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Research Article

Sustainable Coastal Land Management in Serdang Bedagai

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Abstract: Coastal areas are vital for ecosystems, social, and economic systems, yet they face challenges like erosion, land-use conversion, and weak community-based management. Serdang Bedagai Regency, located in North Sumatra, has significant ecological and socio-cultural potential, but this potential has not been sustainably managed. This study analyzes strategies for sustainable coastal land management by integrating local wisdom and village government roles. A mixed-method approach was used, including in-depth interviews, field observations, and surveys with 30 respondents from two coastal villages. The qualitative findings reveal that traditional practices, such as prohibiting mangrove cutting and communal conservation traditions, are still alive in the community. The village government plays a crucial role in strengthening institutions through village regulations (Perdes), environmental programs, and spatial monitoring. However, there is a gap between community understanding of ecological values and the implementation of regulations. Quantitative analysis using multiple linear regression shows that both local wisdom and the village government's role significantly influence sustainable coastal land management, with coefficients of 0.491 and 0.426, respectively ($p < 0.05$). Despite some heteroskedasticity, the model passed tests for multicollinearity and normality. These findings highlight the importance of combining traditional values with institutional support to balance coastal resource utilization and conservation. This study contributes to the development of a socio-ecological coastal governance model and offers practical recommendations for village governments, policymakers, and academics in creating participatory and sustainable coastal preservation programs.

Keywords: Coastal Management; Local Wisdom; Serdang Bedagai; Sustainability; Village Government

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1. Introduction

Coastal areas play a strategic role in national development, encompassing economic, social, and ecological aspects. The economic potential of coastal regions includes sectors such as fisheries, tourism, aquaculture, wetland agriculture, and maritime transportation, all of which contribute to regional gross domestic product. In addition, these areas serve important ecological functions as buffer zones between land and sea and as habitats for coastal biodiversity, such as mangrove forests and estuarine ecosystems. Socially, coastal regions reflect the cultural identity of local communities who have long coexisted with marine and coastal environments, serving as vital spaces for daily subsistence. Therefore, unplanned and unsustainable coastal land management can trigger multidimensional adverse impacts, both on the environment and on the well-being of local communities.

Serdang Bedagai Regency, located in North Sumatra Province, is one of the regions with an extensive coastline and rich coastal resources. This area is known for its vast mangrove forests, community-based fishponds, swampy agricultural lands, and coastal villages with close ties to the sea. These advantages make Serdang Bedagai a promising region for blue economy development and conservation area expansion. However, in recent years, the coastal

zone has faced several serious threats endangering its ecosystems. These include expanding coastal abrasion, the conversion of mangrove areas into fishponds or contaminated zones, pollution from domestic and agricultural waste, and the pressures of climate change, all of which have made coastal lands increasingly vulnerable to degradation (Nugroho & Sugiarto, 2025). These issues are exacerbated by the lack of integration between ecological, social, and spatial planning aspects in local coastal land management policies. In fact, a participatory and community-based approach is crucial to foster sustainable management systems (Nasution Hasyim & Sugiarto, 2024). One approach to address these challenges is to integrate local wisdom into coastal land management.

Local wisdom is the body of knowledge and social practices developed over generations through the long-standing interaction of communities with their environment. Local values include belief systems, customary laws, environmental rituals, and traditional conservation practices, which have proven to be vital instruments in maintaining ecological balance. As described by Rizal (2011), the community in Gumeng Village, Karanganyar Regency, possesses ecological wisdom reflected in their worldview of nature, traditional rituals related to planting and harvesting seasons, and their understanding of the ecological functions of each environmental component. This proves that local communities possess knowledge systems and practices aligned with modern conservation principles. In the context of North Sumatra, the study by Nuraini, Azizah, and Muharrani (2023) highlights the importance of preserving spatial planning based on cultural values in the Mandailing ethnic group, which indirectly strengthens environmental awareness through the community's socio-cultural system. Furthermore, the role of village governments is crucial in facilitating the integration of local wisdom into village development policies (Supriadi & Sugiarto, 2025). Village governments should not merely act as program implementers but also as strategic actors capable of promoting community-based environmental management. A study by Sugiarto and Almuttaqin (2025) notes that sustainable development strategies do not solely rely on top-down structural interventions but also require spatial and social support from grassroots levels, including the use of green open spaces and the understanding of social interaction structures at the local level.

Based on the background above, the research questions of this study are: 1) What forms of local wisdom are held by the communities in two coastal villages in Serdang Bedagai regarding coastal land management?; 2) What is the role of village governments in integrating such local wisdom into sustainable coastal land management policies and programs?

