

Seminar Nasional FMI 2025 Batam

Prosiding



e-ISSN: 3026-4499

Vol. 3

21-23 Oktober 2025

Micro and Small Enterprises, Climate Change Adaptation, and Mangrove-Based Resilience: Pathways to Achieving SDGs 8, 11, and 13 in Coastal Kendal, Indonesia

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Abstract

Micro and small enterprises (MSEs) are vital for local economies in developing countries but remain highly vulnerable to climate change, especially in coastal zones. This study investigates the adaptive capacity of MSEs in Kendal Regency, Central Java, Indonesia, a coastal area experiencing recurrent tidal flooding, land subsidence, and coastal erosion. Using a mixed-methods approach, survey data from 210 enterprises and interviews with 20 entrepreneurs were analyzed through partial least squares structural equation modeling (PLS-SEM) and thematic coding. The quantitative results indicate that access to finance, community collaboration, and entrepreneurial orientation each have a significant positive impact on adaptive capacity (H1–H3), while institutional support enhances these relationships through moderating effects (H4–H6). Among these factors, access to finance emerged as the strongest predictor. The qualitative findings complement these results by illustrating three dominant adaptation strategies: pragmatic operational adjustments, diversification of business activities, and ecosystem-based adaptation through mangrove rehabilitation. However, gendered barriers persist, as women entrepreneurs reported more limited access to finance, community networks, and institutional recognition. By integrating quantitative and qualitative evidence, this study demonstrates that financial resources, collaboration, and entrepreneurship are necessary foundations for resilience, but their effectiveness depends on institutional facilitation. Policy implications include the need for gender-sensitive credit schemes, institutionalization of community collaboration, and recognition of entrepreneurial innovation. These findings highlight the role of coastal MSEs as both economic actors and agents of climate resilience, contributing to the achievement of SDG 8 (Decent Work and Economic Growth), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).

Keywords micro and small enterprises, climate change adaptation, coastal resilience, institutional support, sustainable development goals, mixed method.

1. Introduction

Micro and small enterprises (MSEs) are vital to economic development and employment in developing countries. However, they remain highly vulnerable to climate change due to limited financial capital, weak adaptive capacity, and dependence on climate-sensitive sectors (Forino, von Meding, & Brewer, 2017). Exposure to extreme weather events—such as floods, droughts, and storms—poses direct threats to their assets and operations, often leading to supply chain disruptions and productivity losses (Linnenluecke, Griffiths, & Winn, 2012). Inadequate infrastructure, lack of formal insurance, and insufficient technical expertise further constrain their ability to recover from climate-induced shocks (Trinh, 2022).

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These vulnerabilities are amplified in coastal zones, where many MSEs are concentrated. In Central Java, Indonesia, particularly Kendal Regency, recurrent tidal flooding (*rob*), land subsidence, and coastal erosion disrupt local economies and business operations (Mortreux et al., 2021; Dewi et al., 2021; Chaussard et al., 2013). Geodetic studies confirm that severe land subsidence along the northern Java coastline accelerates sea-level rise and exacerbates flooding risks, further undermining MSE sustainability (Abidin et al., 2011; Andrea et al., 2021). Recent evidence indicates that coastal SMEs in Indonesia face significant barriers in accessing climate finance and government support programs, thereby limiting their capacity to invest in long-term adaptive strategies (Lestari & Purwanto, 2025). At the same time, Indonesia's blue carbon ecosystems—while critical for enhancing climate resilience—remain underutilized due to enduring challenges in financing and governance structures (Vinata, 2024).

Despite the economic importance of micro and small enterprises, empirical evidence from the Global South on how they adapt to compound coastal hazards remains scarce. Existing studies suggest that micro-enterprises can benefit from financial inclusion, resilient infrastructure, and community-based adaptation, yet actual adoption is uneven and strongly mediated by institutional support (Revilla Diez et al., 2024). Moreover, gender dynamics further shape adaptation: female entrepreneurs may suffer from “triple differential vulnerability”—namely higher exposure via sectoral concentration, constrained access to finance and technology, and the dual burden of managing both household and business risks (Gannon et al., 2022; Gannon et al., 2025).

The role of micro and small enterprises (MSEs) as agents of resilience remains insufficiently understood. Research highlights the importance of entrepreneurial mindset, social capital, and institutions, yet these factors are often studied in isolation (Pongtanaalert & Assarut, 2022; Keys et al., 2016; Shahidullah et al., 2023). Despite abundant evidence, the interplay among financial, social, and entrepreneurial drivers remains underexplored. Scholars have not developed a comprehensive framework that integrates these dimensions with the contextual influence of institutional support.

