

# **Analysis of the relationship between the role of Panglima Laot and the balance of coastal ecosystems in North Aceh Regency**

Eva Wardah, Setia Budi, Nopriyanto

Agribusiness Department, Faculty of Agriculture, Malikussaleh University, Aceh Indonesia. Corresponding author: E. Wardah, [evawardah@unimal.ac.id](mailto:evawardah@unimal.ac.id)

**Abstract.** Panglima Laot is the leader of a customary institution that plays a significant role in managing coastal and marine resources in Aceh, particularly in maintaining the balance of coastal ecosystems. This study aims to analyze the relationship between the role of Panglima Laot and the preservation of coastal ecosystems in North Aceh District. The data was analyzed using Spearman correlation analysis to examine the direction of the relationship between relevant variables and qualitative descriptive analysis to examine the relationship between the role of Panglima Laot in regulating the coastal ecosystem balance. Data collection was conducted through interviews using questionnaires, observation, and literature review. The results revealed that the role of Panglima Laot has a significant relationship with maintaining the balance of specific ecosystems, such as the fisheries and the estuary/beach ecosystem. However, the relationship between the role of Panglima Laot and the preservation of mangrove ecosystems and coral reef ecosystems is insignificant. Despite the ecological importance of mangrove ecosystems, the findings suggest that customary maritime law has not been fully effective in protecting and managing these ecosystems. Mangrove habitat destruction is often attributed to human activities such as logging and land-use changes. Similarly, the limited role of Panglima Laot in maintaining coral reef ecosystems reflects insufficient attention and inadequate enforcement of marine customary law to protect coral reefs. Strengthening the role of Panglima Laot in the application of customary law is necessary, particularly by increasing public awareness of the importance of coastal ecosystem balance, with a specific focus on mangrove and coral reef ecosystems in the future.

**Key Words:** ecosystem balance, fishermen, local wisdom, laot customs, the role of Panglima Laot.

**Introduction.** Coastal ecosystems play an important role in maintaining environmental balance and supporting the livelihoods of communities dependent on marine resources. In coastal areas, interactions between humans and the environment often determine the sustainability of these ecosystems. Among the coastal communities in Aceh, a customary leader of the fishing community is Panglima Laot (Abdullah et al 2006; Bustamam-Ahmad 2017). The leader of the Panglima Laot customary institution embodies the local wisdom of Aceh's coastal communities. Panglima Laot, as a part of Aceh's maritime cultural heritage, has been deeply rooted in the community's life since the era of the Sultanate of Aceh Samudera Pasai 1292 AD and has continued to evolve through the 17th century to the present day (Bustamam-Ahmad 2017). According to Marzuki et al (2020), local wisdom, such as that embodied by Panglima Laot, can significantly contribute to managing coastal and marine environments. This customary institution is vital in mobilizing communities to adapt to environmental changes. According to Cinner et al (2012), local institutions provide concrete actions in maintaining ecosystems and sustainability (Pita et al 2010).

Coastal ecosystems are among the most productive ecosystems globally. They cover the transitional area between land and sea, including mangrove forests, fisheries, and coral reef ecosystems (Estradivari et al 2022). This ecosystem supports high biodiversity and provides ecosystem services essential for human life. Recognizing the importance of coastal ecosystems in supporting human well-being and maintaining global environmental balance is becoming increasingly urgent in addressing the challenges of climate change and ecological degradation (Wedding et al 2022).

The involvement of local communities in coastal management can provide numerous benefits for biodiversity, ecosystem health, fisheries, and human well-being (Graham et al 2011; Roberts et al 2017; Strain et al 2019). Unfortunately, government management often employs a 'top-down' approach (Wells et al 2016), with limited engagement from local communities (Glaser et al 2010). In a global context, issues related to coastal ecosystem degradation, such as overfishing, marine pollution, and climate change, have become significant concerns (Hamid et al 2017; Wahid et al 2017). Community-based management and local wisdom, as implemented by Panglima Laot, offer an intriguing perspective for further analysis. This traditional system has proven effective in maintaining the sustainability of marine resources and fostering harmony between humans and nature, even amid the challenges posed by modernization and economic change (Wilson & Linkie 2012; Budi 2015; Silviana et al 2021).