The objectives of this study are: 1) To identify the forms of local wisdom held by communities in two coastal villages in Serdang Bedagai related to coastal land management, 2) To analyze the role of village governments in integrating such local wisdom into sustainable coastal land management policies and programs, 3) The benefits of this research are expected to contribute to the development of theories and literature on coastal land management based on local wisdom and the role of village governments in the context of sustainable development.

The results of this study are also expected to serve as a reference for village governments and other stakeholders in formulating coastal land management policies and programs grounded in local wisdom, as well as to raise public awareness of the importance of coastal environmental conservation.

Several previous studies relevant to this topic include Rizal (2011), who examined the local wisdom of rural communities in environmental management in Gumeng Village, Karanganyar Regency. Additionally, Nuraini, Azizah, and Muharrani (2023) explored the direction of spatial conservation based on the organizational systems of the Mandailing ethnic community in North Sumatra, while Sugiarto and Almuttaqin (2025) analyzed sustainable development strategies through the optimization of green open spaces and patterns of spatial interaction in urban areas.

However, there remains a lack of specific research examining how village governments participate in systematically integrating local wisdom into coastal area management. Moreover, studies focusing on the Serdang Bedagai Regency using a mixed qualitative and quantitative approach are still very limited, leaving an important research gap to fill. This empirical data gap affects the availability of policy references rooted in local contexts, despite each coastal village having unique socio-ecological characteristics that cannot be generalized.

Therefore, this study aims to conduct an in-depth analysis of how coastal land management strategies can be implemented sustainably through the integration of local wisdom and the role of village governments. The study focuses on two coastal villages in Serdang Bedagai

Regency, each with unique socio-cultural and environmental characteristics. A mixed-methods approach will be used, combining qualitative analysis (interviews, field observations) and quantitative analysis (surveys and multiple linear regression). The findings are expected to contribute conceptually to the development of coastal management theory based on local contexts and provide strategic recommendations for policymakers at the village and regency levels to achieve adaptive, participatory, and sustainable coastal land governance.

2. Preliminaries or Related Work or Literature Review

2.1 Theory of Local Wisdom

Local wisdom refers to the knowledge, values, and practices that have been passed down through generations within communities, particularly in efforts to preserve the environment. In the context of coastal resource management, local wisdom reflects the community's ecological awareness in maintaining a balance between humans and nature. A study by Harahap et al. (2021) shows that coastal communities in Sei Nagalawan Village manage their environment traditionally through the preservation of mangrove forests and prohibitions against overharvesting marine resources.

2.2 Community Empowerment Theory

The theory of community empowerment emphasizes the importance of strengthening local capacity to manage resources and make decisions that impact community welfare. In coastal areas, empowerment serves as a key instrument for promoting participatory management that is adaptive to environmental protection. Fitriansah (2012), in his research, found that a community-based empowerment approach successfully increased the participation of residents in Kwala Lama Village in managing their coastal environment.

2.3 Sustainable Management Theory

Sustainable management is an approach that seeks to balance economic, social, and ecological needs without compromising the ability of future generations to meet their own needs. In coastal contexts, this involves ecosystem conservation, prudent use of natural resources, and protecting local communities from environmental degradation. Nuraini, Azizah, and Muharrani (2023) emphasize the importance of preservation based on local values and village institutions in managing traditional spatial organization sustainably.

2.4 Relevant Previous Studies

Table 1. Previous Studies.

Researcher	Year	Research Focus	Relevance
Fitriansah	2012	Community empowerment in coastal areas of Serdang Bedagai	Community empowerment in coastal areas of Serdang Bedagai
Harahap et al.	2021	Local wisdom of coastal communities in mangrove conservation	Local wisdom of coastal communities in mangrove conservation
Maulia et al.	2022	The role of government in the welfare of fishermen	The role of government in the welfare of fishermen

Source: Compiled by the author

3. Proposed Method

This study employs a mixed methods approach with a dominant qualitative descriptive orientation, combined with simple quantitative descriptive analysis. This approach is chosen because the issue of sustainable coastal land management requires an in-depth understanding of the local social, cultural, and institutional context, while still being supported by structured field data obtained through surveys.

The qualitative descriptive approach is used to explore the role of village governments and the forms of local wisdom embedded in coastal communities. Additionally, a simple quantitative descriptive approach is included to support the interpretation of field findings through survey data. This method enables a simultaneous analysis of social, cultural, and land governance aspects in a more comprehensive manner.

