

Model of Capture Fisheries Management Based on Panglima Laôt Local Wisdom in Bubon Subdistrict, West Aceh

Taufiq¹, Mochammad Riyanto², Hamidi³, Nana Ariska⁴, Rony Arif Munandar⁵,
Amarullah⁶

^{1,3,6}Program Studi Perikanan, Fakultas Perikanan dan Ilmu Kelautan, Universitas Teuku Umar, Meulaboh, 23615, Indonesia

²Departemen Pemanfaatan Sumberdaya Perikanan, Fakultas Perikanan dan Ilmu Kelautan, IPB University, Bogor, Indonesia

⁴Program Studi Agroteknologi, Fakultas Pertanian, Universitas Teuku Umar, Meulaboh, 23615, Indonesia

⁵Program Studi Sumberdaya Akuatik, Fakultas Perikanan dan Ilmu Kelautan Universitas Teuku Umar, Meulaboh, 23615, Indonesia

***Corresponding Author:** taufik@utu.ac.id

Submitted: 11/05/2026; Revision Accepted: 22/09/2026; Published: 28/09/2026

How to cite this paper:

Model of Capture Fisheries Management Based on Panglima Laôt Local Wisdom in Bubon Subdistrict, West Aceh. (2026). *Proceedings of International Conference on Agro and Marine Industry*, 2(1).

<https://journal.utu.ac.id/index.php/ICONAMI/article/view/295>

Abstract

Capture fisheries management in coastal areas of Aceh, particularly in Bubon Subdistrict, faces complex challenges due to increasing pressure on fish resources, limited fishing technology, and weak integration between formal governance systems and local wisdom. Meanwhile, the traditional institution of Panglima Laôt has long played a significant role in regulating fishing activities and maintaining social order among fishers. This study aims to analyze the characteristics of capture fisheries, examine the role of Panglima Laôt, and formulate a sustainable fisheries management model based on local wisdom. A mixed-method approach was employed, combining quantitative data from a survey of 60 fishers and qualitative data from in-depth interviews with traditional leaders, fishers, and local authorities. Data were analyzed using descriptive methods, SWOT analysis, and the Ecosystem Approach to Fisheries Management (EAFM). The results indicate that capture fisheries in Bubon are dominated by small-scale fishers with fluctuating incomes and limited access to technology. The Panglima Laôt institution demonstrates a high compliance rate (over 80%) and effectively reduces conflicts while supporting resource sustainability. EAFM analysis shows that social and institutional aspects are in good condition, whereas the economic aspect remains weak. Therefore, a co-management model based on local wisdom is recommended, integrating the role of Panglima Laôt with government policies to achieve sustainable fisheries management.

Keywords: *Capture Fisheries, Local Wisdom, Panglima Laôt, EAFM, Co-Management.*

Introduction

Capture fisheries represent a strategic sector in the development of coastal regions in Indonesia, particularly for communities that depend on marine resources as their primary source of livelihood. As an archipelagic country, Indonesia possesses vast fisheries resources; however, their management continues to face significant challenges, including overfishing, the use of environmentally destructive fishing gear, and weak governance at the local level. These conditions indicate that fisheries management requires not only technical approaches but also strong social and institutional frameworks to ensure resource sustainability [1, 2, 24, 25].

In Aceh Province, particularly in Bubon Sub-district, capture fisheries play a crucial role in supporting the coastal economy. Fishing activities are predominantly carried out by small-scale fishers who face limitations in capital, technology, and market access. Consequently, fishers' income levels remain relatively low and are highly vulnerable to seasonal fluctuations and environmental changes. This phenomenon aligns with the concept of livelihood vulnerability in small-scale fisheries, where fishers are highly dependent on dynamic natural resource conditions [3, 22, 42]. Furthermore, increasing pressure on fish stocks poses a risk to marine ecosystem balance if not accompanied by effective management systems.

Amid these limitations, fishing communities in Aceh possess a traditional institutional system known as Panglima Laôt. This institution functions as a regulator of fishing activities, including the determination of fishing zones and the resolution of conflicts among fishers. Panglima Laôt represents a form of local wisdom that has been passed down through generations and has proven effective in maintaining social order and resource sustainability. Previous studies have highlighted the important role of local wisdom in supporting community-based natural resource management systems [5, 6, 33–36]. Therefore, Panglima Laôt constitutes a critical form of social capital in fisheries management in Aceh.

However, in the modern context, traditional institutions are often not optimally integrated with formal government policies. This results in a gap between local wisdom-based management systems and regulation-based governance frameworks. In fact,

numerous studies suggest that co-management approaches—integrating the roles of government and local communities—represent one of the most effective and sustainable fisheries management models [7,8,37–39, 43, 44]. The integration of traditional institutions with formal policies is therefore essential for developing adaptive and responsive management systems to address socio-ecological dynamics.