This study addresses this gap by proposing and empirically validating an integrated conceptual framework that identifies access to finance, community collaboration, and entrepreneurial orientation as synergistic drivers of adaptive capacity, with institutional support as a key moderating variable. Drawing on empirical evidence from coastal MSEs in Kendal Regency, Indonesia, the study reveals their dual function as both economic actors and agents of resilience. The findings provide policymakers with clear leverage points for strengthening local adaptive capacity, thereby contributing to the attainment of Sustainable Development Goals (SDG) 8, 11, and 13.

2. Literature Review

Micro and small enterprises (MSEs) in developing coastal regions occupy a critical paradox: they are fundamental to local economic vitality yet disproportionately vulnerable to climate impacts. While the Sustainable Livelihoods Framework (SLF) offers a foundational understanding of the assets—financial, human, social, and physical—that MSEs mobilize, it

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e-ISSN: 3026-4499
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often presents a static view of capital endowment. This study argues that a static asset-based view is insufficient; adaptive capacity is dynamically activated and leveraged. It is here that entrepreneurial orientation transforms the SLF from a inventory of capital into a theory of agency, determining how and why entrepreneurs proactively deploy their assets to innovate and take risks in the face of climate threats (Lumpkin & Dess, 2001).

This interplay between assets and agency is further contextualized by social-ecological resilience theory. Community collaboration represents more than just a stock of social capital; it is the mechanism through which resources and knowledge are pooled, creating adaptive responses that are greater than the sum of their parts (Folke, 2006). However, the sustainability of these informal networks is often precarious. This is where institutional theory provides a critical, moderating layer. Formal and informal institutions do not merely provide a backdrop; they actively strengthen or weaken the linkages between assets, entrepreneurial action, and collaborative efforts. The frequent failure of institutions to provide gender-sensitive support, for instance, systematically constrains the adaptive capacity of women-led MSEs, revealing a critical gap between theoretical potential and practical enablement (Arora-Jonsson, 2011).

Therefore, this study synthesizes these theoretical perspectives to construct an integrated model. We posit that access to finance, community collaboration, and entrepreneurial orientation are not just parallel drivers but are interdependent dimensions of adaptive capacity. We thus theorize that the relationships between these three core drivers—financial access, collaboration, and entrepreneurial orientation—and adaptive capacity are not direct but are moderated by institutional support. This support acts as a critical catalyst (or barrier) that determines the extent to which latent capacities translate into manifest resilience outcomes. By testing this synthesized framework (via hypotheses H1-H6), we move beyond a descriptive account of vulnerability to explain the conditional pathways through which coastal MSEs can evolve from passive victims of climate change into active agents of their own resilience and, by extension, contributors to sustainable development (SDGs 8, 11, 13).

Access to Finance and Adaptive Capacity of MSEs. While access to finance is undeniably a cornerstone of adaptive capacity, its role is often oversimplified in the MSE context. Conventional literature posits that financial resources directly enable investments in resilient infrastructure and income diversification (Becker et al., 2025). However, in the specific socio-ecological context of coastal Kendal, where recurrent tidal flooding (rob) systematically erodes business assets, the reality is more complex. Most MSEs are locked into a cycle of dependence on internal savings and informal credit—financial instruments that are inherently inadequate for confronting systemic climate risks. This reliance highlights a critical disconnect; the availability of finance does not automatically translate into its effective application for long-term adaptation. We argue that the relationship between finance and adaptation is not direct but is critically mediated by the nature of the financial mechanisms and the institutional ecosystem. Formal mechanisms like climate-responsive microcredit or green loans are theorized to offer a pathway out of this vulnerability (Lestari & Purwanto, 2025). Yet, without targeted institutional facilitation—such as financial literacy programs, de-risking mechanisms, and policies that incentivize green investments—financial inflows are often diverted to immediate operational

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survival, a phenomenon termed the "adaptation survival paradox" (Gunawan et al., 2022). Therefore, this study posits that access to finance is a necessary but insufficient condition for building adaptive capacity. Its efficacy is contingent upon its alignment with both the specific climate threats and the institutional support that guides its strategic use. Consequently, we hypothesize:

H1: Access to finance has a positive and significant effect on the adaptive capacity of MSEs in coastal Kendal.

