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Local Wisdom and Sustainable Coastal Development through Community Resilience in Paluh Manan Village Indonesia

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Abstract

Coastal communities in Indonesia face intertwined ecological and socioeconomic pressures, while development interventions often prioritize physical infrastructure and formal participation over locally embedded adaptive capacity. This study examines whether participatory communication and local wisdom contribute to community resilience and whether resilience translates these resources into sustainable coastal development. A quantitative explanatory design was applied to 199 valid respondents in Paluh Manan Village, Indonesia. Data were collected using a five-point Likert questionnaire and analyzed using partial least squares structural equation modeling (PLS-SEM) with measurement- and structural-model assessment and 2,000-resample bootstrapping. The final model retained 21 reflective indicators. Local wisdom significantly predicted community resilience ($\beta = 0.608$, $p < 0.001$), whereas participatory communication did not ($\beta = 0.070$, $p = 0.412$). Community resilience had the strongest direct effect on coastal development ($\beta = 0.650$, $p < 0.001$). Local wisdom had no significant direct effect on coastal development ($\beta = 0.058$, $p = 0.266$), but its indirect effect through resilience was significant ($\beta = 0.395$, $p < 0.001$), with 87.1% of the estimated total effect transmitted through the mediator. The findings support an embedded-resilience perspective in which local wisdom becomes developmentally consequential when transformed into collective adaptive capacity. They also suggest that participatory communication should be institutionally embedded in locally legitimate structures rather than treated as a stand-alone intervention.

1 Introduction

Coastal zones are strategic spaces for livelihoods, food production, settlement, transportation, tourism, and ecological services, but they also concentrate environmental and socioeconomic pressures. Small-scale fishing households may face shoreline change, sea-level rise, pollution, fluctuating catches, market uncertainty, insecure resource access, and uneven public investment. In Southeast Asia, coastal transitions are shaped by changing maritime governance and economic activities that interact with established livelihood systems (Fabinyi et al., 2022). Coastal development is therefore a societal as well as environmental problem: the challenge is to protect ecosystems and livelihoods while maintaining community agency, cohesion, and stewardship.

Coastal household vulnerability is multidimensional. Research in Indonesia shows that vulnerability can arise from simultaneous weakening of social, financial, human, physical, and natural livelihood capitals (Saleh et al., 2026). Studies elsewhere similarly show that exposure alone does not determine vulnerability; social networks, financial resources, alternative livelihoods, information, and institutional support influence response capacity (Rahman et al., 2024; Saha et al., 2024). Sustainable coastal development therefore requires attention to the social infrastructure through which communities interpret risks, mobilize resources, coordinate action, and learn.

Community resilience provides a bridge between social resources and development outcomes. It is increasingly understood as the collective capacity to absorb shocks, adapt practices and institutions,

and transform maladaptive arrangements, rather than simply return to a previous condition (Magis, 2010). In tropical coastal communities, adaptive capacity depends on social, institutional, and ecological conditions (Cinner et al., 2018). Resilience therefore includes material resources as well as trust, learning, leadership, coordination, and collective action. Two community resources are particularly relevant: participatory communication and local wisdom. Participatory communication treats residents as actors who generate knowledge, interpret problems, negotiate priorities, and participate in decisions. It reflects a shift from linear development communication toward dialogue, empowerment, and local ownership (Wang & Huang, 2025). Participatory action research shows the value of co-designed risk communication (Moran et al., 2023), while community-based theatre has been examined as a mechanism for coastal risk communication and social engagement (Bubeck et al., 2024). Yet participation is not automatically empowering; local power relations and procedural participation can limit substantive effects.

Local wisdom is a complementary resource comprising locally developed knowledge, norms, values, practices, and social arrangements shaped through long interaction with the environment. Research links communal arrangements and locally embedded practices with social cohesion, resilience, and environmental management (Asmal & Latief, 2023; Asmal et al., 2023). Local wisdom has also been incorporated into contemporary resource-conservation approaches (Aspan et al., 2023). In small-scale fisheries, social relationships, reciprocity, trust, and leadership can support collective resource management, although social capital alone does not guarantee effective governance (Bodin & Crona, 2008).

The distinction between participatory communication and local wisdom is therefore important. Participatory communication emphasizes the process through which people exchange information and influence decisions, whereas local wisdom emphasizes the culturally embedded knowledge and social arrangements that shape collective action. Their overlap is theoretically plausible, but the constructs remain analytically distinct and can be examined empirically. A second gap concerns the mechanism connecting community resources to development. Local wisdom may support environmental stewardship and social cohesion, but it does not necessarily produce measurable development outcomes by itself. Communication may improve awareness without generating collective action. Resilience can therefore be understood as the mechanism that converts community resources into adaptive capacity and, subsequently, sustainable development. Structural modeling in small-scale fisheries supports treating resilience as an empirically testable construct (Amadu et al., 2021), while livelihood research emphasizes interactions between local adaptive strategies and wider social networks (Kuipers & De Jong, 2023).

This study addresses these gaps by testing an integrated structural model in Paluh Manan Village, Indonesia. Participatory Communication (X1) and Local Wisdom (X2) are modeled as antecedents, Community Resilience (Z) as the mediator, and Coastal Development (Y) as the outcome. The model tests direct effects on resilience and development and indirect effects through resilience. The central proposition is that local knowledge and communication become developmentally consequential when

they are translated into collective adaptive capacity. The study has three objectives: (1) to examine the effects of participatory communication and local wisdom on community resilience; (2) to test the effect of community resilience on coastal development and the direct effect of local wisdom on development; and (3) to assess whether resilience mediates the relationships between the two community resources and coastal development.

2 Literature Review and Hypothesis Development

2.1 Participatory Communication and Community Resilience

Participatory communication is grounded in the proposition that development communication should enable communities to become producers and interpreters of knowledge rather than passive recipients of expert messages. The approach emphasizes dialogue, horizontal exchange, mutual learning, and collective decision-making. Its relevance to resilience follows from the assumption that adaptive capacity depends partly on whether people can recognize shared problems, exchange experiential knowledge, coordinate responses, and negotiate priorities. In coastal settings, risk is rarely experienced as an abstract probability. Residents interpret storms, changing fishing conditions, shoreline erosion, pollution, and livelihood uncertainty through lived experience. Communication mechanisms that allow such experience to enter public decision-making can strengthen the fit between interventions and local realities.

