
Resolving Conflicts, Sustaining Livelihoods: A Fisheries Resource Management Model for Enhancing Fishermen's Welfare

Tika Nisari¹, Juliana Pebrina Siburian², Tirta Anugerah³,
Shofian Nanda Adiprayoga⁴

Abstract:

This study aims to analyse the effect of capture fisheries resources and conflict resolution on fishermen's welfare in the coastal area of Sibolga City, as well as to explore the moderating role of conflict resolution in the relationship between capture fisheries resources and fishermen's welfare. The study used a quantitative approach with data collection through questionnaires administered to active fishermen in coastal areas, and analysed using linear regression and moderation tests. The results showed that capture fisheries resources and conflict resolution had a significant effect on fishermen's welfare, but conflict resolution did not act as a moderating variable between capture fisheries resources and fishermen's welfare. These findings emphasise the importance of effective fisheries resource management and conflict resolution strategies as efforts to improve fishermen's welfare. This study has implications for the government and related institutions to strengthen fisheries resource management, improve conflict resolution capacity, and design sustainable development programmes that support the welfare of coastal communities.

Keywords: Fishermen, Welfare, Management, Capture Fisheries, Resolution

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1. Introduction

The management of capture fisheries resources has long faced challenges due to the dominance of economically driven approaches that prioritize profit over sustainability. The tendency towards unlimited exploitation of marine resources has led to degradation, overfishing, and ecological imbalance (Arceo, 2021; Fajri, 2021; Nuraini et al., 2021). When capture fisheries are managed purely from an economic perspective, the carrying capacity of fish stocks is often ignored, causing depletion

¹ Sekolah Tinggi Perikanan Dan Kelautan Matauli, Indonesia. tikanisari96@gmail.com

² Sekolah Tinggi Perikanan Dan Kelautan Matauli, Indonesia. juliana.siburian07@gmail.com

³ Sekolah Tinggi Perikanan Dan Kelautan Matauli, Indonesia. tirta.anugerah1993@gmail.com

⁴ Sekolah Tinggi Perikanan Dan Kelautan Matauli, Indonesia. pra_yoga2305@yahoo.com

and threatening long-term food security (Bambang et al., 2020; Sawestri, 2021). This phenomenon reflects the urgent need for a paradigm shift from resource extraction to sustainable and community-based management.

The depletion of fish resources not only affects ecosystem health but also directly impacts the livelihoods of fishermen, particularly those who rely on small-scale and traditional fishing practices (Chakraborty, 2023; Nurhayati et al., 2020). In regions where marine resources are exploited without control, scarcity and competition over fishing grounds become inevitable. Such conditions often escalate into social conflicts among fishermen, triggered by economic pressures, competition for access, and environmental degradation (Pramono et al., 2021; Dewi & Prasetyo, 2022).

In essence, the management of fish resources is equivalent to managing the human activities that utilize them (Sari & Hidayat, 2020). According to Yusuf et al. (2019) and Daris et al. (2023), conflicts over natural resources often stem from poor communication, ego clashes, and differing values and perceptions. Structural inequalities and differences in access to fishing grounds also exacerbate these disputes (Daris & Massiseng, 2024). Thus, fisheries management should not only focus on biological sustainability but also on the social mechanisms that regulate human behavior and interaction in coastal communities.

Conflicts in capture fisheries are multidimensional and can vary across regions and over time (Li et al., 2024; Nuraini et al., 2021). These conflicts generally involve complex relationships between actors, resources, and environmental conditions. The interplay between declining resource availability, competition among fishermen, and weak institutional arrangements often fuels recurring disputes (Simanjuntak & Purwanto, 2020; Selawaty et al., 2020). Managing these conflicts requires a comprehensive understanding of ecological, social, and economic dimensions.