This study aims to analyze Panglima Laot's role in maintaining the balance of coastal ecosystems in the North Aceh district and to explore how this institution can serve as a model for coastal resource management rooted in local wisdom, thereby contributing to sustainable development. This approach is expected to provide new insights into integrating modern policies with local wisdom to sustain coastal ecosystems' balance.

**Material and Method.** This research was conducted in North Aceh District with coordinates 4°55'00"N 97°00'00"E / 4.9167°N 97°E / 4.9167; 97. The location was deliberately selected based on its status as one of the operational areas of Panglima Laot, where customary law is enforced among fishing communities. This research was conducted from May to August 2024. This study focused on community members whose profession is fishing and who are part of customary law institutions in the sea. The scope of this research is limited to the analysis of the role of Panglima Laot in maintaining the balance of the coastal ecosystem in North Aceh Regency.

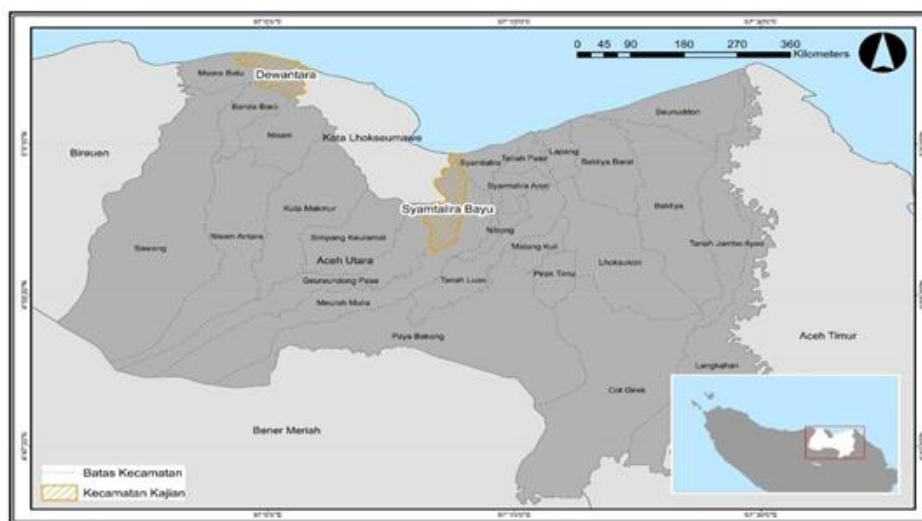


Figure 1. The location of Renggis Reef and the coral nursery at Tekek, Tioman Island, Malaysia.

Respondents in this study were 80 fishermen who were members of the Panglima Laot institution. The data used in this study comprised primary and secondary data. Primary data collection was done by conducting interviews and administering questionnaires to fishermen. Secondary data included documents obtained from BPS (Central Bureau of Statistics) of North Aceh District, North Aceh District Fisheries and Marine Office, scientific journal articles, and a literature review.

This study employed the Likert scale and Spearman rank correlation analyses. Spearman rank correlation analysis was conducted to examine the relationship between the role of Panglima Laot and the balance of coastal ecosystems (Fisheries ecosystem, Mangrove ecosystem, coral reef ecosystem, estuary/beach ecosystem) in this study (Yusuf 2017). The Likert scale, a widely used research measurement tool, was employed to assess the attitudes, opinions, and perceptions of individuals or groups regarding

specific phenomena or symptoms. The Likert scale is the most prevalent measurement tool in survey research. The identification of the Likert scale scores used is presented in Table 1.

Table 1

Likert scale identification

<i>Answer</i>	<i>Score</i>	<i>Description</i>
(1)	(2)	(3)
A	4	Strongly agree
B	3	Agree
C	2	Disagree
D	1	Strongly disagree

Source: Sugiyono 2017.