Community Collaboration and Adaptive Capacity of MSEs. While community collaboration is universally endorsed for its role in risk-sharing and resource-pooling, its function in building adaptive capacity extends beyond mere collective action to constitute a form of distributed resilience. Evidence from contexts like Vietnam confirms that such collaboration lowers costs and improves the uptake of protective measures (Revilla Diez et al., 2024). In coastal Kendal, this is not merely a strategic choice but is deeply embedded in the socio-cultural fabric through gotong royong (mutual cooperation). This cultural institution facilitates rapid, decentralized responses to tidal flooding, such as building temporary embankments. However, we posit a critical limitation: while gotong royong is highly effective for immediate coping and maintaining social cohesion, it often represents a reactive form of adaptation. Its informal and episodic nature can limit its scalability and long-term effectiveness against chronic, intensifying climate risks (Folke, 2006). True adaptive capacity is achieved when these innate, informal networks are recognized, supported, and institutionalized by formal policy frameworks. This synthesis of bottom-up social capital with top-down institutional support transforms temporary coping mechanisms into sustainable adaptation strategies. Therefore, community collaboration is a necessary foundation, but its ultimate impact on adaptive capacity is contingent on its integration into a broader, enabling institutional environment. Hence, it is hypothesized that:

H2: Community collaboration has a positive and significant effect on the adaptive capacity of MSEs in coastal Kendal.

Entrepreneurial Orientation and Adaptive Capacity of MSEs. Entrepreneurial Orientation (EO), with its dimensions of proactiveness, innovativeness, and risk-taking, is theorized as a pivotal mechanism for converting environmental threats into opportunities (Lumpkin & Dess, 2001). However, within the context of resource-constrained MSEs in developing economies, the application of this theory requires critical refinement. In coastal Kendal, observed entrepreneurial behaviors—such as adjusting production schedules or diversifying into mangrove ecotourism—do not merely illustrate EO but represent a form of contextualized entrepreneurial bricolage. These MSEs are not just being "proactive" in a generic sense; they are ingeniously recombining limited resources at hand to navigate systemic climate pressures. This perspective reveals a critical tension: while EO is a driver of adaptation, its manifestation is heavily constrained by the very vulnerability it seeks to overcome. The prevalent reactive posture among many Southeast Asian MSEs (Becker et al., 2025) is not simply a lack of orientation but a rational response to a high-risk, low-resource environment. This highlights a significant research gap in Indonesia, not just in documenting EO's presence, but in

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understanding the conditions that enable its activation. We argue that for EO to translate into sustained adaptive capacity, it must be catalyzed and supported. The raw entrepreneurial spirit must be coupled with access to finance to fund innovations and embedded within collaborative networks to share the inherent risks of experimentation. Therefore, this study posits that EO functions as the essential agentic force that mobilizes other forms of capital, transforming latent potential into manifest adaptive strategies. Its influence is hypothesized as fundamental, yet interdependent with the other drivers in our framework. Accordingly, it is hypothesized that:

H3: Entrepreneurial orientation has a positive and significant effect on the adaptive capacity of MSEs in coastal Kendal.

Institutional Support as a Moderator of the Finance–Adaptive Capacity Relationship. While financial resources are critical, their effectiveness depends on institutional facilitation. Government programs that provide subsidies, technical training, and favorable credit schemes increase the likelihood that finance is invested in resilient infrastructure and diversification (Anwar et al., 2024). Without such Support, financial capital is often consumed for short-term coping rather than long-term adaptation (Gunawan et al., 2022). Therefore:

H4. Institutional Support positively moderates the relationship between access to finance and adaptive capacity.

Institutional Support as a Moderator of the Collaboration–Adaptive Capacity Relationship. Collective initiatives can reduce risks, but they require institutional reinforcement to be sustained. Policies and facilitation by local governments and NGOs help embed community collaboration into formal adaptation programs, ensuring scalability and continuity (Yanuarni et al., 2024). Institutional Support also legitimizes and amplifies community-driven responses, making collaboration more impactful. Thus:

H5. Institutional Support positively moderates the relationship between community collaboration and adaptive capacity.

Institutional Support as a Moderator of the EO–Adaptive Capacity Relationship. Entrepreneurial orientation stimulates adaptive behaviour, but without institutional backing, innovative ideas often fail to reach the market. Supportive policies, infrastructure, and recognition can transform entrepreneurial initiatives into tangible resilience outcomes (Tyler et al., 2024; Yaseen et al., 2024). In Indonesia, adaptive practices become more robust when entrepreneurial innovation is complemented by government facilitation (Gunawan et al., 2022). Hence:

H6. Institutional Support positively moderates the relationship between entrepreneurial orientation and adaptive capacity.