With the evolution of resource management paradigms, the Ecosystem Approach to Fisheries Management (EAFM) has emerged as a widely adopted framework in modern fisheries governance. This approach emphasizes the balance among ecological, economic, social, and institutional dimensions in fisheries management [9, 20, 41]. In addition, recent studies emphasize the importance of operationalizing ecosystem-based fisheries management within policy and practice [40]. In the context of Bubon Sub-district, the implementation of EAFM provides a relevant approach to integrate the local wisdom of Panglima Laôt with policy-based management systems, thereby fostering sustainable fisheries management. Based on the above considerations, this study is essential to comprehensively examine the characteristics of capture fisheries, the role of the Panglima Laôt institution, and to formulate a fisheries management model based on local wisdom that can be effectively implemented. The findings of this study are expected to contribute to the development of more inclusive, adaptive, and sustainable fisheries policies, particularly in coastal regions of Aceh.

Despite the growing body of literature on fisheries co-management and ecosystem-based approaches, limited studies have explicitly examined how local customary institutions can be systematically integrated into formal fisheries governance frameworks using a measurable and operational approach. Previous research has primarily focused either on the descriptive role of customary institutions such as Panglima Laôt in Aceh [21, 33–36] or on the general application of co-management and Ecosystem Approach to Fisheries Management (EAFM) in broader contexts [7–9, 37–41], with little effort to bridge these perspectives into a unified, implementable model. This study addresses this gap by developing an integrative fisheries management model that combines Panglima Laôt local wisdom with EAFM-based analytical frameworks and SWOT strategic assessment. The

novelty of this research lies in its ability to operationalize local wisdom into a structured co-management model supported by empirical socio-economic data and sustainability indicators, thereby providing not only conceptual insight but also practical guidance for policy and implementation. This integrative approach contributes to advancing hybrid governance in small-scale fisheries by demonstrating how traditional ecological knowledge can be quantitatively and strategically embedded within modern fisheries management systems.

Research Methods

Study Area and Period

This study was conducted in the coastal area of Kuala Bubon, Bubon Sub-district, West Aceh Regency. The study site was selected purposively, considering that this area represents one of the small-scale capture fisheries centers that still maintain a local wisdom-based management system through the Panglima Laôt institution. Furthermore, this area exhibits dynamic socio-ecological interactions, particularly in relation to the interplay between customary institutions and formal fisheries governance. The study was carried out over a three-month period, from August to October 2025, covering the stages of preparation, data collection, analysis, and report writing. The selected timeframe was aligned with the fishing season to ensure the collection of representative data on fishing activities [10, 11].

Research Type and Approach

This study employed a mixed-method approach, integrating both quantitative and qualitative methods within a single research design. This approach was chosen to provide a more comprehensive understanding of the socio-ecological phenomena in fisheries management, particularly in the context of integrating local wisdom with formal governance systems. The quantitative approach was used to measure fishers' characteristics and fisheries business conditions numerically, while the qualitative approach was applied to explore the meanings, perceptions, and institutional practices of the Panglima Laôt in depth. The use of mixed methods enables data triangulation, thereby enhancing the validity and reliability of the research findings [12,13].

Data Collection Techniques

Data were collected using multiple techniques, including surveys, in-depth interviews, observation, and documentation. The survey involved 60 fishers selected through purposive sampling, with criteria including active fishers having at least five years of fishing experience. This sampling technique was applied to ensure that respondents possessed relevant knowledge and experience related to the research topic [14].

In-depth interviews were conducted with key informants, including the Panglima Laôt Lhok, community leaders, and village officials. These interviews aimed to explore information regarding the role of customary institutions, management mechanisms, and social dynamics within fisheries activities. A semi-structured interview technique was employed to allow flexibility in exploring information more deeply [15].

Additionally, field observations were carried out to directly examine fishing activities, fishing gear usage, and interactions among fishers. Documentation was used to complement the data, including photographs, reports, and relevant documents related to fisheries management in the study area. The combination of these techniques enabled the collection of richer and more in-depth data [16].

Types and Sources of Data

The data used in this study consisted of primary and secondary data. Primary data were obtained directly from respondents through surveys and interviews, including information on fishers' characteristics, income, fishing gear, and perceptions of the Panglima Laôt institution. Secondary data were collected from various sources, such as government reports, fisheries statistics, and relevant scientific literature. The use of secondary data aimed to strengthen the analysis and provide broader contextual insights into the research findings. Data from government agencies, such as the Ministry of Marine Affairs and Fisheries, were also utilized to support the validity of field data [4, 17]. This approach aligns with the principle of data triangulation in social research, which seeks to enhance the accuracy and credibility of findings [17].

Data Analysis Techniques

Data analysis was conducted in stages by integrating quantitative and qualitative approaches to obtain a comprehensive understanding of the capture fisheries conditions in

Bubon Sub-district. The analysis stages included descriptive analysis, SWOT analysis, and the Ecosystem Approach to Fisheries Management (EAFM). The integration of these three approaches enabled the researchers not only to describe empirical conditions but also to formulate adaptive and sustainable management strategies [12, 18].

Quantitative Descriptive Analysis

Descriptive analysis was used to describe respondents' characteristics and fisheries business conditions, such as fishers' age, education level, types of fishing gear, number of fishing trips, and income. The data were analyzed using simple statistical measures, including mean values, percentages, and frequency distributions. The formulas used in descriptive analysis include the following:

- a. Mean Value (Average):

$$\bar{X} = \frac{\sum X_i}{n}$$

Description:

X = mean value

X_i = value of the i-th data

n = number of samples

- b. Percentage:

$$P = \frac{f}{n} \times 100\%$$

Description:

P = percentage

f = frequency

n = total number of respondents

This analysis aims to provide a general overview of the socio-economic conditions of fishermen in a systematic and easily understandable manner. The use of descriptive statistics in social research is very common for interpreting field data in a simple yet informative way [18,19].