Evidence from participatory risk communication supports this proposition. Moran et al. (2023) show the value of co-designing communication and engagement strategies with rural communities, while Faisal et al. (2021) demonstrate the usefulness of participatory approaches for evaluating climate-induced hazards. Bubeck et al. (2024) further illustrate how community-based theatre can operate as a social communication mechanism for coastal risk mitigation. These studies suggest that communication can contribute to adaptive capacity when it is embedded in social relationships and when residents have meaningful influence over the framing of problems and solutions. However, participatory communication can produce weak or inconsistent effects when participation is procedural rather than substantive. Participation may be organized through meetings or consultations while decision authority remains elsewhere. The existence of a forum therefore does not necessarily mean that local knowledge changes decisions. Wang and Huang (2025) emphasize the strategic dimension of participatory communication and the importance of engagement and empowerment rather than participation as a symbolic activity. This distinction is important in the present study because the effect of participatory communication is tested alongside local wisdom. If communication is already embedded in local institutions, its independent statistical effect may be smaller than expected. Accordingly, the first hypothesis is:

H1: Participatory communication has a positive effect on community resilience.

2.2 Local Wisdom as Social-Ecological Capital

Local wisdom can be understood as a socially accumulated repertoire of environmental knowledge, norms, practices, and relationships. In coastal communities, this repertoire may concern resource use, settlement organization, environmental observation, reciprocity, conflict management, and collective action. Such knowledge can function as social-ecological capital because it links social organization with environmental conditions. Asmal and Latief (2023) demonstrate that local communal arrangements can contribute to cohesion and resilience, while Asmal et al. (2023) show how local practices can shape environmental management. These findings challenge the assumption that effective adaptation must always be imported through formal technical interventions.

The adaptive value of local wisdom is also visible in small-scale fisheries. Fitriani et al. (2023) show that indigenous and local knowledge can support adaptation strategies across diverse fisheries contexts. Cinner et al. (2018) argue that adaptive capacity in tropical coastal communities depends on social and institutional conditions that allow people to learn, reorganize, and act. Local wisdom can support these capacities by providing trusted rules and shared interpretations. Yet local wisdom should not be romanticized. Social norms can also reproduce unequal access to resources or exclude particular groups. The relevant analytical question is therefore not whether local wisdom is inherently beneficial, but whether the locally embedded knowledge and institutions represented in the Paluh Manan context contribute to collective resilience. In the present model, local wisdom is treated as a multidimensional socio-cultural resource. It includes knowledge and values but also the relational infrastructure through which those values are enacted. This framing helps explain why local wisdom may have a stronger effect than communication processes that are introduced or measured separately from the cultural system. When knowledge is trusted, socially legitimate, and connected to reciprocal obligations, it can more readily become coordinated action.

H2: Local wisdom has a positive effect on community resilience.

2.3 Community Resilience as Adaptive Capacity

Community resilience is conceptualized as a collective capacity to maintain essential functions, respond to disturbances, learn from experience, and adapt or transform when existing arrangements become inadequate. The concept is particularly relevant to coastal development because coastal communities must manage recurrent and cumulative stresses rather than a single isolated hazard. Resilience therefore includes both short-term coping and longer-term adaptation. Magis (2010) positions community resilience within social sustainability, while Cinner et al. (2018) connect adaptive capacity to social, institutional, and ecological conditions in tropical coastal communities. Recent empirical work reinforces the multidimensional nature of resilience. Amadu et al. (2021) use structural equation modeling to examine livelihood resilience in small-scale fisheries, demonstrating that resilience can be operationalized and statistically related to different livelihood capitals. Awah et al. (2025) similarly emphasize multidimensional measurement in assessing community resilience to flood risk. Kuipers and De Jong (2023) show that resilience can be expressed through distinct livelihood styles that combine household capabilities and environmental context. These studies support treating resilience as a

measurable construct that links resources and outcomes rather than as an outcome that is simply assumed from the presence of social capital.

For coastal development, the implication is direct. A community may possess knowledge, networks, or communication forums, but sustainable development requires the ability to translate those resources into decisions, livelihood adjustments, environmental management, and collective action. Resilience represents that conversion capacity. Therefore, a resilient community should be better positioned to maintain livelihoods, respond to environmental pressure, participate in development programs, and sustain social-ecological functions.

H3: Community resilience has a positive effect on sustainable coastal development.

2.4 Local Wisdom and Coastal Development

Sustainable coastal development requires more than economic growth. It involves balancing livelihood security, ecological integrity, social inclusion, and institutional capacity. Development interventions that disregard local social organization may generate infrastructure or short-term economic gains without producing durable adaptive capacity. Fabinyi et al. (2022) show that coastal transitions in Southeast Asia involve complex interactions between livelihood systems and maritime-zone development. Posen et al. (2023) likewise demonstrate that coastal vulnerability is shaped by both infrastructure and community conditions. These findings suggest that development should be understood as a socio-ecological process rather than a purely physical intervention.

Local wisdom can plausibly contribute directly to development through environmental stewardship, collective norms, and locally appropriate resource practices. However, the direct pathway may be weaker than expected if local knowledge remains at the level of cultural awareness without institutional mechanisms for collective implementation. Community empowerment research also suggests that sustainable interventions depend on local ownership and agency (Dushkova & Ivlieva, 2024). In this study, the direct relationship is therefore tested rather than assumed.

H4: Local wisdom has a positive direct effect on sustainable coastal development.

2.5 Community Resilience as a Mediating Mechanism

The central theoretical proposition of this study is that community resources do not automatically become development outcomes. They must be converted into adaptive capacity. Local wisdom may provide environmental knowledge and social norms, while participatory communication may provide channels for deliberation and information exchange. Resilience is the process through which these resources become coordinated capacities to absorb shocks, adjust practices, and maintain essential functions. This logic corresponds with a capital-based understanding of resilience, in which different forms of capital are inputs that must be mobilized through collective processes before they generate sustainable outcomes.

The mediation proposition also helps explain why development programs can fail despite substantial community resources. A community may have strong traditions but limited organizational capacity, or extensive communication forums but weak collective trust. Resilience captures the degree to which these resources are operationalized. If resilience mediates the effect of local wisdom, then the policy implication is not simply to preserve traditions; it is to strengthen the institutional and adaptive pathways through which traditions become collective action. Similarly, if participatory communication is mediated by resilience, then communication should be evaluated by its contribution to adaptive capacity rather than by the number of meetings held.