3.1 Research Location and Period

The research was conducted in two coastal villages in Serdang Bedagai Regency, namely: (a)Sei Nagalawan Village – known for community-based mangrove management and ecotourism. (b) Bagan Kuala Village – has developing coastal potential but faces pressure from land-use conversion.

The selection of these two villages was conducted purposively based on active coastal characteristics, the presence of local wisdom, and the tangible role of village governments in managing coastal resources. The study was carried out from November 2024 to February 2025, covering stages such as field observation, in-depth interviews, questionnaire distribution, and data analysis.

3.2 Population and Sample

The population in this study consists of community members and village officials who live and operate in the coastal areas of the two selected villages. Samples were selected using a purposive sampling technique, with the following criteria for informants: (a) Village officials (village head, village secretary, officers in the environmental or development sectors). (b) Traditional or community leaders involved in coastal conservation activities. (c) General community members (fishermen, coastal entrepreneurs, residents living near mangrove ecosystems)

The total number of respondents was set at 30 individuals, with 15 respondents from each village. This number is considered sufficient to capture a range of perspectives and support the validity of both qualitative and descriptive findings.

3.3 Research Variables and Conceptual Framework

This research develops a conceptual framework based on the relationship between the following three variables: (a) Local Wisdom (X1): Local practices, values, and norms related to coastal ecosystem preservation. (b) Role of Village Government (X2): The regulatory, facilitative, and integrative functions of village authorities in managing and empowering communities. (c) Sustainable Coastal Land Management (Y): Indicators of success in ecological, social, and economic aspects of land use and conservation.

The relationship between these variables is illustrated in a conceptual model that shows how X1 and X2 influence Y, which is further analyzed through both qualitative and quantitative methods. The conceptual framework is illustrated as follows:

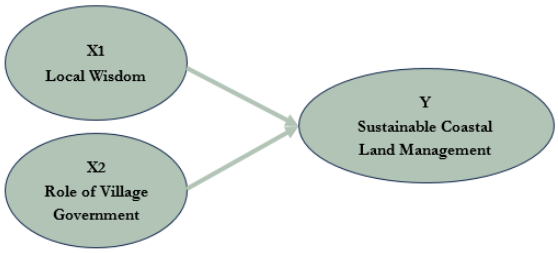

Figure 1. Conceptual Framework of the Study on Sustainable Coastal Land Management in Serdang Bedagai.
Source: Author's Own Illustration

The diagram above represents the conceptual framework of the study, illustrating the relationships between the main variables under investigation. This research is built on the assumption that sustainable coastal land management is influenced by internal community strengths in the form of local wisdom, as well as institutional support through the role of village government. Each variable is formulated based on general indicators that reflect both empirical and theoretical substance within the context of coastal spatial management.

The first variable (X1) is Local Wisdom, which includes indicators such as customary practices, locally developed social norms or informal rules, and ecological values embedded in residents' daily lives. The second variable (X2) is the Role of Village Government, measured through village-level policies and regulations, facilitation of environmental or conservation programs, and local monitoring mechanisms implemented by village officials. The dependent variable (Y) is Sustainable Coastal Land Management, which reflects ecological sustainability of the coastal area, the level of community participation in spatial management, and the success of adaptive and environmentally friendly land use.

3.4 Types and Sources of Data

The study uses primary data, i.e., data collected directly from the field. The data sources include: (a) Village government (formal). (b) Traditional leaders and environmental activists (non-formal). (c) Coastal residents (local communities)

This research does not rely on secondary data from documents, as not all policy or spatial planning documents at the village level are publicly accessible. If official documents (such as Village Regulations or the Village Spatial Plan/RTRW) are obtained from village authorities, they will be recorded as supporting data.

3.5 Data Collection Techniques & Data Analysis Methods

Data Collection Techniques: (a) In-depth Interviews, Used to gather information on the village's role, forms of local wisdom, and sustainability strategies from key informants. (b) Field Observation, Conducted to observe activities in coastal management, such as aquaculture, mangrove conservation, and community interaction with the coastal space. (c) Community Survey, A semi-structured questionnaire is administered to village residents to understand their perceptions, knowledge, and involvement in coastal management activities.

Data were analyzed using two approaches: (a) Qualitative: Data from interviews and observations are analyzed using thematic analysis, starting with data reduction, thematic grouping, and narrative interpretation. (b) Descriptive Quantitative: Data from questionnaires are presented in tables, bar charts, or pie charts to show response frequencies and the general tendencies of community perceptions.

These two approaches are combined in the results and discussion sections, in the form of synthesized findings, to support triangulation validity and to strengthen the overall understanding of the local-based coastal management context in Serdang Bedagai.