SWOT Analysis

SWOT analysis is used to identify internal factors (strengths and weaknesses) as well as external factors (opportunities and threats) in the management of capture fisheries in Bubon District. The analysis process is conducted by identifying variables based on interview and observation results, which are then organized into a SWOT matrix. The strategic position is determined by calculating the IFAS (Internal Factor Analysis Summary) and EFAS (External Factor Analysis Summary) scores using the formula:

$$\text{Score} = \text{Weight} \times \text{Rating}$$

Description:

Weight = level of importance of the factor (0–1)

Rating = level of influence (1–4)

The total IFAS and EFAS values are then plotted into the SWOT matrix to determine the strategic position (aggressive, diversification, defensive, or turn-around). This analysis assists in formulating management strategies based on actual field conditions [19].

EAFM Analysis (Ecosystem Approach to Fisheries Management)

The EAFM approach is used to assess the level of sustainability in fisheries management based on several main domains, namely ecological, economic, social, and institutional aspects. Each domain consists of indicators that are evaluated using a scoring system. The EAFM index formula used is:

$$\text{EAFM Index} = \frac{\sum(\text{Indicator Score} \times \text{Weight})}{\sum \text{Weight}}$$

Description:

Indicator score = assessment value (1–5)

Weight = level of importance of the indicator

The index value is then classified into sustainability categories, as follows:

0–20 = very poor

21–40 = poor

41–60 = moderate

The index value is then classified into sustainability categories. The EAFM approach provides a holistic analytical framework as it considers the interactions between humans and ecosystems in fisheries management. This method has been widely used in evaluating fisheries management in various countries [9, 20, 26, 41].

Qualitative Analysis

Qualitative data obtained from interviews and observations were analyzed using an interactive analysis technique, which includes data reduction, data display, and conclusion drawing. The process was conducted iteratively to ensure that the interpretation of the data accurately reflects field conditions. The stages of analysis include:

1. Data reduction: selecting and simplifying important data;
2. Data display: organizing data in the form of narratives or matrices;
3. Conclusion drawing: interpreting the meaning of the data.

This approach enables researchers to gain an in-depth understanding of the role of Panglima Laôt in fisheries management, including the norms, values, and social practices that develop within the community. Qualitative analysis is essential in community-based research as it captures social realities that cannot be measured quantitatively [16, 17].

Results and Discussion

General Characteristics of Capture Fisheries in Bubon Subdistrict

The survey results from 60 respondents indicate that capture fisheries in Bubon Subdistrict are dominated by small-scale fishers, with vessel sizes ranging from 5–8 GT. Most fishers use traditional fishing gears such as handlines, gillnets, and simple seines. The average fishing trip duration ranges from 1–2 days per trip, with a fishing frequency of approximately 15–20 days per month depending on weather conditions. This pattern

reflects the general characteristics of small-scale fisheries in Indonesia, which still rely on simple technology and natural conditions [2, 3, 29].

From a social perspective, the majority of fishers are within the productive age range (30–50 years), with education levels predominantly at the primary and junior secondary school levels. This condition affects the fishers' ability to adapt to new technologies and innovations in fishing activities. The low level of formal education among fishers is a common phenomenon in coastal areas, which impacts limited access to information and markets [3, 6, 29].

As presented in Table 1, the distribution of respondents shows that most fishers fall within the age group of 25–40 years (45%), followed by 41–55 years (38%), indicating that the fisheries sector is still dominated by individuals in their productive years. In terms of education, the majority of respondents have only completed primary school (52%), while only a small proportion reached senior high school (18%). Furthermore, fishing experience is relatively high, with nearly half of the respondents (48%) having 10–20 years of experience, suggesting strong practical knowledge despite limited formal education. These findings highlight that while fishers possess substantial experiential skills, their limited educational background may constrain their capacity to adopt technological and market innovations.

Table 1. Characteristics of Fisher Respondents.

No	Variable	Category	Percentage (%)
1	Age	25–40 years	45%
		41–55 years	38%
		>55 years	17%
2	Education	Primary School	52%
		Junior High School	30%
		Senior High School	18%
3	Fishing Experience	<10 years	22%
		10–20 years	48%

No	Variable	Category	Percentage (%)
		>20 years	30%

Fishers' income in Bubon Subdistrict shows considerable fluctuation. Based on the survey results, the average monthly income ranges from IDR 2,500,000 to IDR 3,200,000. Fishers' income is influenced by fishing seasons, weather conditions, and the availability of fishery resources. The high dependence on natural factors makes fishers an economically vulnerable group (vulnerable livelihoods) [1, 3, 42].

Table 2. Characteristics of Capture Fisheries Operations.

No	Parameter	Average Value
1	Vessel size	5–8 GT
2	Fishing trip duration	1–2 days
3	Fishing frequency	15–20 days/month
4	Net income	IDR 2,800,000/month

Further details regarding fishing business characteristics are presented in Table 2, which indicates that the average vessel size used by fishers is relatively small (5–8 GT), with fishing trips lasting 1–2 days and a fishing frequency of 15–20 days per month. The average net income is approximately IDR 2,800,000 per month. These data confirm that fishing operations in the study area are still traditional and small-scale, with limited production capacity and income levels that are highly dependent on environmental conditions. This reinforces the notion that economic vulnerability remains a key challenge in the sustainability of capture fisheries in Bubon Subdistrict [3, 42].