H5: Community resilience mediates the effect of participatory communication on sustainable coastal development.

H6: Community resilience mediates the effect of local wisdom on sustainable coastal development.

2.6 Conceptual Model

The conceptual model positions participatory communication and local wisdom as two related but distinguishable community resources. Participatory communication represents the dialogic and decision-oriented process through which residents exchange information, articulate priorities, and participate in collective problem solving. Local wisdom represents locally embedded knowledge, norms, values, practices, and social arrangements that have developed through long interaction with the coastal environment. Both resources are hypothesized to strengthen community resilience. Resilience is then specified as the principal mechanism through which community resources are translated into sustainable coastal development, while a direct path from local wisdom to development is retained to test whether local knowledge has an additional development effect beyond resilience.

Figure 1 shows the six hypotheses tested in the study. H1 and H2 represent the two antecedent paths to community resilience; H3 represents the expected effect of resilience on coastal development; H4 tests the direct effect of local wisdom on development; and H5 and H6 represent the two indirect effects through resilience. The model is deliberately specified so that a significant indirect effect can be distinguished from a direct effect, allowing the study to determine whether resilience acts as a transmission mechanism rather than merely another correlate of development.

3 Methods

3.1 Research Design and Setting

This study employed a quantitative explanatory design to test the structural relationships specified in the conceptual model. The empirical setting was Paluh Manan Village, Indonesia, a coastal community whose livelihoods remain closely connected to marine resources and whose social-cultural arrangements provide a context in which local knowledge and collective practices continue to shape everyday responses to change. The village was selected because it provides an analytically relevant case

for examining the relationship between socio-cultural resources, resilience, and development outcomes in a traditional coastal setting.

3.2 Population, Sample, and Data Collection

Primary data were collected through a structured questionnaire distributed to residents of the coastal community. A total of 200 questionnaires were returned. One response was excluded because it was incomplete, resulting in 199 valid observations for analysis. The questionnaire used a five-point Likert scale, from 1 = strongly disagree to 5 = strongly agree. The sample size was considered adequate for the specified PLS-SEM model based on the number of structural paths and the moderate model complexity. The analysis focuses on relationships among latent constructs rather than on estimating population prevalence.

3.3 Measures and Operationalization

The initial instrument contained 25 reflective indicators across four constructs: participatory communication (X1; six items, Q1–Q6), local wisdom (X2; six items, Q7–Q12), community resilience (Z; seven items, Q13–Q19), and coastal development (Y; six items, Q20–Q25). Participatory communication captured dialogic exchange, opportunities for residents to express views, information sharing, and involvement in collective discussion. Local wisdom represented locally embedded knowledge, norms, values, and practices associated with community and environmental relations. Community resilience represented the perceived capacity to respond to disturbance, adapt, recover, learn, and maintain essential social-ecological functions. Coastal development represented perceived progress toward sustainable livelihood, environmental management, community welfare, and development outcomes in the coastal area. The construct-item coding framework and indicator-retention audit are provided in Supplementary Information 1.

3.4 Data Analysis

PLS-SEM was used to estimate the measurement and structural models. The method was selected because the study is oriented toward explaining and predicting endogenous constructs in a model with multiple latent variables and a mediator, and because the sample size is moderate. The analysis followed two stages. First, the measurement model was assessed through indicator loadings, internal consistency reliability, convergent validity, and discriminant validity. Second, the structural model was assessed using R^2, adjusted R^2, Q^2, f^2, path coefficients, and bootstrapped significance tests. Bootstrapping used 2,000 resamples and a two-tailed significance level of 5%. Indirect effects were assessed using their bootstrapped confidence intervals and the variance accounted for (VAF) was reported to describe the proportion of the total effect transmitted through the mediator. The reporting logic follows established guidance for PLS-SEM assessment and reporting (Hair & Alamer, 2022; Hair et al., 2019), with recent methodological discussion also considered (Guenther et al., 2025; Sarstedt & Danks, 2022).

3.5 Measurement Model Refinement

The initial 25-item model did not meet the desired convergent-validity criteria for community resilience and coastal development. Four indicators—Q17, Q18, Q19, and Q20—showed comparatively low loadings and contributed to AVE values below 0.50. These indicators were removed sequentially because their statistical contribution was weak and, based on the instrument structure, their removal did not materially undermine the conceptual coverage of the constructs. The final model retained 21 indicators: six for participatory communication, six for local wisdom, four for community resilience, and five for coastal development. The final model was then used for hypothesis testing.

4 Results

The results are presented in two stages. The first establishes the adequacy of the final measurement model. The second evaluates the structural model and the six hypotheses. The results are reported using the statistics available from the original analysis; no new observations or estimates are introduced. This distinction is important because the interpretation of local wisdom as a social-ecological resource depends on the statistical evidence rather than on a purely normative characterization of tradition.

4.1 Measurement Model

The final outer loadings ranged from 0.598 to 0.944, and all retained indicators were statistically significant at $p < 0.001$ in the 2,000-resample bootstrap procedure. Participatory communication showed loadings of 0.692, 0.641, 0.944, 0.918, 0.887, and 0.899. Local wisdom showed loadings of 0.798, 0.780, 0.937, 0.928, 0.880, and 0.631. Community resilience retained four indicators with loadings of 0.721, 0.737, 0.810, and 0.598. Coastal development retained five indicators with loadings of 0.818, 0.872, 0.802, 0.723, and 0.742. The lowest retained loading was therefore 0.598, while the highest was 0.944.