3.6 Research Flow

To systematically illustrate the stages undertaken in this study, a research flowchart is constructed, outlining the steps from problem identification to the formulation of conclusions and recommendations. This flow provides a logical framework that guides each stage of the process—from the formulation of the conceptual framework, primary data collection, to data analysis and interpretation. The following diagram presents the research flow used in this study:

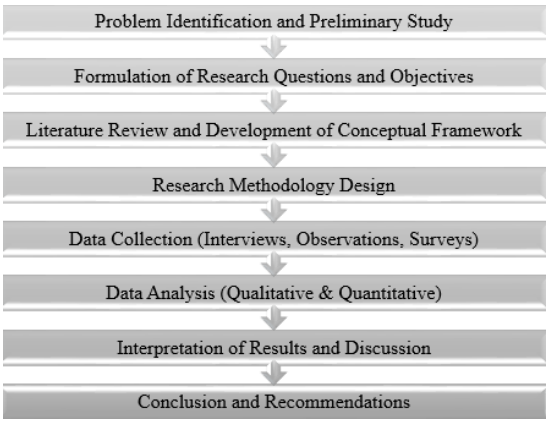

Figure 2. Research Flowchart.
Source: Author's Compilation

Figure 2 above presents the systematic steps used in this study. The process begins with problem identification and preliminary study, aimed at understanding the current issues related to coastal land management in Serdang Bedagai Regency. This is followed by the formulation of research problems and objectives, based on research gaps and academic urgency.

The next stage involves the literature review and development of the conceptual framework, which serves to build a theoretical foundation and formulate research variables based on scientific and contextual perspectives. After that, the research methodology is designed using a mixed methods approach, combining qualitative and quantitative analysis in a complementary manner.

Once the methodological design is complete, primary data collection is conducted through field observation, in-depth interviews, and questionnaire distribution. The data collected is then analyzed using thematic qualitative analysis and descriptive as well as multiple linear regression quantitative analysis, in order to address the research questions and examine relationships among variables.

The subsequent phase is the interpretation of results and discussion, which involves analyzing empirical findings and connecting them with relevant theories and previous studies. The study concludes with drawing conclusions and formulating strategic recommendations, which can serve as a reference for village governments, academics, and stakeholders in developing sustainable coastal management based on local wisdom.

4. Results and Discussion

4.1 General Overview of the Research Location

Serdang Bedagai Regency is one of the strategic coastal regions in North Sumatra Province, located on the eastern coast of Sumatra Island. Administratively, the regency directly borders the Malacca Strait to the east, giving it great potential for developing marine and fisheries sectors, as well as conserving coastal ecosystems. The presence of mangrove forests, fishponds, rivers, and marine tourism areas makes this region a representative example of the complex interaction between humans and the environment in Indonesia's tropical coastal zones. This study focuses on two coastal villages: Sei Nagalawan Village in Perbaungan District, and Bagan Kuala Village in Tanjung Beringin District.

These villages were selected based on their complementary characteristics. Sei Nagalawan is known for its community-based mangrove conservation and ecotourism, while Bagan Kuala is experiencing greater pressure from land-use changes and coastal erosion, offering a more contrasting yet complementary perspective on sustainable management.

Sei Nagalawan Village, located along the eastern coast of Serdang Bedagai under Perbaungan District, has direct access to coastal waters and extensive mangrove areas. The village covers approximately 13 km^2 with a population of around 2,800 people (BPS Serdang Bedagai, 2023). The main livelihoods include fishing, fish farming, and community-run ecotourism. The village is notable for the Muara Baimbai Mangrove Conservation Group, a local community active since 2015 in mangrove ecosystem preservation. These mangroves serve as educational and community-based conservation tourism areas. The village government supports this through participatory policies like annual mangrove planting programs and the creation of marine conservation zones. Public facilities in the village are relatively adequate, including roads, a small pier, and several community-run homestays. However, the village faces major challenges such as imbalanced tourism development and threats of mangrove conversion into shrimp ponds by external investors. Nevertheless, collective mitigation efforts have been initiated by both the community and local government.

Bagan Kuala Village, located in Tanjung Beringin District, is a coastal area known for capture fisheries and aquaculture production. The village spans around 9 km^2 with approximately 3,200 residents (BPS North Sumatra, 2023). Most residents work as traditional fishers and shrimp or milkfish farmers. Compared to Sei Nagalawan, Bagan Kuala faces more vulnerable ecological conditions. Coastal abrasion and conversion of mangroves into intensive fishponds have caused significant environmental degradation over the past decade. Harahap et al. (2021) reported that more than 40% of mangrove land in the area has been converted, leading to reduced fishery yields and increased tidal flood risks. The village government has attempted to establish coastal management working groups and draft Village Regulations (Perdes) on conservation. However, policy implementation has been slow due to limited institutional capacity and low community participation, mainly driven by short-term economic pressures.