For the total score of each statement or question, the following formula was used:

$$\text{Total score} = T \times P_n$$

Where:

T = Total number of respondents who chose the option

P<sub>n</sub> = Likert scale score

Next, to obtain the interpretation results, the highest score (Y) and the lowest (X) for the assessment item were identified using the following formula:

Y = Highest Likert score x number of respondents x number of questions

X = Lowest Likert score x number of respondents x number of questions

The respondent's interpretation of Panglima Laot's role in maintaining the balance of the coastal ecosystem in North Aceh District was evaluated using an indexed percentage, as shown in the formula below (Sugiyono 2017).

$$\% \text{ Index} = \text{TS} / Y \times 100$$

Where:

TS = Total Score

Y = Likert's highest score x Number of Respondents

To determine the index's position, the interval (distance) and percentage interpretation were calculated by finding the percentage score interval (I) using the following method (Sugiyono 2017).

$$I = 100\% - 25\%$$

$$= 75\%$$

$$= 75\% / 4$$

$$I = 18.75\%$$

In this study, the score interpretation criteria for the role of *Panglima Laot* were based on the following intervals.

25% - 43.74% = Very insignificant

43.75% - 62.49% = Less significant

62.50% - 81.24% = significant

81.25% - 100% = Very significant

The interpretation of these intervals is as follows:

- If the index falls within the range of 25% – 43.74%, the role of Panglima Laot in maintaining the balance of the coastal ecosystem is categorized as very insignificant.
- If the index falls within the range of 43.75% – 62.49%, the role of Panglima Laot in maintaining the balance of the coastal ecosystem is categorized as less significant.
- If the index falls within the range of 62.50% – 81.24%, the role of Panglima Laot in maintaining the balance of the coastal ecosystem is categorized as significant.

- d. If the index falls within the range of 81.25% – 100%, the role of Panglima Laot in maintaining the balance of the coastal ecosystem is categorized as very significant.

**Results and Discussion.** The coastal area of North Aceh district has unique characteristics and dynamics, in terms of geography, ecosystem, and socio-economics of its people. North Aceh district is located on the north coast of Sumatra Island, directly bordering the Malacca Strait (BPS 2022). The coast of North Aceh has a fairly long coastline and consists of various types of coastal ecosystems, such as mangroves, beach/estuaries, fisheries, and coral reef ecosystems.

Damage to coastal ecosystems is becoming increasingly severe, often driven by unwise human behavior in utilizing and managing the coastal environment, necessitating serious efforts to address this issue. Among Aceh's coastal communities, local wisdom embodied in the Panglima Laot institution plays a vital role in preserving the coastal environment. This institution supervises and regulates activities that could potentially disrupt the sustainability and balance of the coastal environment, ensuring its protection over the long term.

The findings indicate that the fishing community continues to place significant trust in the Panglima Laot customary institution, recognizing its substantial contributions to preserving environmental functions and ensuring the sustainability of coastal ecosystems. Efforts made by this marine customary law institution include adherence to the principles of marine customary law in managing their territories, guided by the values of local wisdom. The community strongly believes that the beach and the sea are integral to their lives, serving as essential resources upon which fishermen depend for their daily livelihoods.

**Application of customary law rules to coastal ecosystem balance.** The customary law of the sea enforced by the Panglima Laot institution in Aceh plays an important role in preserving the balance of the coastal ecosystem. As a traditional legal system developed over centuries, these regulations are grounded in the principles of local wisdom, reflecting a deeply rooted harmonious relationship between humans and nature, particularly the sea. In the context of coastal resource management, the application of maritime customary law focuses on regulating human activities to ensure that the coastal ecosystem remains sustainable and prevents damage caused by overexploitation.

Table 2 presents the index values of fishermen's attitudes toward implementing customary maritime laws in coastal ecosystems in the North Aceh Regency area, as analyzed using a Likert scale.