Table 1
Outer loadings and bootstrap significance of the final measurement model

Construct	Item	Loading	STDEV	T-statistic	p-value
Participatory communication	Q1	0.692	0.053	13.028	< 0.001
Participatory communication	Q2	0.641	0.055	11.548	< 0.001
Participatory communication	Q3	0.944	0.012	79.953	< 0.001
Participatory communication	Q4	0.918	0.013	69.850	< 0.001
Participatory communication	Q5	0.887	0.023	38.795	< 0.001
Participatory communication	Q6	0.899	0.023	39.960	< 0.001
Local wisdom	Q7	0.798	0.042	18.861	< 0.001
Local wisdom	Q8	0.780	0.043	18.304	< 0.001
Local wisdom	Q9	0.937	0.010	93.478	< 0.001
Local wisdom	Q10	0.928	0.009	104.436	< 0.001
Local wisdom	Q11	0.880	0.015	60.381	< 0.001
Local wisdom	Q12	0.631	0.045	14.087	< 0.001
Community resilience	Q13	0.721	0.037	19.391	< 0.001
Community resilience	Q14	0.737	0.037	19.767	< 0.001
Community resilience	Q15	0.810	0.035	23.360	< 0.001
Community resilience	Q16	0.598	0.073	8.178	< 0.001
Coastal development	Q21	0.818	0.034	24.012	< 0.001
Coastal development	Q22	0.872	0.032	27.053	< 0.001
Coastal development	Q23	0.802	0.022	35.716	< 0.001
Coastal development	Q24	0.723	0.037	19.671	< 0.001
Coastal development	Q25	0.742	0.055	13.588	< 0.001
Source: Research Data Processing, SEM-PLS 2026					

Table 1 shows that all 21 retained indicators load significantly on their intended constructs. The loadings range from 0.598 to 0.944, and every indicator is significant at $p < .001$. The pattern supports retention of the final indicators for subsequent structural analysis, while the comparatively lower loading of Q16 should be treated as an indicator for future instrument refinement.

Internal consistency and convergent validity were satisfactory at the construct level. Composite reliability ranged from 0.810 to 0.933, while AVE ranged from 0.519 to 0.703. Cronbach's alpha was above 0.84 for participatory communication, local wisdom, and coastal development. Community resilience had an alpha of 0.682, slightly below the conventional 0.70 threshold, but its composite reliability was 0.810 and its AVE was 0.519. The combination suggests acceptable internal consistency for the exploratory and predictive purpose of the model, while also indicating that the resilience construct should be measured with particular care in future research.

Table 2
Reliability and convergent validity

Construct	Cronbach's alpha	Composite reliability	AVE
Participatory communication	0.917	0.933	0.703
Local wisdom	0.907	0.930	0.693
Community resilience	0.682	0.810	0.519
Coastal development	0.846	0.894	0.629
Source: Research Data Processing, SEM-PLS 2026			

Table 2 demonstrates acceptable internal consistency and convergent validity for the four constructs. Composite reliability ranges from 0.810 to 0.933 and AVE from 0.519 to 0.703. Community resilience has Cronbach's alpha of 0.682, slightly below .70, but its composite reliability and AVE exceed the reported minimums; therefore, the construct is retained with a recommendation for further measurement refinement.

Discriminant validity was examined through the Fornell–Larcker criterion and HTMT. The square roots of AVE were 0.839 for participatory communication, 0.832 for local wisdom, 0.721 for community resilience, and 0.793 for coastal development. The correlation between participatory communication and local wisdom was comparatively high at 0.810, indicating conceptual proximity, but the constructs remained distinguishable under the reported criterion. HTMT values were 0.891 for participatory communication–local wisdom, 0.703 for participatory communication–resilience, 0.353 for participatory communication–development, 0.852 for local wisdom–resilience, 0.489 for local wisdom–development, and 0.782 for resilience–development. All reported values remained below the conservative 0.90 threshold, although the first two relationships were close to upper limits and should be interpreted cautiously.

Table 3
Heterotrait–monotrait ratios

Construct pair	HTMT
Participatory communication ↔ Local wisdom	0.891
Participatory communication ↔ Community resilience	0.703
Participatory communication ↔ Coastal development	0.353
Local wisdom ↔ Community resilience	0.852
Local wisdom ↔ Coastal development	0.489
Community resilience ↔ Coastal development	0.782
Source: Research Data Processing, SEM-PLS 2026	

Table 3 indicates that the HTMT ratios are below the conservative .90 criterion. Participatory communication and local wisdom show the highest ratio (.891), followed by local wisdom and resilience (.852). These values indicate conceptual proximity between the constructs but do not cross the stated threshold, supporting their treatment as distinct latent variables.

4.2 Structural Model and Hypothesis Testing

The structural model explained 44.3% of the variance in community resilience ($R^2 = 0.443$; adjusted $R^2 = 0.437$) and 47.7% of the variance in coastal development ($R^2 = 0.477$; adjusted $R^2 = 0.472$). The reported Q^2 values were 0.437 for community resilience and 0.469 for coastal development, indicating positive predictive relevance. The effect-size results further differentiated the structural paths. The effect size for participatory communication → resilience was negligible ($f^2 = 0.003$), local wisdom → resilience was 0.228, resilience → development was 0.452, and local wisdom → development was 0.004. Thus, the strongest explanatory contribution in the model was the path from resilience to coastal development, followed by local wisdom to resilience. The extended statistical audit, including the initial-to-final indicator mapping and supporting validity matrices, is provided in Supplementary Information 1.

Table 4
Direct effects and hypothesis testing

Structural path	β	T-statistic	p-value	Decision
Participatory communication → Community resilience	0.070	0.821	0.412	Not supported
Local wisdom → Community resilience	0.608	8.240	< 0.001	Supported
Community resilience → Coastal development	0.650	12.868	< 0.001	Supported
Local wisdom → Coastal development	0.058	1.113	0.266	Not supported
Source: Research Data Processing, SEM-PLS 2026				

Table 4 presents the direct structural effects. Local wisdom is a significant predictor of community resilience (β = .608), and community resilience is a strong predictor of coastal development (β = .650). By contrast, participatory communication does not significantly predict resilience (β = .070), and local wisdom does not have a significant direct effect on coastal development (β = .058).

The indirect-effect analysis produced a different pattern for the two antecedents. The indirect effect of participatory communication on coastal development through resilience was 0.046 and was not statistically significant (T = 0.818, p = 0.413; 95% bootstrap confidence interval − 0.065 to 0.157). The indirect effect of local wisdom through resilience was 0.395 and statistically significant (T = 6.239, p < 0.001; 95% bootstrap confidence interval 0.280 to 0.529). For local wisdom, the total effect was 0.454, obtained by combining the direct effect of 0.058 and the indirect effect of 0.395. The VAF was 87.1%, indicating that most of the estimated total effect was transmitted through community resilience.