Nonetheless, there is great potential for improvement through the integration of local Malay coastal wisdom, such as customary taboos against illegal mangrove logging and the tradition of gotong royong (communal work) to clean beaches. This potential is a crucial focus of the study, as it highlights opportunities for building locally based, participatory models of sustainable management.

The two research sites reflect complementary and contrasting dynamics. Sei Nagalawan illustrates structured and participatory conservation practices, while Bagan Kuala presents real-world management challenges in more exploitative coastal land use. Together, they provide relevant case studies to evaluate how village governments can integrate local wisdom into strategies for sustainable coastal land management, amid both economic and ecological pressures.

4.2 General Profile of Research Respondents

The respondents in this study were purposively selected based on their direct involvement in coastal land management activities, whether as village policymakers or community actors. A total of 30 respondents were selected, with 15 from Sei Nagalawan and 15 from Bagan Kuala. Respondents were divided into three main categories: (1) Village Government Officials, including the village head and relevant administrative staff. (2) Traditional or Community Leaders, including conservation activists and guardians of local traditions. (3) Coastal Community Members, such as fishers, aquaculture farmers, and local tourism entrepreneurs.

Table 2. Distribution of Respondents by Category.

No	Respondent Category	Number	Percentage (%)
1	Village Government Officials	6	20%
2	Traditional/Community Leaders	6	20%
3	General Coastal Community Members	18	60%
	Total	30	100%

Source: Author's Compilation

Table 3. General Profile of Respondents.

Criteria	Category	Number of Respondents	Percentage (%)
Gender	Male	21	70%
	Female	9	30%
Age	18–30 years	4	13.3%
	31–45 years	12	40%
	46–60 years	10	33.3%
	>60 years	4	13.3%
Education	Primary School	5	16.7%
	Junior High School	9	30%
	Senior High School	13	43.3%
	Higher Education	3	10%
Occupation	Fishermen	12	40%
	Fish Farmers	6	20%
	Village Officials	6	20%
	Tourism/Conservation Workers	6	20%

Source: Author's Compilation

The distribution results show that the majority of respondents come from the general coastal community group, particularly fishermen and fish farmers, who are both the most affected and the most actively involved in the utilization of coastal land. Most respondents are within the productive age range (31–60 years), typically involved in informal decision-making and implementation of village activities.

In terms of education, the respondents' educational attainment is dominated by junior and senior high school graduates, indicating a fairly open capacity for understanding government programs and environmental conservation efforts, although still requiring a communicative and participatory approach.

The employment profile also reflects a diversity of roles, ranging from traditional fishermen to ecotourism and conservation actors, making the information obtained from surveys and interviews rich in local perspectives.

4.3 Field Observation and Interview Findings

Field research was conducted through direct observation and in-depth interviews with key informants from the two villages: Sei Nagalawan and Bagan Kuala. This method was used to explore physical environmental conditions, management practices, and the integration of local wisdom implemented by the village government and community members.

4.4 Field Observation Results

Observations were conducted on various coastal environmental components, such as mangrove areas, fishpond zones, village infrastructure, and community activities. The findings are synthesized in Table 3:

Table 3. Observational Results of Coastal Area Conditions.

Location	Observed Object	Field Findings	General Condition
Sei Nagalawan	Mangrove forest	Dense, well-preserved mangroves; used for ecotourism education and community conservation	Good
Sei Nagalawan	Coastal settlements	Stilt wooden houses; evacuation routes and community beach-cleaning initiatives	Fairly Good
Sei Nagalawan	Conservation facilities	Mangrove tracking paths, educational signage, small jetty, signs prohibiting damage	Good
Bagan Kuala	Fishpond areas	Intensive ponds, some overlapping with former mangrove land, murky water	Poor
Bagan Kuala	Mangrove forest	Mostly degraded or deforested, low natural regeneration	Damaged
Bagan Kuala	Village infrastructure	Limited road access, no zoning signs for conservation areas	Inadequate

Source: Author's Compilation

These observations clearly highlight the contrast between the conservation-based approach implemented in Sei Nagalawan and the environmental degradation occurring in Bagan Kuala due to economic pressures and weak spatial regulations.

4.5 In-depth Interview Results

nterviews were conducted with 10 key informants from both villages, including village heads, village officials, traditional leaders, conservation actors, and active community members involved in coastal management. A summary of the interview findings is presented in Table 4:

Table 4. Summary of Interviews with Key Informants.