The coastal area of Sibolga City represents a region with significant potential for capture fisheries. Most residents depend on the sea as their main source of livelihood, engaging primarily in traditional fishing (Nisari et al., 2024; Fesanrey & Tuhulola, 2022). However, increasing pressure on marine resources, coupled with overlapping interests between local fishermen and external operators, has led to social and economic tensions. The entry of large-scale vessels has resulted in unequal competition and reduced fishing grounds for local communities (Mardyani et al., 2023).

Conflicts between traditional and modern fishermen have become increasingly frequent, especially concerning the use of non-environmentally friendly fishing gear and resource access rights. Such disputes have disrupted social harmony and led to declining catches, ecosystem degradation, and worsening economic conditions for small-scale fishermen (Nuraini et al., 2021; Pramono et al., 2021). These conflicts highlight the need for conflict-sensitive resource management that integrates ecological sustainability with social equity.

Existing fisheries management policies in Sibolga are still unable to address conflicts comprehensively and fairly (Bidayani et al., 2023; Bambang et al., 2020). The

approach remains predominantly top-down, limiting the participation of local fishing communities in decision-making processes (Orive, 2022). As a result, social tensions persist, and the welfare of fishermen has not significantly improved despite various government interventions (Dewi & Prasetyo, 2022; Suryana, 2021). The persistence of conflict indicates the absence of inclusive and adaptive management mechanisms.

To overcome these challenges, this research introduces a conflict resolution-based fisheries resource management model aimed at promoting participatory governance and improving fishermen's welfare. The model emphasizes dialogue, negotiation, and cooperation among stakeholders, ensuring that management decisions are socially acceptable and environmentally sustainable (Yusuf et al., 2019; Daris & Massiseng, 2024). Preliminary survey results in Sibolga show that implementing this model can increase fishermen's income, enhance market access, and reduce social conflicts, aligning with findings by Daris et al. (2023) and Fesanrey & Tuhulola (2022).

Based on the identified issues, this study seeks to answer three main research questions: (1) What are the welfare conditions of fishermen in Sibolga before and after implementing a conflict resolution-based management model? (2) What forms of conflict occur in the management of capture fisheries resources in the area? and (3) How effective is the conflict resolution model in reducing the level of conflict and improving fishermen's welfare? The urgency of this study lies in the need to create a fair, participatory, and sustainable management framework that supports the long-term welfare of coastal communities and the sustainability of marine resources (Rath, 2023; Prana Ugiana Gio et al., 2022).

2. Theoretical Background

Capture fisheries resources are a vital component of the marine economy, encompassing fish stocks, aquatic ecosystems, and production facilities that support fishermen's livelihoods (FAO, 2021). These resources form the foundation of coastal community economies and are essential to national food security. According to Bambang and Triarso (2020), sustainable management of capture fisheries can simultaneously ensure ecological balance and economic continuity. However, the increasing pressure from overfishing, pollution, and unregulated exploitation has led to severe degradation of marine ecosystems (Sawestri, 2021; Chakraborty, 2023). As such, the sustainable management of fisheries resources is crucial for achieving long-term productivity and welfare among fishing communities.

Sustainable fisheries management emphasizes the balance between economic benefits and ecosystem preservation. Rahman et al. (2022) and Li et al. (2024) found that effective management practices can improve fishermen's productivity, increase operational efficiency, and strengthen the resilience of coastal economies. In line with this, Nurhayati et al. (2020) stressed the importance of understanding the environmental and socio-economic values of fisheries resources to formulate fair management policies. Studies in various regions, such as Pekalongan (Bambang & Triarso, 2020) and Bitung (Kusumaningrum et al., 2021), show that integrating

ecological and economic considerations can lead to both sustainable exploitation and increased community prosperity.

The welfare of fishermen extends beyond income and economic gain; it also encompasses access to education, healthcare, public services, and social inclusion (World Bank, 2020). Sari and Hidayat (2020) argue that welfare indicators should reflect not only material well-being but also social cohesion and environmental security. Empirical studies show that welfare levels among fishermen are closely tied to the availability of fishery resources, fishing technology, and institutional capacity (Simanjuntak & Purwanto, 2020; Nisari et al., 2024). Nuraini et al. (2021) found that degradation of fishery resources in Indonesian coastal areas has significantly reduced fishermen's incomes and economic security, highlighting the urgent need for adaptive resource governance.