Table 5
Indirect effects and mediation

Indirect path	Indirect effect	T-statistic	p-value	95% bootstrap CI	Decision
Participatory communication → Resilience → Development	0.046	0.818	0.413	−0.065 to 0.157	Not supported
Local wisdom → Resilience → Development	0.395	6.239	< 0.001	0.280 to 0.529	Supported
Source: Research Data Processing, SEM-PLS 2026					

Table 5 clarifies the mediation mechanism. The indirect effect of participatory communication through resilience is not significant because its 95% bootstrap confidence interval includes zero. In contrast, the indirect effect of local wisdom through resilience is significant, with a confidence interval entirely above zero. The reported VAF of 87.1% indicates that most of the local-wisdom effect on development is transmitted through resilience.

4.3 Hypothesis Summary

Table 6
Summary of hypothesis testing

Hypothesis	Relationship	Coefficient	p-value	Decision
H1	Participatory communication → resilience	0.070	0.412	Not supported
H2	Local wisdom → resilience	0.608	< 0.001	Supported
H3	Resilience → coastal development	0.650	< 0.001	Supported
H4	Local wisdom → coastal development	0.058	0.266	Not supported
H5	Participatory communication → resilience → development	0.046	0.413	Not supported
H6	Local wisdom → resilience → development	0.395	< 0.001	Supported
Source: Research Data Processing, SEM-PLS 2026				

Table 6 provides a concise synthesis of the six hypotheses. Three hypotheses concerning local wisdom → resilience, resilience → development, and local wisdom → resilience → development are supported, while the two participatory-communication paths and the direct local-wisdom → development path are not supported. The overall pattern therefore favors a resilience-mediated explanation rather than a simple direct-effects model.

5 Discussion

5.1 Local Wisdom as the Strongest Antecedent of Community Resilience

The most important finding is the significant positive effect of local wisdom on community resilience ($\beta = 0.608$, $p < 0.001$; $f^2 = 0.228$). The coefficient is substantially larger than the effect of participatory communication, and the effect-size statistic indicates a meaningful contribution. This result supports the proposition that locally embedded knowledge, norms, and practices are not merely cultural attributes but resources that can shape how a community responds to environmental and socioeconomic pressures. In Paluh Manan, local wisdom appears to provide a social infrastructure through which people interpret their environment and coordinate responses. The finding is consistent with research showing that communal arrangements and locally grounded practices can strengthen social cohesion and resilience in coastal settlements (Asmal & Latief, 2023). It is also consistent with evidence that local and

indigenous knowledge can contribute to climate adaptation in small-scale fisheries (Galappaththi et al., 2021).

The result is particularly relevant because coastal adaptation is often framed in technical terms. Engineering structures, early-warning systems, livelihood programs, and environmental restoration are necessary components of resilience, but they do not operate in a social vacuum. Residents need to recognize risks, trust information, cooperate with one another, and maintain practices that sustain collective action. Local wisdom can supply these functions because it connects knowledge with norms and social relationships. In this sense, the statistical effect of local wisdom should not be interpreted as evidence that traditional practices alone solve coastal vulnerability. Rather, it indicates that the cultural and relational resources represented by local wisdom are an important foundation upon which adaptive capacity can be built.

The result also adds nuance to the literature on social capital. Bodin and Crona (2008) show that social capital and local leadership can support natural-resource management, but they also caution that social capital does not automatically produce successful collective management when other institutional resources are weak. The same principle applies here. Local wisdom is valuable when it can be translated into coordinated action and connected to contemporary institutional arrangements. The next finding that resilience has the strongest direct effect on coastal development provides evidence for precisely this conversion mechanism.

5.2 Why Participatory Communication Was Not a Significant Independent Predictor

Participatory communication did not have a statistically significant independent effect on community resilience ($\beta = 0.070$, $p = 0.412$; $f^2 = 0.003$). This result contrasts with the normative expectation that more participatory communication should automatically increase adaptive capacity. It should not, however, be interpreted as proof that communication is irrelevant. Instead, the finding suggests that the independent contribution of communication is limited after local wisdom is included in the same model. The relationship between participatory communication and local wisdom was strong: their correlation was 0.810 and the HTMT value was 0.891. This pattern indicates that the two constructs are empirically close in the Paluh Manan setting.

One interpretation is that participatory communication is already embedded in local social-cultural practices. Where collective deliberation, mutual assistance, information exchange, and local decision-making are organized through established community norms, respondents may not experience them as a separate communication intervention. In such circumstances, what researchers call participatory communication may be enacted through the same institutions and relationships that constitute local wisdom. Once local wisdom is statistically controlled, little unique variance remains for participatory communication to explain. This interpretation is consistent with the broader literature warning that participation should be understood as culturally situated rather than as a universal procedural technology (Servaes & Malikhao, 2005; Wang & Huang, 2025).

A second interpretation concerns measurement. The HTMT value of 0.891 is below the conservative 0.90 threshold but close to it. This does not invalidate the distinction between constructs, yet it signals that future research should sharpen the operational definitions. Participatory communication could be measured more specifically in terms of agenda-setting power, influence over decisions, feedback loops, inclusion of marginalized voices, and the extent to which community-generated knowledge changes formal policy. Local wisdom could then focus more explicitly on intergenerational knowledge, environmental norms, cultural practices, and locally legitimate rules. Such differentiation would help determine whether the present non-significant result reflects genuine contextual embeddedness, measurement overlap, or both.

A third interpretation is substantive: communication may matter most when it is connected to a process that converts information into action. Communication without decision authority can produce awareness but not resilience. This aligns with evidence that co-designed communication is more effective when communities have meaningful roles in defining risks and solutions (Moran et al., 2023). The implication is therefore not to reduce communication investment, but to redesign it so that communication is institutionally connected to local knowledge, collective learning, and adaptive decision-making.

5.3 Community Resilience as the Main Driver of Sustainable Coastal Development

Community resilience had the strongest direct relationship in the model with coastal development ($\beta = 0.650$, $p < 0.001$; $f^2 = 0.452$). This result is theoretically important because it places adaptive capacity at the center of the development process. The R^2 value of 0.477 indicates that resilience and local wisdom together explain nearly half of the variance in the coastal-development construct. More importantly, the large effect size for resilience shows that the relationship is not only statistically significant but substantively prominent within this model.

The result supports a shift from viewing sustainable coastal development primarily as an output of physical investment toward understanding it as an outcome of community capacity. A village may receive infrastructure or external programs, but their sustainability depends partly on whether residents can maintain, adapt, and collectively govern them. Posen et al. (2023) demonstrate that coastal infrastructure vulnerability is connected to community conditions, while Dushkova and Ivlieva (2024) emphasize local empowerment as a component of sustainability and resilience. The present finding adds quantitative evidence from an Indonesian village that community resilience is closely associated with perceived coastal development. The result is also compatible with research on livelihood resilience in small-scale fisheries. The broader implication is that resilience should be treated as a community capacity that connects household adaptation with collective development rather than as a passive condition.