Village	Informant	Interview Narrative
Sei Nagalawan	Village Head	Since 2015, we have prioritized mangrove preservation because it's the main asset of this village. Aside from preventing abrasion, it's also a source of ecotourism and education.
	Community Conservation Leader	When there was a mangrove rehabilitation program, the community agreed to an unwritten rule: no one may cut mangroves without permission. Now we've developed an educational tourism route too.
	Village Secretary	We plan to incorporate the conservation efforts into village regulations so they have legal authority. But we need external support to ensure the legal process is strong.
Bagan Kuala	Local Resident	We used to collect firewood from the mangroves, but not anymore. Now, our children also learn about the ecosystem through the school conservation program.
	Hamlet Head	There used to be lots of mangroves here, but now they've been converted into ponds. We know this has an impact, but it's hard to control since our family income depends on aquaculture.
	Traditional Leader	We have customary taboos against cutting mangroves indiscriminately, but they are being forgotten. I hope we can revive those traditions.

Village	Informant	Interview Narrative
	Village Official	We once discussed drafting a conservation village regulation, but it hasn't materialized. Many residents aren't convinced of the direct benefits yet.
	Fisherman	It's getting harder to find fish. Maybe it's because the mangroves are disappearing. We need solutions, but we don't know where to start.

Source: Author's Compilation

The results of observations and interviews indicate that (1) Sei Nagalawan Village implements a community-based institutional approach in preserving the coastal ecosystem, including the integration of local values into both formal and informal governance systems. (2) Bagan Kuala Village faces a dilemma between short-term economic needs and ecological sustainability. Although there is cultural awareness among the community, weak regulations and limited participation remain major obstacles. This second village reflects the broader reality of many coastal areas in Indonesia: on one hand, there is potential for locally driven conservation efforts; on the other hand, there is vulnerability due to the lack of consistent and sustainable institutional intervention.

Table 5. Summary of Community Survey Results.

No	Statement	Average Score	Interpretation
1	I understand the importance of preserving the coastal environment	4.6	Strongly Agree
2	I am familiar with local traditions related to coastal management	3.9	Agree
3	The village government is active in protecting coastal areas	3.8	Fairly Agree
4	The community is often involved in coastal conservation programs	3.4	Fairly Agree
5	I feel a personal responsibility for coastal sustainability	4.3	Agree
6	The coastal areas in my village are managed sustainably	3.6	Fairly Agree
7	There are customary or local restrictions on marine resource use	3.2	Neutral–Fairly Agree
8	I have participated in village activities related to environmental conservation	2.9	Neutral
9	I feel the village government listens to the aspirations of coastal communities	3.7	Fairly Agree
10	I hope coastal conservation programs will be enhanced in the future	4.8	Strongly Agree

Source: Compiled by the author

In general, the survey results indicate that the community's awareness of the importance of coastal sustainability is high (Statements 1 and 5 with scores > 4.0). This reflects a strong ecological awareness among residents, although community involvement in conservation programs is still moderate (Statements 4 and 8 with scores < 3.5).

One key finding is that local wisdom remains known (Statements 2 and 7), but it has not been fully integrated into formal governance, as community participation in policy-making or village activities remains limited. This aligns with earlier interview findings in Bagan Kuala, which revealed that although local wisdom is still valued, it is gradually being forgotten in practice.

Statement 10 ("I hope coastal conservation programs will be enhanced in the future") received the highest score, indicating that most respondents have strong hopes for more sustainable coastal management moving forward.

4.6 Results of Quantitative Analysis: Multiple Linear Regression

The quantitative analysis in this study was conducted to examine the influence of Local Wisdom (X1) and the Role of the Village Government (X2) on Sustainable Coastal Land Management (Y) in the two coastal villages of Serdang Bedagai Regency. The analytical model used was multiple linear regression, which was statistically tested and adjusted using the strong standard error approach to address potential heteroskedasticity. Below are the results of the multiple linear regression analysis after adjustments with strong standard error to ensure the reliability of the findings:

Table 6. Multiple Linear Regression Test Results.

Variable	Koefisien	Robust Std. Error	t-Statistik	P-Value	VIF
Constant	-0.060	1.181	-0.052	0.959	-
Local Wisdom (X1)	0.491	0.183	2.683	0.012	1.01
Role of Village Government (X2)	0.426	0.206	2.072	0.048	1.01
Residual Normality (Shapiro-Wilk Test)					
Statistic	0.964				
P-Value	0.383				
Heteroscedasticity (Breusch–Pagan Test)					
LM Statistic	12.456				
P-Value (LM)	0.0019				
F Statistic	9.584				
P-Value (F)	0.0007				

Source: SPSS 20, processed independently

Based on the table above, the Constant (-0.060 | not significant, p = 0.959) indicates that if there is no influence from local wisdom and the role of the village government, the coastal land management score tends to approach zero and is statistically insignificant. This means effective management heavily depends on the presence of the predictor variables studied.