Table 2

Fishermen's attitude index values towards the implementation of customary law rules in coastal ecosystems

No.	Application of lao customary law rules to coastal ecosystems	Index value	Interpretation
1	Fisheries ecosystem	79.56	Significant
2	Mangrove ecosystem	59.75	Less significant
3	Coral reef ecosystem	61.58	Less significant
4	Estuary/Coastal ecosystem	80.37	Significant
	Average	70.31	Significant

Based on the index value of the Likert scale analysis results, the application of marine customary law provisions in the fisheries ecosystem is categorized as having a significant role. These results indicate that the rules of marine customary law for fisheries ecosystems include environmentally friendly fishing gear regulations. This rule aims to prevent overfishing and maintain a stable fish population. With the implementation of these rules, fish resources can continue to be renewed, enabling fishermen to achieve sustainable yields without damaging the marine ecosystem. Panglima Laot also

supervises the prohibition of destructive fishing gear, such as fish bombs or poisons, which have the potential to disrupt the balance of the marine ecosystem. Panglima Laot also enforces the regulation of fishing times (such as the prohibition of fishing during certain seasons or when fish are spawning).

The enforcement of customary law rules to mangrove ecosystems is categorized as having a less significant role (Table 2). This may occur because customary law primarily focuses more on marine resources and fisheries. In the research location, mangroves are often damaged due to land conversion for ponds and coastal area development. The law also has a less significant role for coral reef ecosystems, with an index value of 61.58 (Table 2). At the research site, customary marine regulations include prohibitions against using explosives or poisons for fishing, which helps mitigate damage to coral reef ecosystems. However, the impacts of climate change and rising sea temperatures also contribute to the decline of coral reefs. Efforts by Panglima Laot to monitor and restore coral reefs include supervising the area to prevent destructive fishing practices and encouraging community participation in preserving coral reefs.

Furthermore, the application of customary law rules governing the sustainability of estuarine/coastal ecosystems has a significant role, with an index value of 80.37 (Table 2). These customary laws include rules to maintain and supervise the cleanliness of beaches and efforts to protect the coastal environment from pollution caused by fishing waste or oil residue from ship repair activities.

**Analysis of the relationship between the role of Panglima Laot and the balance of coastal ecosystems.** This study used Spearman correlation analysis to examine the relationship between the role of Panglima Laot and the balance of coastal ecosystems in the North Aceh district. The results indicated that the role of Panglima Laot is significant to the fisheries ecosystem and the estuary/beach ecosystem. However, its role in maintaining the balance of mangrove ecosystems and coral reefs was insignificant (Table 3).

Table 3  
Analysing the role of Panglima Laot in maintaining the balance of coastal ecosystems

		<i>Role of the Panglima Laot ecosystem</i>					
		<i>Fisheries ecosystem</i>	<i>Mangrove ecosystem</i>	<i>Coral reef ecosystem</i>	<i>Estuary/Beach ecosystem</i>		
Spearman's rho	Role of the Panglima Laot	Correlation Coefficient	1.000	-0.525**	0.008	0.110	-0.567**
		Sig. (2-tailed)	0	0	0.945	0.330	0.000
		N	80	80	80	80	80
	Fisheries ecosystem	Correlation Coefficient	-0.525**	1.000	-0.005	-0.059	0.116
		Sig. (2-tailed)	0	0	0.965	0.603	0.305
		N	80	80	80	80	80
	Mangrove ecosystem	Correlation Coefficient	0.008	-0.005	1.000	0.147	0.049
		Sig. (2-tailed)	0.945	0.965	0	0.194	0.667
		N	80	80	80	80	80
	Coral reef ecosystem	Correlation Coefficient	0.110	-0.059	0.147	1.000	0.092
		Sig. (2-tailed)	0.330	0.603	0.194	0	0.416
		N	80	80	80	80	80
	Estuary/Beach ecosystem	Correlation Coefficient	-0.567**	0.116	0.049	0.092	1.000
		Sig. (2-tailed)	0	0.305	0.667	0.416	0
		N	80	80	80	80	80

\*\* . Correlation is significant at the 0.01 level (2-tailed). Source: Primary Data (analyzed) 2024.