The Role of Panglima Laôt Institution in Fisheries Management

The Panglima Laôt institution in Bubon Subdistrict functions not only as a regulator of fishing activities but also as a social system that integrates customary norms, cultural values, and sustainable marine resource management practices. Based on the research findings, the roles of Panglima Laôt include regulating fishing taboos (*hari pantang laôt*), determining fishing zones, and monitoring destructive fishing practices. This function indicates that Panglima Laôt operates as a local institution with strong regulatory and normative capacity, which in the literature is recognized as a form of traditional ecological governance [5, 21, 33–36].

In the context of fisheries resource management, the presence of customary institutions such as Panglima Laôt can enhance management effectiveness due to their high level of social legitimacy within the community. This is reflected in the compliance rate of fishers, which exceeds 80%, significantly higher than compliance with formal government regulations in many coastal areas. A study shows that the success of community-based management is strongly influenced by the level of trust and compliance toward local institutions [24, 25].

The role of Panglima Laôt is also crucial in maintaining social stability through conflict resolution mechanisms. Fisheries conflicts, whether occurring among local fishers or with those from outside the region, are resolved through customary deliberations that emphasize principles of justice and balance. This approach aligns with the concept of co-management in fisheries governance, where local communities actively participate in decision-making and problem-solving processes [7,8,37–39].

However, modernization dynamics and economic pressures have begun to pose challenges to the existence of this institution. Increasing economic demands, the introduction of modern fishing technologies, and external interventions may weaken compliance with customary rules. This phenomenon can lead to what is referred to as social-ecological traps, a condition in which communities remain in unsustainable systems due to economic pressures and limited alternatives [22]. Therefore, strengthening the Panglima

Laôt institution is essential to maintain a balance between economic needs and resource sustainability.

Furthermore, the integration of the Panglima Laôt institution with formal government management systems represents a strategic step forward. This approach is known as hybrid governance, a combination of customary and formal systems in natural resource management. International studies indicate that such integration can improve management effectiveness, particularly in small-scale fisheries contexts [37–39]. In Indonesia, similar approaches have been recommended in various EAFM-based fisheries management policies, which emphasize the importance of local community participation [31, 32].

Thus, the Panglima Laôt institution in Bubon Subdistrict serves not only as a regulator of fishing activities but also as a central pillar in maintaining social and ecological sustainability. Strengthening this institution—through integration with formal policies and enhancing community capacity—is key to achieving sustainable and equitable fisheries management.

Sustainability Analysis of Fisheries Using the EAFM Approach

The results of the analysis using the Ecosystem Approach to Fisheries Management (EAFM) indicate that the sustainability level of capture fisheries in Bubon Subdistrict falls within the “moderate–good” category, with a composite index value of 68.5. This value reflects that the fisheries management system has been functioning relatively well, although improvements are still needed in several key aspects.

The high score in the institutional domain indicates that the role of Panglima Laôt as a local institution remains effective in regulating fishing activities and maintaining fishers' compliance. This finding aligns with the concept of ecosystem-based management, which emphasizes the integration of social and institutional aspects in ensuring resource sustainability [9, 20, 41].

However, the relatively low score in the economic domain highlights significant challenges in improving fishers' welfare. Dependence on middlemen, fluctuating fish prices, and limited access to markets and technology are the main factors contributing to the weak economic performance of the fisheries sector. A study emphasizes that successful fisheries management depends not only on strong institutions but also on the presence of economic incentives that support sustainability [25, 42]. In addition, research in the Indonesian context shows that EAFM implementation often faces constraints in the economic domain due to weak integration within fisheries value chains [27, 29].

From an ecological perspective, the index value of 68 indicates that fishery resources in the study area are still in relatively good condition, although there are signs of pressure due to increasing fishing intensity. Some fishers reported declining catches during certain seasons, suggesting changes in fish stock dynamics. This phenomenon is consistent with findings that gradual overexploitation can lead to a decline in fisheries productivity [1, 22]. Therefore, the EAFM approach is highly relevant as it integrates ecological, social, and economic aspects within a holistic management framework [9, 20].

Overall, the EAFM analysis shows that the sustainability of fisheries in Bubon Subdistrict is strongly influenced by the interaction between local institutional systems, the socio-economic conditions of fishers, and the dynamics of marine ecosystems. From a social-ecological systems perspective, sustainability can only be achieved when there is a balance between resource utilization and the regenerative capacity of ecosystems [24].

SWOT Analysis of Capture Fisheries Management

The SWOT analysis results indicate that capture fisheries management in Bubon Subdistrict has its primary strengths in institutional and social aspects, particularly the presence of Panglima Laôt as a local institution with strong legitimacy within the community. This strength is supported by a high level of compliance among fishers and strong social solidarity within coastal communities. From a social-ecological systems

perspective, strong local institutions play a crucial role in maintaining resource sustainability [24, 25].