Next, Local Wisdom (β = 0.491 | p = 0.012). This coefficient indicates that every one-unit increase in perception of local wisdom will increase the coastal management score by 0.491, assuming other variables remain constant. Substantively, local wisdom makes a meaningful contribution to the preservation of coastal lands. For example, customary values such as prohibitions against indiscriminate mangrove cutting or mutual cooperation systems in beach cleaning serve as key drivers of sustainable environmental governance. This finding aligns with interviews conducted in Sei Nagalawan Village, highlighting the existence of customary rules and local cultural values integrated into community-based conservation activities.

The next variable is Role of the Village Government (β = 0.426 | p = 0.048). This result indicates that increased support, oversight, and policy actions from the village government can improve the coastal management score by 0.426 units. Although the coefficient is slightly lower than that of local wisdom, the role of the village government remains significant. This reflects the necessity of formal institutional functions in strengthening spatial policies, community assistance, and facilitating local regulations such as the establishment of environmental village regulations (*Perdes Lingkungan*). This finding is consistent with observations in both villages: in Sei Nagalawan, village officials are actively engaged in mangrove education and eco-tourism, whereas in Bagan Kuala, coordination is weak and there are no strong local regulations in place.

To ensure the model's validity, a series of classical assumption tests were conducted: (a) Multicollinearity: VIF values are < 1.1 for all variables, indicating no excessive correlation among the independent variables. The model passes the multicollinearity assumption. (b) Residual Normality: The Shapiro-Wilk test shows a p-value of 0.383 > 0.05, indicating that the

residuals are normally distributed. (c) Heteroscedasticity: There is evidence of heteroscedasticity ($p < 0.05$); however, this has been addressed using Robust Standard Errors (HC3), which ensure the validity of the coefficients despite assumption deviations.

Based on the results of the multiple linear regression model, both local wisdom and the role of the village government significantly influence sustainable coastal land management. Both contribute positively and substantially, suggesting that: (a) Coastal management cannot rely solely on formal government or technocratic approaches. (b) The integration of local values and village-level policies is crucial for preserving coastal environments.

This finding strengthens the argument that concerns in the coastal context are not only technical (physical and spatial) in nature but also social-cultural and institutional.

4.7 Discussion

The discussion in this study focuses on a comprehensive interpretation of the quantitative and qualitative results obtained, as well as their relation to relevant theories and previous research findings. The analysis is based on three main variables: Local Wisdom (X1), the Role of Village Government (X2), and Sustainable Coastal Land Management (Y).

4.8 The Influence of Local Wisdom on Coastal Land Management

The regression analysis results show that local wisdom has a positive and significant effect on sustainable coastal land management. A coefficient of **0.491 ($p = 0.012$)** confirms that the stronger the traditional values and practices upheld by the community, the more effective the coastal management efforts.

This finding aligns with the concept of culturally based spatial preservation as proposed by Nuraini (2024), who emphasized that the architecture and spatial use in traditional Mandailing communities are not merely physical constructs but represent sustainable spiritual and ecological values. In the coastal context, this is reflected in local practices such as community-based mangrove management, seasonal fishing restrictions, and the use of eco-friendly natural materials for housing construction.

These findings are also consistent with Linda et al. (2024), who found that communities rich in cultural traditions tend to be more adaptive to spatial and environmental challenges due to strong social norms and value-based collective interaction systems.

4.9 The Role of Village Government and Its Implications for Sustainability

The Role of Village Government variable also shows a significant effect ($\beta = 0.426$, $p = 0.048$), indicating that the presence of village institutions plays a crucial role in directing, regulating, and facilitating coastal management. This is evident from initiatives such as waste management training programs, the drafting of Village Regulations (Perdes) on the Environment, and logistical support provided to local communities.

Research by Hidayat et al. (2023) supports this finding, stating that the success of sanitation infrastructure in Medan Deli heavily depends on active collaboration between residents and local government. When the village government is passive, even a community with great potential will experience stagnation in development efforts.

Similarly, Sugiarto & Ramadania (2024) emphasize the importance of strengthening spatial regulations based on RTRW/RDTR (Spatial and Zoning Plans) in riparian areas to prevent overexploitation and land-use conversion that harm environmental carrying capacity.