Conflicts in the fisheries sector often arise from competition over limited resources, overlapping regulations, and inequality in access between traditional and industrial fishermen (Yusuf et al., 2019; Dewi & Prasetyo, 2022). According to Pramono et al. (2021), these conflicts can manifest as disputes over fishing areas, gear usage, and fishing permits. The conflicts are often exacerbated by weak communication and institutional coordination between stakeholders (Daris et al., 2023). Similar conditions have been reported in various regions, including Bangka Regency (Bidayani & Kurniawan, 2023; Mardyani et al., 2023) and South Sulawesi (Daris et al., 2024), where conflicts between fishermen significantly disrupt production and social stability.

Conflict resolution in fisheries management involves various strategies such as mediation, negotiation, and participatory decision-making (Yusuf et al., 2019; Dewi & Prasetyo, 2022). Daris and Massiseng (2024) emphasized the critical role of local community institutions and women's participation in mediating disputes and promoting cooperative management. Their study in South Sulawesi revealed that community-based conflict resolution can effectively rebuild trust, reduce social tension, and enhance collective action in fisheries governance. Similarly, Pramono et al. (2021) demonstrated that inclusive dialogue and shared decision-making processes contribute to the sustainability of fishing practices and improve the welfare of marginalized fishing groups.

Institutional support and governance play an essential role in conflict mitigation and sustainable fisheries development. According to Orive et al. (2022), participatory governance and the "blue economy" framework promote cooperation across sectors and support the development of environmentally friendly fishing industries. Selawaty et al. (2020) further observed that local government strategies, such as enforcing catch limits and encouraging traditional fishing practices, are key to maintaining capture fisheries sustainability. These findings highlight that good governance, transparency, and stakeholder participation are prerequisites for effective conflict resolution and resource conservation.

Empirical studies across Indonesia illustrate the interconnectedness between conflict dynamics, resource availability, and fishermen's welfare. For instance, research by

Fesanrey and Tuhulola (2022) in Bara Village showed that conflicts tend to increase when access to resources is restricted or unequal. Similarly, Daris et al. (2023) in Maros Regency reported that local fishing institutions play an important role in balancing resource utilization and conflict mediation. Meanwhile, Nuraini et al. (2021) and Chakraborty (2023) found that environmental degradation and declining fish stocks not only reduce economic productivity but also intensify social tension within fishing communities.

Several studies recommend the implementation of a conflict resolution-based fisheries management model as an integrative approach that combines ecological, economic, and social perspectives (Yusuf et al., 2019; Daris & Massiseng, 2024). This model focuses on fostering cooperation among fishermen, government agencies, and other stakeholders through participatory mechanisms. In the context of small-scale fisheries, Bidayani and Kurniawan (2023) emphasize that participatory management improves efficiency and fairness in resource allocation. The application of this model aligns with the sustainable development principles advocated by Rahman et al. (2022) and Rath (2023), who highlight the importance of blue-green, nature-based solutions in addressing socio-environmental challenges.

In summary, the literature reveals that the sustainability of capture fisheries and the welfare of fishermen are mutually reinforcing. Sustainable management supported by strong institutional frameworks and effective conflict resolution can significantly enhance fishermen's productivity, economic stability, and social well-being (Nurhayati et al., 2020; Fajri, 2021). However, gaps remain in translating policy frameworks into practice, especially in regions like Sibolga City, where overlapping interests and weak institutional capacity persist. Therefore, further empirical investigation into the implementation of a conflict resolution-based fisheries management model is crucial to formulate adaptive and participatory strategies for improving the welfare of coastal communities.