On the other hand, the main weaknesses identified include limited fishing technology, low levels of formal education among fishers, and weak access to markets and information. These conditions reflect the common characteristics of small-scale fisheries in developing countries [3, 29, 42].

Table 3. SWOT Matrix.

Internal Factors	External Factors
Strengths • Strong customary institutions (Panglima Laôt) • High fisher solidarity	Opportunities • Government program support (EAFM, empowerment, infrastructure) • High resource potential (diverse fishery resources)
Weaknesses • Low technology adoption • Limited infrastructure and facilities • Limited access to markets and information	Threats • Illegal fishing activities • Climate change and extreme weather • Influx of fishers from outside the region

As shown in Table 3, the SWOT matrix clearly categorizes the internal and external factors influencing fisheries management in Bubon Subdistrict. The internal strengths are dominated by strong customary institutions and high fisher solidarity, while the main weaknesses relate to technological limitations and inadequate infrastructure. On the external side, opportunities arise from government support programs and the high potential of fishery resources, whereas threats include illegal fishing activities and the impacts of climate change. This structured classification provides a comprehensive overview of the strategic environment, allowing for a clearer identification of priority areas for intervention.

From the external perspective, the development opportunities for fisheries in Bubon Subdistrict are quite significant, particularly with the support of government policies through the EAFM approach and the increasing market demand for fishery products. This

potential can be leveraged to enhance production capacity and improve the competitiveness of local fishers. However, there are also considerable threats that cannot be overlooked, such as climate change, increasing pressure on resource exploitation, and the entry of fishers from outside the region, which may trigger conflicts. This phenomenon is consistent with findings, which indicate that uncontrolled exploitation pressure can threaten global fisheries sustainability [23]. Additionally, emphasize that the resilience of fisheries systems is strongly influenced by their capacity to adapt to environmental changes and external pressures[1, 28].

Based on the SWOT matrix results, the position of fisheries management in Bubon Subdistrict falls into Quadrant I (aggressive strategy), indicating that internal strengths can be optimally utilized to seize external opportunities. This positioning is derived from the dominance of strength and opportunity factors as presented in Table 3, which collectively indicate a favorable condition for proactive development strategies. Recommended strategies include strengthening the Panglima Laôt institution, enhancing fishers' capacity through training and technology adoption, and developing market access based on local institutions. This approach aligns with the concept of co-management, which emphasizes collaboration between government and communities in resource management [24]. Furthermore, the integration of local strengths with formal policies represents a form of adaptive governance, which has been proven effective in addressing social-ecological dynamics [3, 12]. Thus, an aggressive strategy grounded in local wisdom and supported by formal policy frameworks is key to achieving sustainable fisheries management in Bubon Subdistrict [7, 8, 39].

Local Wisdom-Based Fisheries Management Model

Based on the results of the analysis, the most relevant capture fisheries management model in Bubon Subdistrict is a local wisdom-based *co-management* model. This approach is collaborative in nature, integrating the roles of government, fishing communities, and the customary institution of *Panglima Laôt*. In this model, *Panglima Laôt* serves as the main actor in regulating operational activities at the local level, while the government plays roles in

policy formulation, supervision, and resource facilitation. This approach aligns with the concept of fisheries *co-management*, which emphasizes the sharing of authority and responsibility between the state and local communities in resource management [7, 8, 37].

The main strength of this model lies in its ability to integrate local wisdom values with modern ecosystem-based management principles. Customary practices such as determining fishing taboos (*hari pantang laôt*), regulating fishing areas, and resolving conflicts through deliberation represent forms of *traditional ecological knowledge* that have proven effective in sustaining marine resources [3, 32]. Research in the Aceh context also demonstrates that local wisdom plays a significant role in maintaining the balance between resource exploitation and conservation. The integration of local knowledge with the EAFM approach becomes highly relevant in addressing the complexities of modern fisheries management [5, 33–36].

However, the implementation of this model is not without challenges, particularly those related to socio-economic dynamics and external pressures. Market globalization, climate change, and the introduction of modern fishing technologies may disrupt the balance of existing local systems. In this context, an *adaptive governance* approach is required to accommodate change and enhance the adaptive capacity of fishing communities [17, 21]. Furthermore, emphasize that successful fisheries management is strongly influenced by local leadership, social trust, and the presence of economic incentives that support sustainability [22, 24].

Moreover, this local wisdom-based *co-management* model has strong potential to be replicated in other coastal regions of Indonesia, particularly in communities where customary institutions remain robust. To support this, more concrete policy support from the government is needed, such as formal recognition of customary institutions, strengthening fishers' capacity, and developing more equitable and transparent market systems. This approach is consistent with global recommendations for small-scale fisheries management, which emphasize community participation and the strengthening of local institutions [9, 34]. Thus, this model is not only locally relevant but also holds strategic

significance in advancing sustainable fisheries management at both national and global levels [30, 41].

The characteristics of small-scale capture fisheries in Bubon Subdistrict, dominated by traditional gear and fluctuating incomes, align with broader patterns observed in Indonesian and global small-scale fisheries, where fishers face livelihood vulnerability due to seasonal and environmental dependencies [1, 3, 42]. The productive age of fishers (30–50 years) combined with relatively low levels of formal education further constrains the adoption of technological innovations, thereby perpetuating economic instability. These findings are consistent with previous studies highlighting structural limitations in small-scale fisheries systems; however, they also reveal a distinctive institutional context that differentiates Bubon Subdistrict from many comparable regions.