From Table 3, the Spearman correlation coefficients reveal that the role of Panglima Laot and the fisheries ecosystem shows a significance value ( $r=-0.525$ ,  $p<0.01$ ). The role of Panglima Laot and the estuary/coastal ecosystem also has a significance value ( $r=-0.567$ ,  $p<0.01$ ). These findings indicate a significant negative relationship between the role of Panglima Laot and the fisheries and estuary/coastal ecosystems. This suggests that an increase in the role of Panglima Laot is associated with a decrease in the condition or diversity of these ecosystems, potentially reflecting that better management by Panglima Laot contributes to reducing pressure on fisheries resources.

In contrast, the role of Panglima Laot and the mangrove ecosystem is not significant ( $r=0.0080$ ,  $p>0.05$ ). A similar case occurs for its role in the coral reef ecosystem ( $r=0.1100$ ,  $p>0.05$ ). The lack of a significant relationship indicates that Panglima Laot's role does not directly affect these two ecosystems or that other unmeasured factors may play a more substantial role. Furthermore, the results confirm a highly significant relationship between the role of Panglima Laot and the fisheries and estuary/coastal ecosystems ( $p<0.01$ ), while no significant relationship is observed between Panglima Laot's role and the mangrove and coral reef ecosystems ( $p>0.05$ ). These results suggest that the policies and actions implemented by Panglima Laot have a more pronounced impact on ecosystems directly connected to fishing activities and coastal management.

The results of this study indicate that the efforts made by Panglima Laot through customary law regulations, such as enforcement of maritime customs, dispute resolution, and coordination with the government, have a greater impact on ecosystems directly related to fishing activities. Key indicators of institutional performance include the direct and indirect impacts on fishermen in maintaining and supervising the implementation of customary law regulations in coastal areas, such as prohibitions on destructive fishing practices, bombing, and the use of anesthetics, which directly affect the coastal ecosystem's health. These findings align with the research of Murhaini (2021), which underscores the importance of conserving nature to sustain the lives of its biota and inhabitants. Destroying natural resources, by contrast, adversely impacts their ecosystems. Thus, community livelihood management should incorporate local wisdom values passed down through generations. Hamid et al (2021) similarly advocated for using local wisdom as an integral approach to conservation program management.

The challenges and obstacles faced by the Panglima Laot Institution are currently unavoidable. One of the primary challenges relates to ensuring the sustainability of fishermen's income from the fisheries sector, which is influenced by various factors, such as climate change, overfishing, and marine resource sustainability issues. According to Teniwut (2016) and Muñoz (2020), the ability to adapt to environmental changes through appropriate policies is crucial for the success of traditional institutions in ensuring coastal environmental sustainability. Therefore, the Panglima Laot Institution must adapt and develop innovative solutions to address these challenges. This aligns with the findings of Marshall et al (2019) and Losciale et al (2022), which highlighted the importance of raising awareness of fishing communities about climate change and its impact on marine habitats, leading to declining incomes for fishermen.

Uncontrolled climate change and harmful human activities seriously threaten the institution's efforts. Climate change contributes to a decline in fish populations, underscoring the need for local communities to continue upholding traditional wisdom in their daily activities, particularly in fishing practices (Hamid et al 2023). Research by Kathijotes (2013) highlighted that fishermen must reduce their dependence on ecosystem services and act as guardians of the marine environment. Illegal fishing and overfishing remain significant threats, as the depletion of fish stocks can lead to irreversible damage, even when strict protective measures are implemented. Moreover, unsustainable fishing practices exert additional pressure on marine resource sustainability in the area (Visbeck et al 2014). Another major challenge the Panglima Laot Institution faces is managing conflicts of interest among various stakeholders and resource users in marine resource management. Transforming fishing communities' perceptions about coastal resource management into collective actions is critical for achieving sustainable resource management (Kitolelei & Sato 2016; Espectato et al

2022). The strategic allocation of human resources and sustainable utilization of coastal areas can help prevent conflicts and foster synergy between sectors in coastal resource management (Papageorgiou 2016).

