbara Ntombi Ngwenya, Ketlhatlogile Keta Mosepele, and Lapologang Magole (2012). A case for gender equity in governance of the Okavango Delta fisheries in Botswana. Journal of Regional Studies, 36(2), 116.

4. Bennett, N. J., Blythe, J., White, C. S., & Campero, C. (2021). Blue growth and blue justice: Ten risks and solutions for the ocean economy. Marine Policy, 125, 104387. https://doi.org/10.1016/j.marpol.2020.104387
5. Chen, Y., et al. (2022). Designing effective marine protected areas: A synthesis of global evidence. Science Advances, 8(12), eabl4647. https://doi.org/10.1126/sciadv.abl4647
6. Cinner, J. E., et al. (2020). Social and economic dimensions of small-scale fisheries: A global review. (Check source: Fish and Fisheries, Marine Policy, or World Development)
7. ClimateSort, T. (2022). Fishing practices that mitigate overfishing: A review of global evidence. Sustainability Science, 17(3), 789–805.
8. Costello, C. (2020). Efficacy of fishery management. Proceedings of the National Academy of Sciences (PNAS).
9. De la Puente, S., López de la Lama, R., Llerena-Cayo, C., Martínez, B.R., Rey-Cama, G., Christensen, V., Rivera-Ch, M., & Valdés-Velasquez, A. (2022). Adoption of sustainable low-impact fishing practices is not enough to secure sustainable livelihoods and social wellbeing in small-scale fishing communities. Marine Policy, 146, 105321.
10. Directorate-General for Environment. (2023). Biodiversity: EU supports strengthening of largest marine protected area in the North-East Atlantic.
11. Fabinyi, M. (2024). Small-scale fisheries, large-scale fisheries and fisheries governance in the Philippines. Journal of Environmental Policy & Planning, 26(2), 159–172. https://doi.org/10.1080/1523908X.2024.2314451
12. Farid, M., et al. (2024). Rapid appraisal methods for assessing fisheries sustainability. Fish and Fisheries, 25(2), 1–15. https://doi.org/10.1111/faf.12712
13. Fidler, R. B. (2022). Strong correlation between community participation and fisheries sustainability. Marine Policy, 136, 104890. https://doi.org/10.1016/j.marpol.2021.104890
14. Folke, C., Carpenter, S., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience thinking: Integrating resilience, adaptability, and transformability. Ecology and Society, 15(4), 20. https://doi.org/10.5751/ES-03610-150420
15. Folke, C., et al. (2021). Resilience and social-ecological systems: A handful of frontiers. ResearchGate.
16. Food and Agriculture Organization (FAO). (2022). The role of community support in global fisheries sustainability. FAO Fisheries Report No. 789. Rome. https://www.fao.org/fisheries/en
17. Freeman, R. E. (1984). Strategic Management: A Stakeholder Approach. Boston.
18. Garcia, S.M., Zerbi, A., Aliaume, C., Do Chi, T., & Lasserre, G. (2003). The ecosystem approach to fisheries: Issues, terminology, principles, institutional foundations, implementation and outlook. FAO Fisheries Technical Paper, 443, 31–35.
19. Garcia, L., et al. (2022). Socio-economic and cultural barriers to community-based conservation efficacy. Human Ecology or Environmental Management (verify actual source).
20. Garcia, S. M., & Le Cren, D. (2023). Socioeconomic and environmental trade-offs of fishing practices: A global meta-analysis. Marine Policy, 148, 105432.
21. Gill, D. A., et al. (2023). Measuring the effectiveness of marine protected areas: Ecological and socio-political insights. (Check source: Nature Sustainability or Global Environmental Change)
22. Gonzales, R., & Martinez, E. (2021). Community-based approaches to sustainable fisheries management: Lessons from Latin America. Ocean & Coastal Management, 203, 105512.
23. Guggisberg, S., et al. (2022). Transparency as a pillar of sustainable fisheries governance. Global Environmental Change, 72, 102421.
24. Gutiérrez, N. L., Hilborn, R., & Defeo, O. (2011). Leadership, social capital and incentives promote successful fisheries. Nature, 470(7334), 386–389. https://doi.org/10.1038/nature09689