5.4 Full Mediation: Local Wisdom Becomes Development Capacity through Resilience

The mediation analysis provides the most distinctive theoretical contribution of the study. Local wisdom had no significant direct effect on coastal development ($\beta = 0.058$, $p = 0.266$), yet its indirect effect through resilience was significant ($\beta = 0.395$, $p < 0.001$). The estimated VAF of 87.1% indicates that most of the total effect of local wisdom on development operates through community resilience. The evidence therefore supports an indirect conversion mechanism rather than a simple direct association.

This finding changes how local wisdom should be positioned in development policy. If local wisdom is treated only as heritage, it may be preserved symbolically without improving development capacity. If it is treated only as a tourism or cultural asset, its deeper adaptive function may be lost. The mediation result suggests that its development relevance lies in the capacity of communities to mobilize it. Knowledge becomes developmentally consequential when it supports learning, coordination, collective problem solving, livelihood adjustment, environmental stewardship, and institutional adaptation. Resilience is the process through which this occurs. The finding also cautions against a simplistic "tradition versus modernity" framing. Local wisdom does not need to replace contemporary technology, scientific information, or formal government programs. Instead, it can provide the social legitimacy and contextual knowledge necessary for those interventions to be adapted locally. The policy challenge is to connect local knowledge with contemporary institutions rather than to choose one over the other. In this sense, resilience is a bridge between cultural continuity and development transformation.

5.5 An Embedded-Resilience Perspective for Coastal Governance

Taken together, the results support an embedded-resilience perspective. In this perspective, local wisdom constitutes a foundational socio-cultural resource; participatory communication functions as a mechanism for dialogue and collective learning; resilience represents the adaptive capacity generated through the mobilization of those resources; and coastal development is the resulting social-ecological outcome. The model does not imply that these components are independent in practice. On the contrary, their interdependence is part of the explanation for why communication had little independent statistical effect.

The concept of embeddedness is important for governance. Development agencies often introduce participatory mechanisms through standardized meetings, consultations, training, or communication campaigns. Such mechanisms may be useful, but their effectiveness can be limited if they operate outside locally legitimate structures. A more context-sensitive strategy would use existing community institutions as platforms for deliberation while introducing new information and technical resources through them. This approach can combine local legitimacy with external knowledge. It is consistent with participatory risk communication research and with the emphasis on local ownership in community empowerment programs (Moran et al., 2023; Dushkova & Ivlieva, 2024).

For public policy, this means that coastal resilience should not be organized exclusively through sectoral programs. Environmental agencies, fisheries institutions, village governments, social-development programs, and community organizations need mechanisms for coordinating around local knowledge and

community priorities. Local actors should participate not only in implementation but also in defining the problems to be addressed and evaluating whether interventions fit local conditions. Such arrangements can help avoid a common weakness of coastal development: the separation of physical investment from social capacity building.

5.6 Theoretical Contribution to Community Development and Global Society Research

The study contributes to broader social-science debates in three ways. First, it empirically positions community resilience as a mediator between socio-cultural resources and development outcomes. This moves the analysis beyond the assumption that social capital or local knowledge has an automatic effect on sustainability. The evidence indicates that the conversion of resources into adaptive capacity is a critical analytical step. Second, the findings qualify theories of participatory communication by emphasizing context and embeddedness. Participatory communication is widely valued because it challenges top-down development, but its effectiveness cannot be assumed independently of institutional and cultural context. The non-significant path in this study suggests that where participatory practices are already woven into local social relations, their incremental contribution may be difficult to distinguish statistically from local wisdom. This does not weaken participatory communication theory; rather, it encourages more context-sensitive theorization and measurement.

Third, the study connects culture and sustainability through a social-ecological lens. Local wisdom is often studied in cultural or environmental terms separately. The mediation result shows how cultural resources can become developmentally relevant through resilience. This linkage is particularly compatible with Discover Global Society's interdisciplinary orientation toward sustainability, culture, governance, public policy, environmental degradation, and community development. The case is local, but the mechanism socially embedded knowledge becoming adaptive capacity and then development capacity may be relevant to other coastal communities facing similar transitions.

5.7 Policy and Practical Implications

The empirical pattern suggests several policy priorities. First, coastal development programs should invest in community resilience as an explicit outcome rather than assuming it will emerge from infrastructure or communication activities. Resilience-building can include local leadership development, community-based environmental monitoring, livelihood diversification, collective learning, disaster preparedness, and institutional linkages. Second, local wisdom should be incorporated into planning and implementation rather than used only as a symbolic cultural reference. Government agencies can document locally relevant environmental knowledge, establish mechanisms for intergenerational knowledge transfer, and create spaces where local knowledge is compared constructively with scientific and technical information. This approach avoids treating local knowledge as either infallible or obsolete.

Third, participatory communication should be integrated with locally legitimate decision-making structures. Instead of creating parallel forums, agencies can use existing community deliberation

mechanisms and strengthen their capacity to connect residents with government information, scientific expertise, and development resources. Communication should be evaluated by whether it improves understanding, trust, collective problem solving, and influence over decisions not merely by the number of participants or meetings. Fourth, coastal policy should adopt a co-creative orientation. Local government, community leaders, civil-society actors, researchers, and sectoral agencies can jointly define priorities, implement interventions, and review outcomes. Such arrangements are particularly important where coastal development involves competing interests in fisheries, conservation, settlement, tourism, and infrastructure. A resilient governance arrangement should be capable of revising interventions as ecological and social conditions change. Finally, the findings support a policy sequence: recognize local knowledge; connect it to participatory deliberation; build collective adaptive capacity; and then scale development interventions. This sequence is not rigid, but it captures the central empirical lesson of the study: cultural resources become powerful development resources when they are converted into resilience.

5.8 Limitations and Future Research

The study has several limitations. First, its cross-sectional design limits causal interpretation over time. Although the structural model tests theoretically specified relationships, the data were collected at one point and therefore cannot establish how resilience changes after particular environmental or policy shocks. Longitudinal research could examine whether local wisdom continues to predict resilience across different periods of ecological stress. Second, the study focuses on a single coastal village. The setting provides contextual depth but limits statistical generalization to communities with different cultural, economic, or institutional conditions. Comparative research across multiple Indonesian coastal villages could examine whether the dominance of local wisdom is replicated or whether participatory communication becomes more influential where formal participatory institutions are stronger.