A key finding of this study is the central role of the Panglima Laôt institution, which demonstrates a high level of compliance (over 80%) and effectiveness in regulating fishing activities and resolving conflicts. Unlike conventional fisheries governance models that emphasize formal regulatory frameworks, this study shows that Panglima Laôt operates as a socially embedded governance system with strong legitimacy and enforcement capacity. This supports the concept of traditional ecological governance, where local norms and customary rules function as effective mechanisms for resource management [5, 21, 33–36]. More importantly, this finding challenges the dominant assumption in fisheries governance literature that formal institutions are the primary drivers of compliance, by demonstrating that locally rooted institutions can play an equally, if not more, influential role in shaping sustainable practices [24, 25].

Table 4. EAFM score.

No	Domain	Score	Category
1	Ecological	68	Moderate
2	Economic	52	Low
3	Social	75	Good
4	Institutional	80	Very Good

As presented in Table 4, the EAFM assessment results provide a comprehensive picture of sustainability performance across domains. The institutional domain achieved the

highest score (80, categorized as “very good”), followed by the social domain (75, “good”), indicating strong governance structures and social cohesion within the fishing community. In contrast, the economic domain recorded the lowest score (52, “low”), highlighting persistent challenges in improving fishers’ welfare. Meanwhile, the ecological domain scored 68 (“moderate”), suggesting that while resource conditions remain relatively stable, early signs of pressure from fishing activities are emerging. This uneven distribution reflects a structural imbalance in fisheries sustainability, where strong institutional and social foundations have not yet translated into economic resilience [9, 20, 41].

This imbalance is consistent with broader findings in fisheries research, where governance effectiveness does not automatically lead to improved economic outcomes [27, 29, 42]. In the case of Bubon Subdistrict, the results indicate that while Panglima Laôt successfully regulates fishing behavior and maintains social order, economic pressures—such as dependence on middlemen, fluctuating market prices, and limited access to capital—continue to constrain fishers’ livelihoods. This highlights a critical gap in fisheries management: the need to integrate economic incentives and market-based interventions into otherwise well-functioning governance systems. Without such integration, sustainability efforts risk being socially and institutionally robust but economically fragile.

From an ecological perspective, the moderate score and reported decline in catches during certain periods indicate increasing pressure on fish stocks, consistent with global trends of gradual overexploitation in small-scale fisheries [1, 22]. However, unlike contexts where ecological degradation is primarily driven by weak governance, the findings suggest that in Bubon Subdistrict, ecological pressure is more closely linked to economic drivers and increasing fishing intensity. This reflects a more complex social-ecological dynamic, in which strong institutions are not sufficient to prevent resource pressure when economic needs continue to rise. Such conditions are often described as social-ecological traps, where communities remain locked in unsustainable practices due to limited livelihood alternatives [22].

The SWOT analysis further reinforces this interpretation by positioning fisheries management in Bubon Subdistrict within Quadrant I (aggressive strategy). This indicates that existing internal strengths—particularly the strong legitimacy of Panglima Laôt and high social cohesion—can be strategically leveraged to capitalize on external opportunities such as government support and increasing market demand. At the same time, external threats including climate change, resource competition, and technological disparities must be addressed through adaptive strategies. This finding aligns with the concept of adaptive governance, which emphasizes the integration of local knowledge and formal policy frameworks to respond to complex and dynamic resource management challenges [7, 8, 37–39, 43].

Importantly, this study extends existing literature by demonstrating that Panglima Laôt should not be positioned merely as a complementary institution within co-management frameworks, but rather as a core governance actor capable of shaping sustainability outcomes. While previous studies have largely documented the cultural and regulatory roles of Panglima Laôt in descriptive terms [21, 33–36], this research advances the discussion by operationalizing its role within a structured management framework that integrates EAFM indicators and SWOT-based strategic analysis. This integrative approach represents a form of hybrid governance, in which traditional ecological knowledge is systematically embedded within modern fisheries management systems, thereby enhancing both analytical rigor and policy relevance.

Nevertheless, the study also highlights several challenges that must be addressed to ensure long-term sustainability. The increasing influence of modernization, including the adoption of advanced fishing technologies and the expansion of market networks, poses a risk to the continuity of customary compliance. If not carefully managed, these dynamics may weaken the authority of Panglima Laôt and lead to institutional erosion. Therefore, strengthening this institution through formal recognition, capacity building, and integration with government policies becomes a critical priority.

In this context, the findings suggest that future fisheries management strategies should prioritize economic interventions alongside institutional strengthening. These include improving access to markets, enhancing value chains, promoting livelihood diversification, and facilitating technology adoption that is compatible with local ecological conditions. Such strategies are consistent with the Ecosystem Approach to Fisheries Management (EAFM), which emphasizes the balanced integration of ecological, social, economic, and institutional dimensions to achieve long-term sustainability [9, 20, 30, 41].

Despite its contributions, this study acknowledges certain limitations. The analysis is based on cross-sectional data, which may not fully capture temporal dynamics and long-term trends in fisheries systems. Additionally, the economic dimension could be further explored through more detailed value chain analysis and quantitative economic modeling. Future research should therefore focus on longitudinal approaches, comparative regional studies, and the development of policy simulation models to strengthen the applicability of the proposed management framework.