3. Research Method

This study adopted a mixed-methods design to examine the adaptive capacity of micro and small enterprises (MSEs) in the coastal areas of Kendal Regency, Central Java, Indonesia (see Figure 1). A mixed-methods approach was considered appropriate because it allows both the

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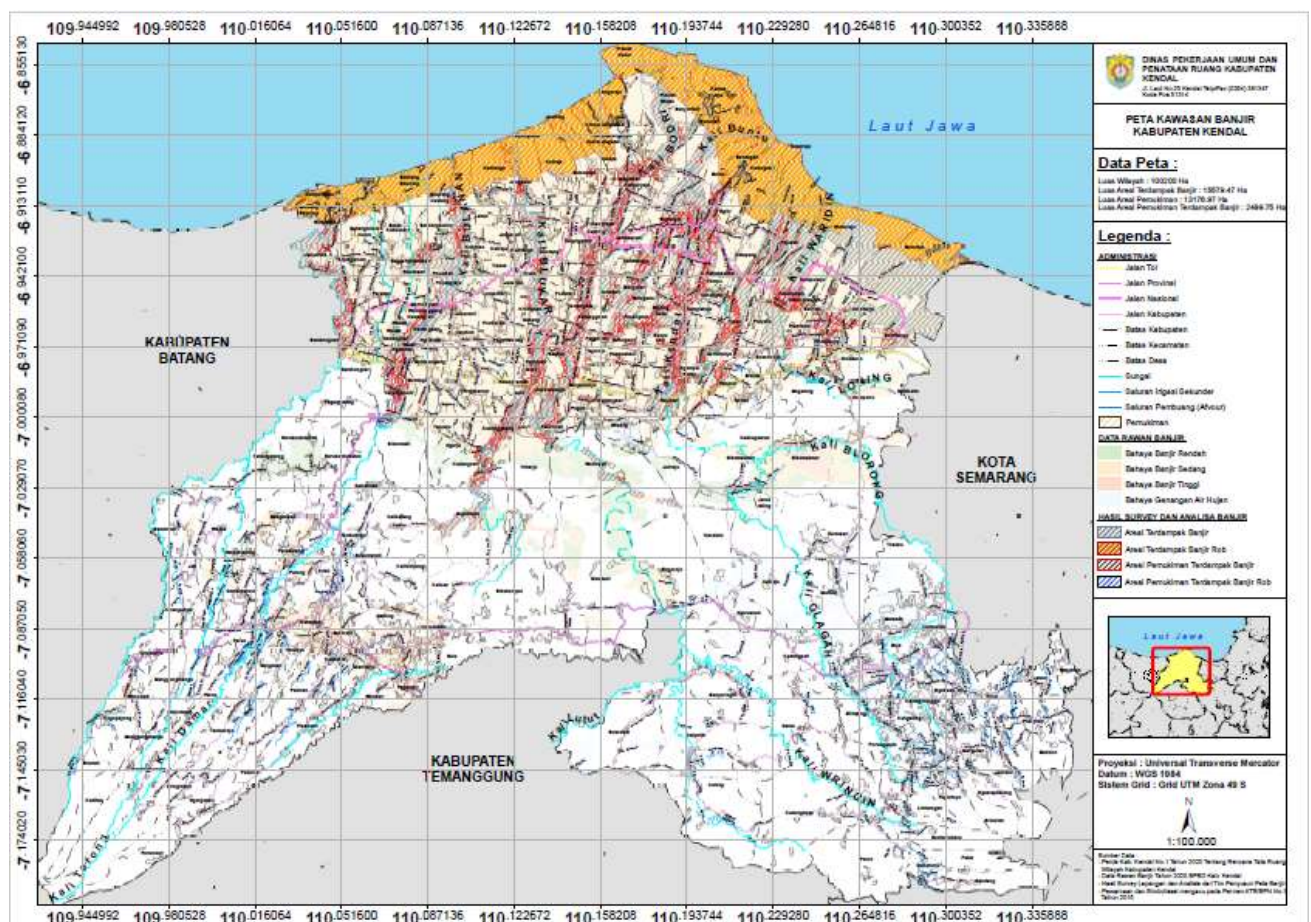
e-ISSN: 3026-4499

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testing of hypothesized statistical relationships and the generation of in-depth contextual insights into entrepreneurial adaptation under climate stressors (Creswell & Plano Clark, 2018). The design follows a convergent parallel model in which quantitative and qualitative data were collected during the same period, analyzed separately, and subsequently integrated to achieve comprehensive inferences (Fetters, Curry, & Creswell, 2013; Guetterman, Fetters, & Creswell, 2015).

Figure 1. Site Location (yellow area)



Source: DPUPR Kabupaten Kendal (2025)

Quantitative Strand. The quantitative component employed a cross-sectional survey to test the relationships between access to finance, community collaboration, entrepreneurial orientation, institutional Support, and adaptive capacity. The population consisted of registered MSEs operating in coastal subdistricts of Kendal that are highly exposed to tidal flooding (rob) and land subsidence, making them particularly relevant for climate adaptation research. A purposive sampling strategy was used to ensure inclusion of enterprises directly affected by coastal hazards. The final sample comprised 210 MSEs across food processing, fisheries, trade, and