Research by Jack-Kadioglu et al (2020) asserted that community involvement in managing coastal conservation areas is the key to maintaining the sustainability of marine ecosystems. This is in line with the efforts of the Panglima Laot Institution, which actively involves indigenous communities in marine resource management in Aceh.

The continued relevance of the Panglima Laot Institution is vital due to its significant role in preserving coastal ecosystems and maintaining local wisdom. Despite numerous challenges, collaboration among various stakeholders can ensure that the institution remains effective and substantially benefits coastal communities. By fostering sustainable, culture-based development, the Panglima Laot Institution can continue to preserve cultural heritage and traditional practices while maintaining the sustainability of coastal ecosystems in the North Aceh district.

**Conclusions.** Overall, the results indicated that fishermen's perceptions of the application of maritime customary law in coastal ecosystems and its impact on the balance of coastal ecosystems in North Aceh District fell within the significant category. Specifically, fishermen categorized the application of maritime customary law as having a significant role in the fisheries and coastal ecosystems. In contrast, its application in the mangrove and coral reef ecosystems was classified as having a less significant role. Statistically, the p-value obtained from the Spearman correlation analysis revealed that the relationship between the role of the Panglima Laot and the fisheries and estuary/coastal ecosystems was highly significant ( $p < 0.01$ ). However, the relationship between the role of the Panglima Laot and the mangrove and coral reef ecosystems did not demonstrate statistical significance ( $p > 0.05$ ). These findings suggest that applying maritime customary law, as a form of local wisdom, in managing mangrove and coral reef ecosystems requires greater attention from the Panglima Laot, the customary leader of the Laot institution in coastal Aceh.

**Acknowledgements.** The author would like to thank the Panglima Laot institution of Aceh Province and the Panglima Laot District of North Aceh, as well as the fishing communities as respondents in this study.

**Conflict of interest.** The authors declare no conflict of interest.

## References

- Abdullah M. A., Tripa S., Mansur T. M., 2006 [As long as wisdom is wealth: the existence of Panglima Laot and customary law of laot in Aceh, First]. Ed. Lembaga Panglima Laot Aceh, Banda Aceh 01(02):48-57. [in Indonesian]
- BPS (Central Bureau of Statistics), 2022 [Pidie Jaya district in figures in 2022. Central bureau of statistics of Pidie Jaya regency] 01(01):5-10. [in Indonesian]
- Budi S., 2015 Identification of fishermen characteristics and their perception onto the role of Laot Customary Law Institution at Lhokseumawe City (case study: fishermen at Pusong Village). *Acta Aquatica: Aquatic Sciences Journal* 2(2):79-82.
- Bustamam-Ahmad K., 2017 A Study of Panglima Laot: an adat institution in Aceh. *Al-Jami'ah Journal of Islamic Studies* 55(1):155-188.
- Cinner J. E., McClanahan T. R., Graham N. A. J., Daw T. M., Maina J., Stead S. M., Wamukota A., Brown K., Bodin Ö., 2012 Vulnerability of coastal communities to key impacts of climate change on coral reef fisheries. *Global Environmental Change* 22(1):12-20.
- Espectato L. N., Monteclaro H. M., Arceo H. O., Catedrilla L. C., Baylon C. C., 2022 Community perceptions on the role of inter-local government units alliance in coastal resource management: the case of Banate Bay alliance in Iloilo, Philippines. *Ocean & Coastal Management* 219(3):106059.