4. 10 Synergy Between Traditional Values and Formal Institutions

This study reveals that local wisdom and the role of village government do not operate independently, but instead complement each other. Communities require formal guidance to ensure that local practices remain relevant to changing times, while village governments need support from social values to gain legitimacy and policy effectiveness.

Hartini et al. (2023), in their study on infrastructure management in Medan Sunggal, noted that the success of public facility management hinges on the ability of local institutions to integrate social, cultural, and spatial understanding of local communities. It is therefore not surprising that in coastal contexts, the success of land management is greatly influenced by the collaborative strength between tradition and formal systems.

The findings of this study resonate strongly with prior research emphasizing the importance of integrating local values, community participation, and institutional roles in territorial management. For instance, Nuraini et al. (2023) highlighted that traditional community structures and their ecological functions act as a generational survival system, reflecting that environmental management is inseparable from social and cultural contexts.

Hidayat et al. (2023) also revealed that the success of infrastructure—including sanitation and spatial management—is significantly influenced by active community involvement and local institutional support. Meanwhile, Sugiarto and Ramadania (2024) stress that well-managed riparian spatial governance must be grounded in community-based local policies,

consistent with this study's emphasis on the village government's role as a facilitator of integration between policy and local wisdom.

Haloho and Sugiarto (2024) also support the notion that infrastructure development in coastal areas must consider the local environmental carrying capacity to prevent ecological stress beyond the area's limits. Moreover, Aini et al. (2023)underline the importance of preserving space based on the social structures of indigenous communities, ensuring that spatial planning aligns with the values upheld and believed by local residents.

From a social and cultural interaction perspective, Linda et al. (2024) add that the social characteristics and interaction patterns of communities influence organizational capacity in responding to environmental changes—an aspect also observed in this study through the dynamics of participation and customary values in the two coastal villages.

However, the findings are not entirely consistent with some other studies. For instance, Purba et al. (2024) place more emphasis on economic aspects and infrastructure growth, with less attention to the importance of local values in spatial governance. Similarly, Sugiarto et al. (2023) focus on economic and tax indicators as development drivers but have yet to explore the integration of local culture and institutional roles in sustaining coastal ecosystems.

Overall, the analysis indicates that coastal land management in Serdang Bedagai Regency is deeply embedded in the complex interplay of ecological, social, and institutional aspects. Management processes centered on sustainability are greatly influenced by the presence of local wisdom and the village government's ability to translate these values into policies, supervision, and environmental programs.

Hence, the success of coastal governance is not only reliant on technical capacity but also on the quality of collaboration between communities, local cultures, and village institutions in maintaining the balance between utilization and conservation of coastal spaces.

5. Conclusions

Based on the analysis conducted using a mixed-methods approach, this study concludes that sustainable coastal land management in Serdang Bedagai Regency is strongly influenced by the synergy between local wisdom and the active role of village governments. Local wisdom has proven to contribute significantly to preserving ecological values and the environmental ethics of coastal communities, while the village government plays an essential role in regulating, directing, and facilitating the sustainability of coastal spatial governance through regulations, programs, and empowerment efforts.

These two factors do not operate in isolation but reinforce each other. The traditional values passed down through generations require institutional strengthening to remain relevant and effective in the face of dynamic spatial development challenges.

In line with the statistical results, which indicate both variables have a positive and significant influence, it can be concluded that the success of coastal management cannot be solely determined by a technocratic approach. Instead, it requires the integration of social, cultural, and local institutional dimensions.

Therefore, the researcher recommends that village governments immediately draft and ratify Environmental Village Regulations (Perdes) that regulate coastal land conservation based on local wisdom, accompanied by periodic participatory education programs to foster collective community awareness. Furthermore, in the second and third years of implementation, it is proposed that local wisdom values be digitized as an adaptive form of cultural inheritance, along with the establishment of inter-village coastal collaboration forums to serve as platforms for effective knowledge exchange and cross-regional program coordination.

In the medium term (fourth to fifth year), there is a need to strengthen environmental institutional capacity at the village level through certified training, and to replicate local wisdom-based management models in other coastal villages with similar characteristics. This process should include a continuous monitoring and evaluation systeminvolving various community elements—traditional leaders, youth, and village officials—to ensure that policies and programs are not merely symbolic but have real impacts on ecological sustainability and the social welfare of coastal communities.

Thus, it is expected that through systematic, collaborative efforts grounded in local strengths, coastal land management in Serdang Bedagai Regency can become a model of inclusive and contextual sustainable development, not only for the present but also for the future of Indonesia’s coastal regions.

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