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service sectors. This sample size exceeds the minimum requirements for SEM, thereby ensuring statistical power and model stability (Hair et al., 2019). Data were collected between June and August 2024 using a structured questionnaire administered to MSE owners or managers. The instrument comprised three sections: (1) socio-demographic and business characteristics, (2) indicators of access to finance—including microcredit, formal loans, and green financing schemes—and (3) indicators of adaptive capacity, including resilient infrastructure investment, product diversification, and disaster preparedness. Measurement items were adapted from prior validated scales (Becker et al., 2025; Lestari & Purwanto, 2025) and refined through a pre-test with 20 respondents in Kendal, ensuring content validity. Reliability and validity were established through multiple procedures. Content validity was confirmed via expert reviews by academics and local government officials familiar with MSE and climate adaptation issues. Internal consistency was assessed using Cronbach's alpha, applying the 0.70 threshold for acceptability (Nunnally & Bernstein, 1994). Data analysis employed PLS-SEM using SmartPLS 4. PLS-SEM was chosen not only because it is suitable for smaller samples and fewer distributional assumptions but also because it enables testing of complex models with multiple latent constructs and moderation effects. This makes it particularly appropriate for exploratory studies in developing-country contexts where measurement models are still being refined (Hair et al., 2019).

Qualitative Strand. To complement the quantitative findings, qualitative data were collected through semi-structured interviews with 20 MSE owners and managers in the same coastal subdistricts (see Table 2 for informant profiles). Informants were selected purposively to reflect variations in gender, sector, and exposure to tidal flooding. This distribution allowed for capturing gendered experiences, particularly the “triple differential vulnerability” faced by women entrepreneurs. Interviews explored entrepreneurs' lived experiences of climate hazards, their perceptions of financing barriers, and specific adaptation strategies implemented in daily business operations. Each interview lasted between 45 and 90 minutes and was conducted in Bahasa Indonesia. Interviews were audio-recorded with consent and subsequently transcribed verbatim. Thematic analysis was employed, following Braun and Clarke's (2006) iterative coding approach, to identify patterns across cases. Coding was both deductive, guided by constructs in the quantitative framework (e.g., financial access, adaptive practices), and inductive, allowing new themes to emerge directly from the narratives. **Integration of Quantitative and Qualitative Strands.** Integration occurred at both the analysis and interpretation stages. First, joint displays were created to juxtapose statistical findings from SEM with illustrative qualitative excerpts, thereby facilitating comparison, corroboration, and expansion (Guetterman et al., 2015). For example, the quantitative finding that access to finance significantly enhanced adaptive capacity was triangulated with interview evidence showing that female entrepreneurs often leveraged microcredit programs to diversify products and sustain business operations during flooding. Second, interpretive integration synthesized both strands to build a cohesive understanding of how financial inclusion, entrepreneurial orientation, and community collaboration interact with institutional Support to enhance climate resilience among MSEs. Integration was not limited to the results stage but also informed interpretation,

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ensuring that quantitative patterns were grounded in local realities while qualitative accounts were contextualized within broader statistical trends.

4. Finding and Discussion

Quantitative Results. The quantitative results presented in Table 1 confirm that all proposed hypotheses (H1–H6) were supported. Access to finance (H1) exhibited the most substantial direct effect on adaptive capacity ($\beta = 0.42$, $p < 0.001$), highlighting the central role of financial capital in enabling MSEs to invest in resilient infrastructure, diversify income sources, and absorb shocks caused by tidal flooding and land subsidence. This finding aligns with prior research emphasizing financial inclusion as a cornerstone of climate resilience in vulnerable economies (Becker et al., 2025; Lestari & Purwanto, 2025). Community collaboration (H2) also demonstrated a significant positive effect on adaptive capacity ($\beta = 0.31$, $p < 0.01$). This indicates that collective action—through mutual assistance, resource pooling, and knowledge exchange—enhances the resilience of MSEs. Such outcomes resonate with socio-ecological resilience theory (Folke, 2006), which underscores the importance of social networks in enabling communities to cope with environmental shocks. Entrepreneurial orientation (H3) was another significant predictor of adaptive capacity ($\beta = 0.27$, $p < 0.05$). Proactiveness, innovativeness, and risk-taking behaviors allow entrepreneurs to identify new opportunities, reconfigure business models, and implement adaptive strategies. This result is consistent with Lumpkin and Dess's (2001) perspective that EO enables enterprises to transform environmental challenges into business opportunities. Importantly, the moderating role of institutional Support was also validated. Institutional Support significantly strengthened the relationships between finance and adaptive capacity (H4, $\beta = 0.19$, $p < 0.05$), community collaboration and adaptive capacity (H5, $\beta = 0.23$, $p < 0.05$), and entrepreneurial orientation and adaptive capacity (H6, $\beta = 0.27$, $p < 0.05$). These findings suggest that financial resources, social capital, and entrepreneurial drive are necessary but not sufficient conditions for resilience. Without institutional facilitation—such as favorable credit policies, technical assistance, and recognition of innovation—these internal capacities tend to remain short-term coping strategies rather than long-term adaptation pathways (Gunawan et al., 2022; Anwar et al., 2024). By amplifying and legitimizing adaptation practices, institutional Support acts as a multiplier that transforms individual and collective capacities into sustainable resilience outcomes.