Third, the relatively high association between participatory communication and local wisdom raises a measurement issue. Future studies should refine indicators so that participatory communication captures decision-making power and communication quality, while local wisdom captures knowledge, norms, practices, and cultural legitimacy more precisely. Qualitative interviews, observation, and social-network analysis could complement PLS-SEM and reveal the mechanisms that survey data cannot fully capture. Fourth, the model does not test interaction or moderation between participatory communication and local wisdom. It is possible that communication becomes more effective when it is embedded in local wisdom, rather than having a simple additive effect. Future studies should therefore test interaction terms and multi-group differences, including differences by livelihood, gender, age, or degree of participation in community institutions, where such comparisons are ethically and methodologically justified. Finally, future research could incorporate objective environmental and development indicators alongside perceptions. Combining survey measures with data on shoreline change, livelihood diversification, ecosystem condition, public investment, or participation in local institutions would strengthen the connection between perceived resilience and observable outcomes. A mixed-methods

design would be especially valuable for explaining how local wisdom is translated into concrete adaptive decisions.

6 Conclusion

This study examined whether participatory communication and local wisdom contribute to community resilience and whether resilience translates these resources into sustainable coastal development in Paluh Manan Village, Indonesia. The empirical pattern is clear. Local wisdom is the strongest antecedent of community resilience, while community resilience is the strongest direct predictor of coastal development. Participatory communication does not have a significant independent effect on resilience in the presence of local wisdom, and local wisdom does not have a significant direct effect on coastal development. Instead, local wisdom operates primarily through community resilience, with 87.1% of its estimated total effect transmitted through the mediator.

The findings suggest that the development value of tradition lies not in tradition as a symbolic object but in its capacity to support collective adaptation. Local wisdom becomes a development resource when it strengthens learning, trust, coordination, environmental stewardship, and collective agency. Participatory communication remains important, but its effectiveness is likely to depend on how deeply it is embedded in legitimate local institutions and how effectively it connects information to collective decision-making. For coastal governance, the implication is a move from stand-alone participation toward embedded resilience. Policies should recognize local knowledge, strengthen community adaptive capacity, and connect participatory communication with locally legitimate institutions. This approach can help align contemporary development resources with community knowledge without romanticizing tradition or excluding scientific and technical expertise. More broadly, the study demonstrates how culture, communication, resilience, governance, and sustainability can be analyzed within one empirical framework, offering a transferable conceptual direction for research on coastal communities and other socially and environmentally exposed localities.

Declarations

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Ethical approval and accordance: The study involved human participants and was reviewed and approved by the Research Ethics Committee of Universitas Muhammadiyah Sumatera Utara under Protocol No. 197/II.3-AU/UMSU-LP2M/C/2026. The research was conducted in accordance with the applicable institutional ethical principles and requirements for research involving human participants, including the institutional principles of academic integrity established by Universitas Muhammadiyah

Sumatera Utara and Rector Regulation of Universitas Muhammadiyah Sumatera Utara No. 3/PRN/II.3.AU/UMSU/F/2024 on Academic Integrity in the Production of Scientific Works.

Consent to participate: Written informed consent to participate was obtained from all participants before they completed the questionnaire. Participants were informed about the purpose and general nature of the research, the voluntary nature of participation, the use of the information for scholarly research, and the confidentiality of their responses.

Consent for publication: Not applicable. The manuscript contains no individually identifiable participant information, and the study findings are reported in aggregate form.

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Data availability: The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author contributions: SH, TN, EY conceived and designed the study; SH conducted data collection and analysis and Theoretical framework; SH and EY contributed to the development of the theoretical framework; TN assisted in data validation and interpretation; EY drafted the manuscript; SH and TN critically revised the manuscript for important intellectual content; all authors reviewed and approved the final version of the manuscript**.**

References

1. Amadu I, Armah FA, Aheto DW, Adongo CA. A study on livelihood resilience in the small-scale fisheries of Ghana using a structural equation modelling approach. Ocean Coastal Manage. 2021;215:105952. https://doi.org/10.1016/j.ocecoaman.2021.105952.
2. Asmal I, Latief R. The presence of a family communal space as a form of local wisdom towards community cohesion and resilience in coastal settlements. Sustainability. 2023;15(10):8167. https://doi.org/10.3390/su15108167.
3. Asmal I, Walenna MA, Nas W. Application of local wisdom in handling waste in coastal settlements as an effort to minimize waste production. Environ Sustain Indic. 2023;19:100283. https://doi.org/10.1016/j.indic.2023.100283.
4. Aspan Z, Widodo E, Jurdi F. Local wisdom-based water resources conservation: Enhancing local wisdom in Society 5.0. Hasanuddin Law Rev. 2023;9(2):233–48. https://doi.org/10.20956/halrev.v9i2.4298.
5. Awah LS, Belle JA, Orimoloye IR, Nyam YS. Towards measuring community resilience to flood risk: A baseline analysis. Sci Afr. 2025;30:e02948. https://doi.org/10.1016/j.sciaf.2025.e02948.