3. Methodology

This study uses a mixed-method approach that integrates quantitative and qualitative methods to provide a comprehensive understanding of the research problem. The mixed-method design involves a process of collecting, analyzing, and combining quantitative and qualitative data in a single study to obtain deeper and more complete findings. Specifically, this research applies an explanatory sequential design, where the quantitative phase is conducted first and followed by a qualitative phase to explain and elaborate on the quantitative results.

The population of this research consists of fishermen operating in the coastal area of Sibolga City, North Sumatra. The informants include fishermen, local micro, small, and medium enterprise (MSME) actors, and traditional leaders who are directly or indirectly involved in capture fisheries activities. The sampling technique used is the snowball sampling method, starting with the head of the fishermen's group, who then

recommends other participants. Through this process, a total of 100 respondents were involved in the study.

The data collection process was carried out in two main phases. In the first phase, quantitative data were obtained using structured questionnaires designed to measure fishermen's welfare and to analyze the impact of implementing a conflict resolution-based capture fisheries resource management model. The quantitative phase aimed to provide an overview of fishermen's socio-economic conditions, participation levels, and perceptions of fisheries management effectiveness.

In the second phase, qualitative data were collected through in-depth interviews, direct observations, and documentation studies. These techniques were used to explore and deepen the understanding of the findings from the quantitative phase, especially regarding the dynamics of conflict resolution, management practices, and their effects on fishermen's welfare. The qualitative data helped to explain the relationships between variables and to uncover new insights that were not captured in the quantitative phase.

To ensure the validity of the findings, the results of the qualitative analysis were further discussed through Focus Group Discussions (FGDs) involving experts, practitioners, and community representatives. This stage was conducted to validate and refine the results, ensuring their practical relevance and accuracy in the context of fisheries management in Sibolga.

For quantitative data analysis, the study uses Partial Least Squares–Structural Equation Modelling (PLS-SEM). This analytical method allows for the examination of complex relationships between variables, including those represented by latent constructs. PLS-SEM consists of two models: the outer model, which tests the validity and reliability of indicators, and the inner model, which analyzes the structural relationships between variables. This method was chosen because it is robust for small sample sizes and does not require strict normality assumptions.

Qualitative data were analyzed using an interactive approach that included data reduction, data display, and conclusion drawing or verification. Data reduction involved sorting, selecting, and simplifying information obtained from interviews and observations. The data display stage involved presenting organized information in descriptive form to identify emerging themes and patterns. The final stage, conclusion drawing, was conducted continuously throughout the research process until data saturation was reached, ensuring that the findings accurately reflected the field conditions.

The integration of quantitative and qualitative results in this mixed-method approach provides a comprehensive picture of the implementation and impact of a conflict resolution-based fisheries resource management model. This combination allows the research to not only measure the relationships between variables but also to

understand the underlying social and contextual factors that influence the welfare of fishermen in Sibolga City.

4. Empirical Findings/Results

Outer Model Test

Convergent Validity

According to the validity criteria, predictors or items are considered valid if they have a factor loading value greater than 0.7. Based on the analysis results obtained using the PLS algorithm, several indicators were found to have factor loading values below 0.7. These indicators were therefore eliminated to meet the convergent validity requirements, as indicators with loading values lower than 0.7 do not contribute significantly to the construct measurement. After removing these low-loading indicators, the model was retested. The subsequent testing confirmed that all remaining indicators achieved factor loading values above 0.7, in accordance with the SmartPLS 4.0 standardisation criteria. This indicates that all constructs in the model have met the required level of convergent validity.

Average Variance Extracted (AVE)

A construct can be considered valid if it has an AVE value > 0.5 .

Table 2. Composite Reliability

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average Variance Extracted (AVE)
Fishermen's Welfare	0.913	0.914	0.929	0.622
Conflict Resolution	0.874	0.882	0.905	0.616
Capture Fisheries Resources	0.899	0.909	0.918	0.586

Source: Data Processed (2025)

Cronbach Alpha, Average Variance Extracted (AVE) Based on Table 1 above, it can be seen that all constructs have an AVE value > 0.5 , which means that each indicator has a valid construct.