Conclusion

This study reveals that capture fisheries in Bubon Subdistrict are characterized by small-scale operations that rely heavily on traditional fishing methods, while facing economic vulnerabilities due to dependence on natural and market conditions. Nevertheless, the Panglima Laôt institution plays a crucial role in maintaining sustainability through strong regulatory functions, high compliance levels, and effective conflict resolution mechanisms. The results of the EAFM and SWOT analyses indicate that fisheries management in the study area falls within a moderate to good sustainability category, supported by strong social and institutional dimensions but constrained by economic weaknesses.

The recommended fisheries management model is a local wisdom-based co-management approach that integrates the roles of Panglima Laôt and government institutions. This model reflects a form of hybrid governance, combining traditional ecological knowledge with modern policy frameworks to achieve balanced fisheries

management. Such an approach is consistent with global recommendations emphasizing community participation and the strengthening of local institutions in small-scale fisheries management [7, 8, 30, 41, 44].

Future research should focus on testing the implementation of this model through longitudinal studies, designing appropriate economic incentives, and expanding its application to other regions with similar socio-cultural characteristics. Policymakers are encouraged to formally recognize the role of Panglima Laôt, improve access to technology and markets, and strengthen community capacity to support adaptive and sustainable fisheries management in Aceh and other coastal regions.

References

- D. Pauly, V. Christensen, S. Gu  nette, T.J. Pitcher, U.R. Sumaila, C.J. Walters, R. Watson, D. Zeller, Towards sustainability in world fisheries, *Nature* 418 (2002) 689–695. <https://doi.org/10.1038/nature01017>
- Food and Agriculture Organization (FAO), *The State of World Fisheries and Aquaculture 2020: Sustainability in Action*, FAO, Rome, 2020. <https://doi.org/10.4060/ca9229en>
- E.H. Allison, F. Ellis, The livelihoods approach and management of small-scale fisheries, *Marine Policy* 25 (2001) 377–388. [https://doi.org/10.1016/S0308-597X\(01\)00023-9](https://doi.org/10.1016/S0308-597X(01)00023-9)
- Ministry of Marine Affairs and Fisheries (KKP), *Capture Fisheries Statistics of Indonesia 2022*, KKP Republic of Indonesia, Jakarta, 2022.
- F. Berkes, J. Colding, C. Folke, Rediscovery of traditional ecological knowledge as adaptive management, *Ecological Applications* 10 (2000) 1251–1262.
- A. Satria, *Introduction to Coastal Community Sociology*, Yayasan Pustaka Obor Indonesia, Jakarta, 2015.
- R.S. Pomeroy, F. Berkes, Two to tango: The role of government in fisheries co-management, *Marine Policy* 21 (1997) 465–480. [https://doi.org/10.1016/S0308-597X\(97\)00017-1](https://doi.org/10.1016/S0308-597X(97)00017-1)
- F. Berkes, Evolution of co-management: Role of knowledge generation, bridging organizations and social learning, *Journal of Environmental Management* 90 (2009) 1692–1702. <https://doi.org/10.1016/j.jenvman.2008.12.001>
- Food and Agriculture Organization (FAO), *The Ecosystem Approach to Fisheries*, FAO Technical Guidelines No. 4 Suppl. 2, FAO, Rome, 2003.
- J.W. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 4th ed., Sage Publications, Thousand Oaks, 2014.
- W.L. Neuman, *Social Research Methods: Qualitative and Quantitative Approaches*, 7th ed., Pearson, Boston, 2014.
- J.W. Creswell, V.L. Plano Clark, *Designing and Conducting Mixed Methods Research*, 3rd ed., Sage Publications, Thousand Oaks, 2018.
- A. Tashakkori, C. Teddlie, *Mixed Methodology: Combining Qualitative and Quantitative Approaches*, Sage Publications, Thousand Oaks, 2010.
- I. Etikan, S.A. Musa, R.S. Alkassim, Comparison of convenience sampling and purposive sampling, *American Journal of Theoretical and Applied Statistics* 5 (2016) 1–4. <https://doi.org/10.11648/j.ajtas.20160501.11>
- S. Kvale, *Doing Interviews*, Sage Publications, Thousand Oaks, 2007.