6. Bodin Ö, Crona BI. Management of natural resources at the community level: Exploring the role of social capital and leadership in a rural fishing community. World Dev. 2008;36(12):2763–79.
7. Bubeck P, Pham M, Nguyen T, Hudson P. Disaster risk reduction on stage: An empirical evaluation of community-based theatre as risk communication tool for coastal risk mitigation and ecosystem-based adaptation. Progress Disaster Sci. 2024;22:100323. https://doi.org/10.1016/j.pdisas.2024.100323.
8. Cinner JE, Adger WN, Allison EH, Barnes ML, Brown K, Cohen PJ, Gelcich S, Hicks CC, Hughes TP, Lau J, Marshall NA, Morrison TH. Building adaptive capacity to climate change in tropical coastal communities. Nat Clim Change. 2018;8(2):117–23. https://doi.org/10.1038/s41558-017-0065-x.
9. Dushkova D, Ivlieva O. Empowering communities to act for a change: A review of the community empowerment programs towards sustainability and resilience. Sustainability. 2024;16(19):8700.
10. Fabinyi M, Belton B, Dressler WH, Knudsen M, Adhuri DS, Aziz AA, et al. Coastal transitions: Small-scale fisheries, livelihoods, and maritime zone developments in Southeast Asia. J Rural Stud. 2022;91:184–94. https://doi.org/10.1016/j.jrurstud.2022.02.006.
11. Faisal M, Saha M, Sattar M, Biswas A, Hossain M. Evaluation of climate induced hazards risk for coastal Bangladesh: A participatory approach-based assessment. Geomatics Nat Hazards Risk. 2021;12(1):2477–99. https://doi.org/10.1080/19475705.2021.1967203.
12. Fitriani KRA, Lubis DP, Adhuri DS. Poverty and livelihood strategy of small-scale fishers in Tanjung Kait, Banten. Sosial Ekonomi Kelautan dan Perikanan. 2023;18:117–31.
13. Galappaththi EK, Ford JD, Bennett EM, Berkes F. Adapting to climate change in small-scale fisheries: Insights from indigenous communities in the global North and South. Environ Sci Policy. 2021;116:160–70. https://doi.org/10.1016/j.envsci.2020.11.009.
14. Guenther P, Guenther M, Ringle CM, Zaefarian G, Cartwright S. PLS-SEM and reflective constructs: A response to recent criticism and a constructive path forward. Ind Mark Manage. 2025;128:1–9. https://doi.org/10.1016/j.indmarman.2025.05.003.
15. Hair JF, Alamer A. Partial least squares structural equation modeling (PLS-SEM) in second language and education research: Guidelines using an applied example. Res Methods Appl Linguistics. 2022;1(3):100027. https://doi.org/10.1016/j.rmal.2022.100027.
16. Hair JF, Risher JJ, Sarstedt M, Ringle CM. When to use and how to report the results of PLS-SEM. Eur Bus Rev. 2019;31(1):2–24. https://doi.org/10.1108/EBR-11-2018-0203.
17. Kuipers K, De Jong EBP. Resilient livelihood styles: An enriched perspective on household livelihood resilience in the sensitive natural environments of Indonesia. Reg Envriron Chang. 2023;23:164. https://doi.org/10.1007/s10113-023-02155-7.
18. Magis K. Community resilience: An indicator of social sustainability. Soc Nat Resour. 2010;23(5):401–16. https://doi.org/10.1080/08941920903305674.
19. Moran VH, Ceballos-Rasgado M, Fatima S, Mahboob U, Ahmad S, McKeown M, Zaman M. Participatory action research to co-design a culturally appropriate COVID-19 risk communication

and community engagement strategy in rural Pakistan. Front Public Health. 2023;11:1160964. https://doi.org/10.3389/fpubh.2023.1160964.

20. Posen PE, Beraud C, Jones CH, Tyllianakis E, Joseph-Witzig A, Louis S, A. Vulnerability of coastal infrastructure and communities to extreme storms and rising sea levels: An improved model for Grenada and its dependencies. Land. 2023;12(7):1418. https://doi.org/10.3390/land12071418.
21. Rahman MM, Belal MEI, Hossen MA, Tabassum N, Mehzabin J, Mumu MNS. Assessing the climate induced livelihood vulnerability of coastal people using sustainable livelihood framework: A study in south-central Bangladesh. Social Sci. 2024;13(12):638. https://doi.org/10.3390/socsci13120638.
22. Saha MK, Biswas AAA, Faisal M. Livelihood vulnerability of coastal communities in context of the climate change: An index-based assessment. World Dev Sustain. 2024;4:100152. https://doi.org/10.1016/j.wds.2024.100152.
23. Saleh SE, Canon S, Djakaria I. Multicapital vulnerability and social resilience in coastal Bone Bolango Regency, Indonesia. Int J Popul Stud. 2026;12(4):025220107. https://doi.org/10.36922/IJPS025220107.
24. Sarstedt M, Danks NP. Prediction in HRM research–a gap between rhetoric and reality. Hum Resource Manage J. 2022;32(2):485–513. https://doi.org/10.1111/1748-8583.12400.
25. Servaes J, Malikhao P. Participatory communication: The new paradigm? In: Hemer O, Tufte T, editors. Media and glocal change: Rethinking communication for development. CLACSO/Nordicom; 2005. pp. 91–104.
26. Wang X, Huang X. Strategic participatory communication and development: Engagement and empowerment. Commun Dev J. 2025. https://doi.org/10.1093/cdj/bsaf034.

Figures

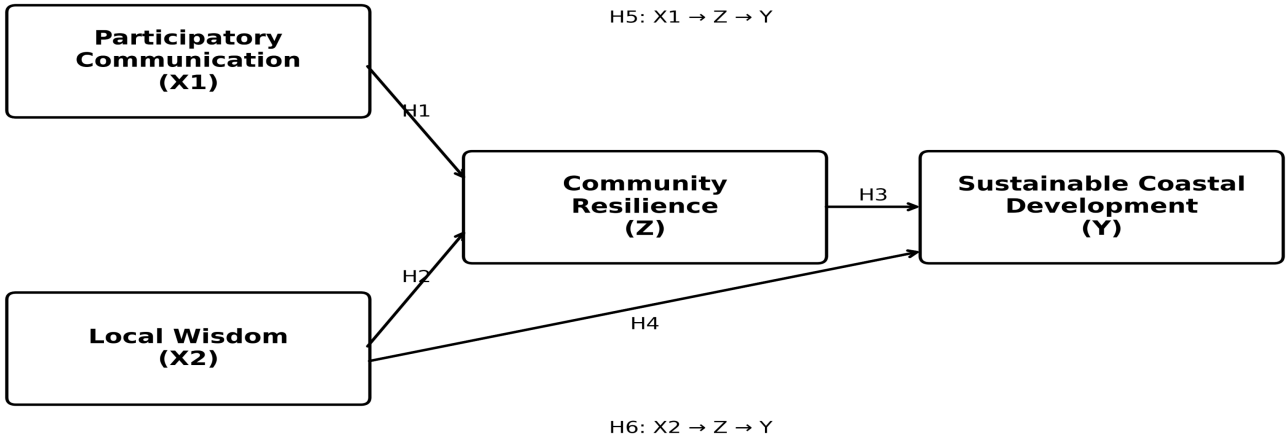


Figure 1

Conceptual model linking participatory communication and local wisdom with community resilience and sustainable coastal development

Supplementary Files

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