Discriminant Validity

Discriminant validity is a stage conducted to determine whether the variables or indicators in the study have unique values and are only related to their own variables or indicators, and not to variables or indicators outside of those expected.

A study is said to have good discriminant validity if the Fornell-Larcker criterion value, which is the root of the AVE in the construct, is higher than the correlation of the construct with other latent variables.

Table 3. Fornell-Larcker Criterion Values

	Fishermen's Welfare	Conflict Resolution	Fisheries Resources
Fishermen's Welfare	0.789		
Conflict Resolution	0.667	0.785	
Capture Fisheries Resources	0.667	0.610	0.765

Source: Data Processed (2025)

From Table 3, it can be seen that the AVE root for all variables is greater than its correlation with other variables. Therefore, it can be concluded that this study has good discriminant validity.

Composite Reliability

Composite Reliability is used to test the reliability of each indicator in the study. A variable can be said to be reliable if it has a composite reliability value > 0.7 . From Table 1, it can be seen that all indicators in this study have good reliability because the Composite Reliability value is > 0.7 .

Cronbach's Alpha

In addition to Composite Reliability, another way to determine the reliability of research indicators is to look at the Cronbach Alpha value. An instrument or questionnaire is considered reliable if the Cronbach's Alpha value is > 0.6 . Table 1 shows that each construct has good reliability because the Cronbach's Alpha value is > 0.6 .

Inner Model Test

R-Square

The R-Square value is used to see how much the independent variable can explain the dependent variable. Based on Table 10, it can be seen that the R-Square value for fishermen's welfare is 0.555 or 55.5% and the R-Square value for Tax Compliance is 0.555 or 55.5%. From these figures, it can be categorised that the dependent variable can be explained by the independent variable on a moderate scale.

Table 4. R-Square

	R-square	Adjusted R-square
Fishermen's Welfare	0.555	0.541

Source: Data Processed (2025)

F-Square

The F-Square value indicates the strength of the influence of exogenous latent variables on endogenous latent variables, where an F-Square value < 0.02 indicates no influence, a value between 0.02 and 0.15 indicates a small influence, a value between 0.15 and 0.35 indicates a medium influence, and a value > 0.35 indicates a large influence.

Table 5. F-Square

	f-square
Conflict Resolution $\rightarrow$ Fishermen's Well-being	0.188
Fisheries Resources $\rightarrow$ Fishermen's Welfare	0.201
Conflict Resolution x Capture Fisheries Resources $\rightarrow$ Fishermen's Welfare	0.006

Source: Data Processed (2025)

The F-Square value:

1. The variable Conflict Resolution on Fishermen's Welfare is 0.188, which means it has a small effect.
2. The variable of Capture Fisheries Resources on Fishermen's Welfare is 0.201, indicating a small effect.
3. The variable of Capture Fisheries Resources through Conflict Resolution on Fishermen's Welfare is 0.006, indicating no effect.

Hypothesis Testing

Hypothesis testing was conducted by examining the path coefficient and p-value obtained through the bootstrapping process with an alpha of 0.05 (see Table 6).

Table 6. Path Coefficient

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T-statistic (O/STDEV)	P- values
Conflict Resolution - > Fishermen's Well-being	0.390	0.393	0.078	5.016	0.000
Fisheries Resources - > Fishermen's Welfare	0.394	0.404	0.079	4.981	0.000
Conflict Resolution x Capture Fisheries Resources -> Fishermen's Welfare	-0.040	-0.035	0.036	1.105	0.269

From Table 6, it can be seen that the Capture Fisheries Resources variable has a p-value of $0.000 < 0.05$, indicating that the null hypothesis (H_0) is rejected, meaning that Capture Fisheries Resources have a significant effect on Fishermen's Welfare. Similarly, the Conflict Resolution variable has a p-value of $0.000 < 0.05$, so H_0 is also rejected, implying that Conflict Resolution significantly influences Fishermen's Welfare. However, the moderating effect of Conflict Resolution on the relationship between Capture Fisheries Resources and Fishermen's Welfare shows a p-value of $0.269 > 0.05$, indicating that H_0 is accepted; therefore, Conflict Resolution does not have a significant moderating effect on the influence of Capture Fisheries Resources on Fishermen's Welfare.