Table 1. Results of hypothesis testing using PLS-SEM

Hypotheses	Pathway	Std. Coefficient (β)	p-value	Interpretation
H1	Access to Finance $\rightarrow$ Adaptive Capacity	0.42	<0.001	Strong, significant effect
H2	Community Collaboration $\rightarrow$ Adaptive Capacity	0.31	<0.01	Moderate, significant effect
H3	Entrepreneurial Orientation $\rightarrow$ Adaptive Capacity	0.27	<0.05	Positive, significant effect
H4	Institutional Support $\times$ Access to	0.19	<0.05	The moderating

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	Finance → Adaptive Capacity			effect strengthens financial access
H5	Institutional Support × Community Collaboration → Adaptive Capacity	0.23	<0.05	The moderating effect strengthens community resilience
H6	Institutional Support × Entrepreneurial Orientation → Adaptive Capacity	0.27	<0.05	The moderating effect strengthens community resilience

Qualitative Results. The qualitative findings provide complementary evidence that deepens the interpretation of the quantitative results (see Table 2 and Table 3). Three main adaptive strategies emerged from the interviews: pragmatic operational adjustments, diversification strategies, and ecosystem-based adaptation. These themes illustrate how MSEs translate financial resources, community collaboration, and entrepreneurial orientation into concrete practices under climate stress. First, pragmatic operational adjustments were widely adopted by entrepreneurs to minimize disruption during tidal flooding. For example, respondents reported rescheduling production to nighttime hours, temporarily relocating operations, or reducing output during extreme weather events. Such flexibility reflects the role of entrepreneurial orientation (H3) in fostering adaptive problem-solving. It also shows how community support networks help sustain operations during short-term shocks, thereby reinforcing the positive effect of collaboration on adaptive capacity (H2). Second, diversification strategies emerged as a critical coping mechanism. Several entrepreneurs engaged in supplementary businesses—such as food stalls, online snack sales, or small laundry services—when their main activities were disrupted by flooding. This evidence supports the quantitative finding that access to finance (H1) enhances adaptive capacity, as many diversification initiatives were made possible through microcredit and cooperative savings. Female entrepreneurs, in particular, highlighted microfinance as essential for starting side businesses, underscoring the intersection of finance and gendered adaptation capacities. Third, ecosystem-based adaptation was observed through mangrove planting, small embankment construction, and participation in village-led greenbelt programs. These practices exemplify the synergistic role of community collaboration (H2) and institutional Support (H5). While collective action initiated mangrove rehabilitation, its sustainability was achieved when institutional actors, such as local governments and NGOs, provided seedlings, technical assistance, and recognition. This triangulates the quantitative finding that institutional Support moderates the collaboration–adaptive capacity relationship. Gendered differences were also evident in the narratives. Although women constituted nearly half of the respondents, they reported limited access to formal credit, weaker representation in community organizations, and lower institutional recognition compared to their male counterparts. This reinforces the notion of “triple differential vulnerability” discussed in the introduction (Arora-Jonsson, 2011; Djoudi et al., 2016), showing that institutional barriers intersect with gender to constrain adaptive capacity.

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Table 2. General Characteristics of the Respondents

Code	Gender	Age Range	Last Education	Type of Business	Years in Business	Group Membership	Access to Formal Financing
R1	Female	31–40	SMP	Processed dried fish	6	Yes (community group)	Yes
R2	Male	41–50	SD	Fishpond/fish farming	12	Yes (youth group)	No
R3	Male	26–35	SMA	Handicrafts (weaving)	4	Yes (cooperative)	Yes
R4	Female	36–45	SMA	Tailor/batik	8	No	No
R5	Female	46–55	SD	Food stall/snack seller	15	Yes (business savings group)	No
R6	Male	51–60	SMP	Fisherman (fresh sales)	20	Yes (fish farming group)	No
R7	Female	21–30	SMA	Fish cracker processing	3	No	Yes
R8	Female	31–40	SMK	Souvenir/small crafts business	7	Yes (cooperative)	Yes
R9	Male	41–50	SMA	Small boat workshop/service	10	No	Yes
R10	Female	36–45	SMP	Seafood processing (intermediate)	9	Yes (community group)	No
R11	Male	26–35	D3	Small logistics/packaging business	5	Yes (cooperative)	Yes
R12	Female	46–55	SD	Traditional food maker	18	No	No
R13	Female	31–40	SMA	Batik artisan	6	Yes (business group)	Yes
R14	Male	56–65	SD	Fishpond farmer/household	25	Yes (cooperation)	No
R15	Female	26–35	SMA	Ready-to-eat food seller	4	No	Yes
R16	Male	41–50	SMP	Small wholesale trade	11	Yes (cooperative)	Yes
R17	Female	36–45	SMA	Marine craft business (shell)	9	Yes (community group)	No
R18	Male	31–40	SMA	Boat transport	7	No	No