- Estradivari, Agung Muh. F., Adhuri D. S., Ferse S. C. A., Sualia I., Andradi-Brown D. A., Campbell S. J., Iqbal M., Jonas H. D., Lazuardi M. E., Nanlohy H., Pakiding F., Pusparini N. K. S., Ramadhana H. C., Ruchimat T., Santiadji I. W. V., Timisela N. R., Veverka L., Ahmadia G. N., 2022 Marine conservation beyond MPAs: towards the recognition of other effective area-based conservation measures (OECMs) in Indonesia. *Marine Policy* 137:104939.
- Glaser M., Baitoningsih W., Ferse S. C. A., Neil M., Deswandi R., 2010 Whose sustainability? Top-down participation and emergent rules in marine protected area management in Indonesia. *Marine Policy* 34(6):1215-1225.
- Graham N. A. J., Ainsworth T. D., Baird A., Ban N. C., Bay L. K., Cinner J., De Freitas D. M., Diaz-Pulido G., Dornelas M., Dunn S. R., Fidelman P., Foret S., Good T. C., Kool J., Mallela J., Penin L., Pratchett M. S., Williamson D. H., 2011 From microbes to people: tractable benefits of no-take areas for coral reefs. *Oceanography and Marine Biology* 49:105-136.
- Hamid S. K., Marasabessy I., Royani D. S., 2023 Performance of local fishermen: competitiveness of smoked fish domestic supplier in Kei Islands, Indonesia. *AACL Bioflux* 16(3):1488-1498.
- Hamid S. K., Teniwut W. A., Renhoran M., Teniwut R. M. K., 2021 A novel framework for marine protected areas in small island regions using integrated local wisdom. *Regional Studies in Marine Science* 45(6):101819.
- Hamid S. K., Teniwut W. A., Teniwut R. M. K., Rahantoknam M. A., Hasyim C. L., Hungan M., 2017 The support of MPA (Marine Protected Area) in coral triangle area: evidence from Kei Islands, Indonesia. *IOP Conference Series Earth Environmental Science* 89:012025.
- Jack-Kadioglu T., Pusparini N. K. S., Lazuardi M. E., Estradivari, Rukma A., Campbell S. J., Jakub R., Claborn K., Glew L., Rusandi A., Hakim A., Sapari A., Andradi-Brown D. A., 2020 Community involvement in marine protected area governance. In: *Management of marine protected areas in Indonesia: status and challenges*. Ministry of Marine Affairs and Fisheries and WWF Indonesia Foundation, Jakarta, Indonesia. Pp. 23-55.
- Kathijotes N., 2013 Keynote: blue economy - environmental and behavioural aspects towards sustainable coastal development. *Procedia - Social Behavioral Science* 101:7-13.
- Kitolelei J. V., Sato T., 2016 Analysis of perceptions and knowledge in managing coastal resources: a case study in Fiji. *Frontiers in Marine Science* 3:189.
- Losciale R., Hay R., Rasheed M., Heron S., 2022 The public perception of the role, importance, and vulnerability of seagrass. A case study from the Great Barrier Reef. *Environmental Development* 44:100757.
- Marshall N. A., Thiault L., Beeden A., Beeden R., Benham C., Curnock M. I., Diedrich A., Gurney G. G., Jones L., Marshall P. A., Nakamura N., Pert P., 2019 Our environmental value orientations influence how we respond to climate change. *Frontiers in Psychology* 10:1-8.
- Marzuki, Mukminin A., Ikhsan, Gani M. A., 2020 Panglima Laôt, the guard of Weh Island coastal ecosystems. In: *Management of marine protected areas in Indonesia: status and challenges*. Ministry of Marine Affairs and Fisheries and WWF Indonesia Foundation, Jakarta, Indonesia. Pp. 257-258.
- Muñoz J. M. B., 2020 Progress of coastal management in Latin America and the Caribbean. *Ocean & Coastal Management* 184:105009.
- Murhaini S., 2021 The farming management of Dayak People's community based on local wisdom ecosystem in Kalimantan Indonesia. *Heliyon* 7(12):e08578.
- Papageorgiou M., 2016 Coastal and marine tourism: a challenging factor in marine spatial planning. *Ocean & Coastal Management* 129:44-48.
- Pita C., Pierce G. J., Theodossiou I., 2010 Stakeholders participation in the fisheries management decision-making process: fishers' perceptions of participation. *Journal of Marine Policy* 34(5):1093-1102.
- Roberts C. M., O'Leary B. C., McCauley D. J., Cury P. M., Duarte C. M., Lubchenco J., Pauly D., Sáenz-Arroyo A., Sumaila U. R., Wilson R. W., Worm B., Castilla J. C.,