- M.Q. Patton, *Qualitative Research & Evaluation Methods*, 4th ed., Sage Publications, Thousand Oaks, 2015.
- M.B. Miles, A.M. Huberman, J. Saldaña, *Qualitative Data Analysis: A Methods Sourcebook*, 3rd ed., Sage Publications, Thousand Oaks, 2014.
- Sugiyono, *Quantitative, Qualitative, and R&D Research Methods*, Alfabeta, Bandung, 2019.
- F. Rangkuti, *SWOT Analysis Techniques for Business Case Studies*, Gramedia, Jakarta, 2016.
- Food and Agriculture Organization (FAO), *EAFM Monitoring and Evaluation Tool*, FAO, Rome, 2018.
- Sulaiman, The role of Panglima Laot in fisheries management in Aceh, *Journal of Customary Law* 12 (2017) 45–58.
- J.E. Cinner, Social-ecological traps in reef fisheries, *Global Environmental Change* 21 (2011) 835–839. <https://doi.org/10.1016/j.gloenvcha.2011.04.012>
- J.E. Cinner, M.J. Marnane, T.R. McClanahan, T.H. Almany, Periodic closures as adaptive coral reef management in the Indo-Pacific, *Ecology and Society* 11 (2006) 31.
- E. Ostrom, A general framework for analyzing sustainability of social-ecological systems, *Science* 325 (2009) 419–422. <https://doi.org/10.1126/science.1172133>
- N.L. Gutiérrez, R. Hilborn, O. Defeo, Leadership, social capital and incentives promote successful fisheries, *Nature* 470 (2011) 386–389. <https://doi.org/10.1038/nature09689>
- D. Staples, R. Brainard, S. Capezzuoli, S. Funge-Smith, C. Grose, A. Heenan, R. Hermes, P. Maurin, M. Moews, C. O'Brien, R.S. Pomeroy, K. Sainsbury, *Essential EAFM: Ecosystem Approach to Fisheries Management Training Course*, FAO Regional Office for Asia and the Pacific, Bangkok, 2014.
- S. Gelcich, T.P. Hughes, P. Olsson, C. Folke, O. Defeo, M. Fernández, S. Foale, L.H. Gunderson, C. Rodríguez-Sickert, M. Scheffer, Navigating transformations in governance of Chilean marine coastal resources, *PNAS* 107 (2010) 16794–16799.
- N.A. Marshall, P.A. Marshall, J. Tamelander, D. Obura, D. Malleret-King, J.E. Cinner, Ecosystem-based adaptation in fisheries, *Fish and Fisheries* 19 (2018) 725–742. <https://doi.org/10.1111/faf.12280>
- E.H. Allison, B.D. Ratner, B. Åsgård, R. Willmann, R. Pomeroy, J. Kurien, Rights-based fisheries governance: From fishing rights to human rights, *Fish and Fisheries* 13 (2012) 14–29.
- Food and Agriculture Organization (FAO), *Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries*, FAO, Rome, 2015.
- WWF Indonesia, *EAFM Implementation in Indonesia*, WWF Indonesia, Jakarta, 2021.
- Ministry of Marine Affairs and Fisheries (KKP), *National Policy on Ecosystem-Based Fisheries Management*, Jakarta, 2020.
- E. Wardah, Agussabti, I. Indra, Y. Rinaldi, Fishermen's perspective on Panglima Laot performance, *International Journal of Environmental Impacts* 7 (2024) 791–802. <https://doi.org/10.18280/ije.070419>
- F. Fikri, I. Idris, A.G. Catursiswandi, Imamulhadi, Local wisdom and sustainable fisheries management in Aceh, *Samarah Journal of Law* 10 (2024). <https://doi.org/10.22373/sjhk.v10.i1.27335>
- C. Permatasari, T. Yuwono, K. Kismartini, Panglima Laot and marine resource safeguarding in Aceh, *International Journal of Sustainable Development & Future Society* 1 (2023) 18–23.
- H. Susetyo, S.A. Febriyanto, S. Laidinar, M. Rizal, R. Fadhli, Panglima Laot in customary marine law enforcement, *Indonesian Journal of Socio-Legal Studies* 3 (2023) 45–58.
- L. d'Armengol, M. Prieto Castillo, I. Ruiz-Mallén, E. Corbera, A systematic review of fisheries co-management, *Global Environmental Change* 53 (2018) 206–217.
- L. Evans, N. Cherrett, D. Pems, Assessing fisheries co-management interventions, *Marine Policy* 117 (2020) 103927.

- S. Partelow, D.J. Armitage, S.M. Alexander, D. Campbell, D. Johnson, T.R. McClanahan, T.H. Morrison, M. Sowman, A. Tuda, L.C. Zulu, Co-management and adaptive governance in small-scale fisheries, *Fish and Fisheries* 21 (2020) 903–921. <https://doi.org/10.1111/faf.12484>
- J.S. Link, H.I. Browman, Operationalizing ecosystem-based fisheries management, *ICES Journal of Marine Science* 78 (2021) 1031–1043.
- Food and Agriculture Organization (FAO), *Advancing the Ecosystem Approach to Fisheries Management*, FAO, Rome, 2022.
- A. Schuhbauer, U.R. Sumaila, R. Chuenpagdee, W.W.L. Cheung, J. Lam, The economic dimension of small-scale fisheries, *Nature Sustainability* 3 (2020) 107–114. <https://doi.org/10.1038/s41893-019-0448-4>
- R. Chuenpagdee, S. Jentoft, S. Jayasinghe, M. De Alessi, N. Said, D. Isaacs, M.J. Barragán-Paladines, D. Sumaila, Blue justice for small-scale fisheries, *Nature Sustainability* 3 (2020) 448–456. <https://doi.org/10.1038/s41893-020-0475-4>
- J. Bennett, T.H. Morrison, D. Brown, G. Buncle, P. Cinner, A. Gray, D. Hurlbert, J. James, E. Marshall, S. Meyer-McLean, Local support for conservation is associated with perceptions of good governance, *Conservation Letters* 12 (2019) e12640. <https://doi.org/10.1111/conl.12640>