5. Discussion

The results of this study indicate that capture fisheries resources have a significant influence on fishermen's welfare. The availability and sustainability of fish stocks remain key determinants of income stability and living standards among coastal fishing communities. This finding aligns with Bambang and Triarso (2020), who emphasised that maintaining the productivity and preservation of fish resources directly supports local fishermen's welfare. Similarly, Chakraborty (2023) highlighted that scarcity of fish resources due to ecological degradation can threaten economic livelihoods in fishing-dependent regions. Nuraini et al. (2021) also found

that the depletion of marine resources caused by overfishing and pollution reduces the income of coastal fishermen, reinforcing that the sustainable management of capture fisheries resources is crucial for socio-economic resilience. Field interviews further confirm that fishermen perceive the abundance of fish as the most decisive factor for welfare. Most informants stated that when fish are plentiful, their income increases significantly despite fluctuating prices, illustrating that fish availability directly affects their economic condition.

In addition, conflict resolution was also found to play an important role in improving fishermen's welfare. Effective conflict resolution in fishing activities—whether related to access to fishing grounds, competition over resources, or the distribution of catches—helps maintain social stability and cooperation among fishermen. This supports the findings of Yusuf et al. (2019), who demonstrated that community-based conflict resolution mechanisms can reduce economic losses resulting from disputes at sea. Dewi and Prasetyo (2022) further emphasised that institutional mechanisms such as fishermen's cooperatives facilitate fair resource distribution, enhance collaboration, and ultimately improve collective welfare. Qualitative data from interviews show that conflicts are commonly resolved through deliberation involving traditional leaders or fishing group representatives. One fisherman noted that resolving conflicts amicably helps maintain peace and allows them to work productively without disrupting income, suggesting that social harmony contributes indirectly to welfare stability.

However, the study also reveals that conflict resolution does not significantly moderate the relationship between capture fisheries resources and fishermen's welfare. This indicates that while managing disputes promotes social cohesion, it does not necessarily enhance the direct economic benefits derived from fish resource availability. Similar findings were reported by Simanjuntak and Purwanto (2020), who observed that ecological factors, particularly the abundance of fish stocks, have a more dominant influence on fishermen's income compared to social factors. Pramono, Utami, and Lestari (2021) also found that conflict resolution primarily functions to sustain social stability rather than to directly increase catch productivity or income. Interviews with fishermen support this conclusion, as many explained that even when conflicts are resolved, their income still depends largely on natural conditions and fish availability. One fisherman remarked, "Conflicts can be resolved, but if there are few fish, income will remain low." This reinforces that the sustainability of fish resources remains the main driver of fishermen's welfare, while conflict resolution serves as a complementary factor that supports a conducive and cooperative fishing environment.

6. Conclusions

Based on the results of the study, it can be concluded that capture fisheries resources have a significant effect on the welfare of fishermen, and conflict resolution has been proven to significantly improve the welfare of fishermen in the coastal area of Sibolga City. However, conflict resolution does not act as a moderating variable between

capture fishery resources and fishermen's welfare, indicating that improvements in fishermen's welfare are more directly influenced by fishery resource management and conflict resolution capabilities separately. These findings emphasise the importance of sustainable fishery resource management strategies and the implementation of effective conflict resolution mechanisms to improve fishermen's welfare.

A practical recommendation from this study is that local governments and relevant institutions need to strengthen fishermen's capacity in fisheries resource management, provide conflict management training, and encourage collaboration between fishermen, the government, and the private sector to achieve sustainable fisheries development. The implications of this study indicate that policy interventions focusing on these two aspects can improve the effectiveness of fisheries resource management and the welfare of coastal communities.

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