- 2017 Marine reserves can mitigate and promote adaptation to climate change. *Proceedings of the National Academy of Sciences* 114(24):6167–6175.
- Silviana A., Utama Y. J., Ismail N., Ardani M. N., 2021 Land management policy in the coastal area based on the local wisdom. *AACL Bioflux* 14(6):3403–3415.
- Strain E. M. A., Edgar G. J., Ceccarelli D., Stuart-Smith R. D., Hosack G. R., Thomson R. J., 2019 A global assessment of the direct and indirect benefits of marine protected areas for coral reef conservation. *Diversity and Distributions* 25(1):9–20.
- Sugiyono, 2017 [Research methodology quantitative, qualitative, combination, R & D and evaluation research approaches]. CV. Alfabeta, Bandung 225(87):48-61. [in Indonesian]
- Teniwut W. A., 2016 For sustainable revenue of fisheries sector in small islands: evidence of Maluku, Indonesia. *AACL Bioflux* 9(3):722–732.
- Visbeck M., Kronfeld-Goharani U., Neumann B., Rickels W., Schmidt J., van Doorn E., Matz-Lück N., Ott K., Quaas M. F., 2014 Securing blue wealth: the need for a special sustainable development goal for the ocean and coasts. *Marine Policy* 48:184–191.
- Wahid W. A., Muksal M., Nirzalin N., Zulfikar Z., 2017 [The influence of illegal fishing practices on fishermen’s economic welfare in Aceh Province]. *Jurnal kemaritiman* 1(2):411–417. [in Indonesian]
- Wedding L. M., Reiter S., Moritsch M., Hartge E., Reiblich J., Gourlie D., Guerry A., 2022 Embedding the value of coastal ecosystem services into climate change adaptation planning. *PeerJ* 10:e13463.
- Wells S., Ray G. C., Gjerde K. M., White A. T., Muthiga N., Creel J. E. B., Causey B. D., McCormick-Ray J., Salm R., Gubbay S., Kelleher G., Reti J., 2016 Building the future of MPAs – lessons from history. *Aquatic Conservation: Marine and Freshwater Ecosystems* 26(S2):101–125.
- Wilson C., Linkie M., 2012 The Panglima Laot of Aceh: a case study in large-scale community-based marine management after the 2004 Indian Ocean tsunami. *Oryx* 46(4):495–500.
- Yusuf M., 2017 [Research methods: quantitative, qualitative, and combined research]. *Kencana, Jakarta* 04(02):480. [in Indonesian]

Received: 13 November 2024. Accepted: 14 January 2025. Published online: 14 January 2025.

Authors:

Eva Wardah, Agribusiness Department, Faculty of Agriculture, Malikussaleh University, Aceh Indonesia.24335 e-mail; [evawardah@unimal.ac.id](mailto:evawardah@unimal.ac.id)

Setia Budi, Agribusiness Department, Faculty of Agriculture, Malikussaleh University, Aceh Indonesia. 24335, e-mail; [setiabuddi@unimal.ac.id](mailto:setiabuddi@unimal.ac.id)

Nopriyanto, Agribusiness Department, Faculty of Agriculture, Malikussaleh University, Aceh Indonesia.24355, e-mail; [nopri.bbc@unimal.ac.id](mailto:nopri.bbc@unimal.ac.id)

This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

How to cite this article:

Wardah E., Budi S., Nopriyanto, 2025 Analysis of the relationship between the role of Panglima Laot and the balance of coastal ecosystems in North Aceh Regency. *AACL Bioflux* 18(1):44-52.