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Code	Gender	Age Range	Last Education	Type of Business	Years in Business	Group Membership	Access to Formal Financing
				services			
R19	Female	46–55	SD	Small food business (chips/snacks)	14	Yes (business savings group)	No
R20	Male	26–35	SMA	Micro digital startup (marketing)	3	No	Yes

Source: Authors' field interviews (2024)

Table 3. Qualitative Insights on the Adaptive Capacity of MSEs in Coastal Kendal

Theme	Illustrative Quotes from Informants	Implications for Adaptive Capacity
Pragmatic Operational Adjustments	"If the flood tide enters, we have to stop production for a few hours, then continue at night. So, work must be flexible so that orders keep running." (Respondent 7, batik entrepreneur) "If it rains heavily during the production season, I tell employees to go home first. Later, when the water has receded, I will work overtime until night." (Respondent 5, Contractor Garment) "If the road to the production site is flooded, we temporarily move to a higher employee house. So, production can still run even if it's simple." (Respondent 2, snack producer)	Flexibility in production schedules and relocation strategies reduces disruption and maintains business continuity under climate stress (Smit & Wandel's, 2006).
Diversification Strategies	"I now make processed dried fish in addition to written batik. So, if the flood season cannot produce batik, there is still income from side businesses." (Respondent 12, female entrepreneur) "In addition to the knitting business, I started selling snacks online. So, if production is disrupted by floods, there is still income from that sale." (Respondent 9, female entrepreneur) "Now I am opening a small laundry service at home. So, if the main business is stopped due to robbery, there is a reserve income. (Respondent 11, coastal household entrepreneur)	Diversification spreads risks across sectors, providing alternative income streams that safeguard livelihoods during climate-induced disruptions.
Ecosystem-Based Adaptation	"We participate in planting mangroves around the pond. In addition to being able to reduce rob, he said it is also good for storing blue carbon." (Respondent 3, aquaculture entrepreneur) "We work together to make a small embankment on the edge of the pond, while planting mangroves. That is how we protect our business from abrasion."	Ecosystem-based adaptation integrates environmental stewardship with business survival, reducing long-term risks while generating

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Theme	Illustrative Quotes from Informants	Implications for Adaptive Capacity
	(Respondent 4, fishpond entrepreneur) "We participated in the village program to make a green belt with mangroves. It is said that it can reduce large waves as well as become a new tourist attraction." (Respondent 6, youth entrepreneur)	ecological and economic co-benefits.

Source: Authors' field interviews and thematic analysis (2024)

Synthesizing both strands, the quantitative and qualitative results provide a holistic account of how coastal MSEs in Kendal cultivate adaptive capacity. The survey findings (Table 1) indicate that access to finance, community collaboration, and entrepreneurial orientation significantly predict adaptive capacity, with institutional support acting as a moderating factor that strengthens these relationships (H1–H6). Complementing this, the interview evidence (Tables 2 and 3) substantiates the statistical results by illustrating how entrepreneurs operationalize adaptive strategies in practice—most notably through flexible production schedules, business diversification, and ecosystem-based adaptation. These findings align with broader insights from the Global South, where financial inclusion, institutional support, and localized adaptive practices are consistently highlighted as critical enablers for small enterprises facing compound climate risks (Revilla Diez et al., 2024; Gannon et al., 2022).

The integrative findings reveal three important insights. First, finance is a necessary but insufficient condition for adaptation. Quantitative analysis identified finance as the strongest driver (H1), yet interviewees emphasized that loans and savings groups often served only short-term needs unless linked to institutional programs. This explains why institutional Support significantly moderated the finance–adaptive capacity relationship (H4).

Second, community collaboration is most effective when institutionalized. While gotong royong initiatives provided immediate relief during flooding, long-term resilience was only achieved when these efforts were embedded in formal village or government programs, such as mangrove rehabilitation projects. This triangulates the positive interaction found in H5 and underscores the principle that collective action requires governance reinforcement to be sustainable.

Third, entrepreneurial orientation facilitates innovation, but institutional recognition is essential for scalability. Proactive entrepreneurs who diversified into ecotourism or digital sales platforms enhanced their adaptive capacity (H3). However, without certification, market access, or policy incentives, many innovations remained small-scale. The moderating effect of institutional Support on EO (H6) highlights the role of governance systems in legitimizing and amplifying entrepreneurial adaptation.

From a theoretical standpoint, these findings strengthen the Sustainable Livelihoods Framework (SLF) by showing how financial, social, and human capitals interact with institutional structures to shape adaptive outcomes. They also extend socio-ecological resilience theory by demonstrating that collaboration, while valuable, becomes transformative only when

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coupled with formal support mechanisms. Moreover, the evidence highlights the importance of gender-sensitive institutional arrangements, as women entrepreneurs face persistent barriers to finance and recognition despite their demonstrated agency in adaptation.

In terms of policy implications, the findings point to three strategic priorities for strengthening the adaptive capacity of coastal MSEs. First, expanding financial inclusion through climate-responsive microcredit and gender-sensitive lending schemes can lower entry barriers for vulnerable entrepreneurs and stimulate long-term adaptive investments. This aligns with World Bank (2023) recommendations that financial innovation and inclusive banking systems are critical for enhancing resilience in climate-vulnerable communities. Second, institutionalizing community collaboration—via cooperatives, village-level adaptation programs, and participatory governance mechanisms—can ensure that collective efforts are sustained beyond ad-hoc initiatives, consistent with UNDP (2022) frameworks on locally led adaptation. Third, recognizing and incentivizing entrepreneurial innovation through certification, market facilitation, and targeted fiscal incentives can transform individual adaptive practices into scalable solutions with wider socioeconomic benefits, reflecting IPCC (2022) guidance on enabling conditions for transformative adaptation.

These measures resonate with the broader policy agenda of the Sustainable Development Goals (SDGs). By enhancing productivity and decent work opportunities (SDG 8), fostering resilient coastal livelihoods and inclusive urban development (SDG 11), and advancing climate action through ecosystem-based adaptation and blue carbon initiatives (SDG 13), coastal enterprises are positioned not merely as economic actors but as critical agents of resilience and sustainability in the face of escalating climate risks.

5. Conclusion

This study examined the adaptive capacity of micro and small enterprises (MSEs) in the coastal areas of Kendal, Indonesia, using a mixed-methods design. The quantitative analysis confirmed that access to finance, community collaboration, and entrepreneurial orientation each have a significant positive effect on adaptive capacity (H1–H3), while institutional Support strengthens these relationships (H4–H6). These findings indicate that internal resources and entrepreneurial behavior are critical enablers of resilience, but their effectiveness is contingent upon supportive institutional frameworks. The qualitative evidence complements these results by illustrating how MSEs implement adaptation in practice through flexible production schedules, business diversification, and ecosystem-based measures such as mangrove rehabilitation. These strategies highlight both the agency of entrepreneurs and the limitations they face, particularly among women, in accessing resources and institutional recognition.

Taken together, the findings emphasize that finance, collaboration, and entrepreneurship are necessary foundations for resilience, but without institutional facilitation, they remain fragmented coping mechanisms. Institutional Support acts as a multiplier, enabling adaptive practices to evolve into sustainable pathways that contribute not only to local livelihoods but also to global climate goals.

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Policy implications include the need for gender-sensitive financial inclusion, institutionalization of collective adaptation, and recognition of entrepreneurial innovation. Strengthening these areas can enhance the role of coastal MSEs as agents of resilience and sustainability. By advancing decent work (SDG 8), resilient communities (SDG 11), and climate action (SDG 13), this study underscores the importance of inclusive and integrated frameworks for sustainable coastal development.

This study has several limitations. First, the analysis is geographically restricted to coastal MSEs in Kendal, Indonesia, which constrains the generalizability of the findings to other coastal settings with different socio-economic and institutional contexts. Second, although the mixed-methods approach enriches interpretation, the quantitative strand is cross-sectional, limiting causal inference about dynamic adaptation processes over time. Third, the study focused on access to finance, collaboration, and entrepreneurial orientation, while other potential drivers—such as technological innovation, market volatility, and supply chain linkages—were not explicitly examined. Finally, although gender dimensions were qualitatively highlighted, the quantitative analysis did not fully disaggregate by gender, potentially obscuring important heterogeneities in adaptive capacity.

Future research could address these gaps in several ways. Longitudinal designs are needed to track how MSEs' adaptive capacity evolves in response to recurrent and compound climate hazards. Comparative research across coastal regions in the Global South would capture contextual variations and provide transferable lessons. Further, technological and digital pathways deserve greater attention, particularly the roles of digital finance, e-commerce, and data-driven early warning systems in enhancing resilience. Gender-disaggregated analyses are essential to systematically assess the “triple differential vulnerability” of women entrepreneurs and inform targeted interventions. Finally, participatory action research and experimental approaches could be used to evaluate the effectiveness of policy instruments such as climate microcredit, cooperative-based adaptation, and blue carbon market mechanisms.

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