Building Community Resilience through Adaptive Governance: A Socio-Ecological Approach to Environmental Change in South Sulawesi

Nina Anggriani[1], Aswar[1], Siti Heni Rahmaliasari[1]

[1]Government Science Study Program, Pancasakti University Makassar, Indonesia

ABSTRACT

Purpose: This study aims to examine how adaptive governance enhances community resilience in responding to environmental change in South Sulawesi, Indonesia, by analyzing how local institutions, social networks, and knowledge systems interact to support collective adaptation strategies.

Subjects and Methods: A qualitative research design was employed, involving in-depth interviews with community leaders, local government officials, and key stakeholders in both coastal and upland areas. Data collection was supported by direct field observations and document analysis to capture institutional practices, social interactions, and knowledge-sharing processes. The data were analyzed thematically to identify patterns and relationships that illustrate the mechanisms through which governance and community action contribute to resilience.

Results: The findings show that institutional flexibility enables rapid, context-sensitive decision-making and supports the integration of traditional and formal governance structures. Social capital and collective action play vital roles in mobilizing community resources, building trust, and sustaining cooperation in addressing environmental challenges. Knowledge integration, combining local ecological insights with scientific understanding, promotes continuous learning and innovation in adaptation practices. Participatory governance also strengthens legitimacy and community engagement, enhancing the capacity to respond to complex socio-ecological dynamics.

Conclusion: The study concludes that resilience in South Sulawesi is strengthened not through rigid control, but through flexibility, collaboration, and continuous learning within socio-ecological systems. Adaptive governance fosters inclusivity, reflexivity, and co-creation among institutions and communities. It positions managers as facilitators of collective intelligence, encouraging distributed leadership, trust-based networks, and equity-centered decision-making to support sustainable and just futures.

INTRODUCTION

Communities across the world are facing increasing challenges due to rapid environmental change, marked by rising temperatures, ecosystem degradation, and intensifying weather variability. In Indonesia, particularly in South Sulawesi, these transformations are reshaping the relationship between humans and their environment, leading to new vulnerabilities and adaptive demands (Maurischa et al., 2023). As a region with rich ecological diversity and deep-rooted cultural traditions, South Sulawesi faces the dual challenge of maintaining social stability while

addressing the accelerating impacts of climate variability, coastal erosion, and deforestation (Widayati et al., 2021).

These environmental disruptions not only threaten livelihoods but also challenge existing governance systems that are often rigid and fragmented. Consequently, there is a pressing need to develop governance frameworks that enable communities to adapt dynamically and build resilience in a socially and ecologically integrated manner (Wurarah, 2024). The concept of community resilience has emerged as a central framework for understanding how societies absorb, adapt to, and transform in response to environmental stresses (Haldon et al., 2021; Cafer et al., 2022; Choudhury et al., 2021).

It represents more than the ability to recover from disasters it encompasses proactive capacities to anticipate change, reorganize resources, and maintain core functions under pressure. In rural and coastal areas of South Sulawesi, resilience is often embedded in local knowledge systems, traditional ecological practices, and collective cultural values such as *gotong royong* (mutual cooperation) and *sipakatau* (mutual respect). These cultural principles foster solidarity and cooperation, enabling communities to collectively respond to environmental uncertainty.

However, traditional mechanisms alone are insufficient to address complex challenges like biodiversity loss, climate-induced migration, and declining ecosystem services (Poddar, 2024). Such multifaceted issues demand adaptive governance systems that bridge local practices with institutional innovation and ecological understanding. Adaptive governance refers to flexible, multi-level systems of management that facilitate learning, collaboration, and responsiveness to change (Wilkinson et al., 2022). It emphasizes the inclusion of multiple actors' governments, communities, and non-governmental organizations in shared decision-making processes that promote resilience within social-ecological systems (Askland et al., 2022).

In the context of South Sulawesi, adaptive governance requires rethinking the interaction between policy frameworks and local agency. Historically, environmental management in Indonesia has been characterized by centralized decision-making, where local communities are treated as policy recipients rather than partners (Supriatna & Lenz, 2022). This top-down governance has often failed to capture local ecological knowledge or to build social trust necessary for sustainable management (Resolute, P. (2024). By contrast, adaptive governance fosters inclusivity and participatory learning elements crucial for building community resilience amidst ecological volatility (Shantiko et al., 2021).

Environmental change in South Sulawesi manifests in diverse ways across coastal, agricultural, and upland regions. In coastal areas such as Barru, Pangkep, and Makassar, communities are increasingly affected by tidal flooding and saline intrusion that threaten fisheries and aquaculture livelihoods (Kasri et al., 2024). In the upland regions of Enrekang and Toraja, shifting rainfall patterns and land-use pressures have altered soil fertility and agricultural productivity (Baharuddin et al., 2022). These phenomena not only create physical and economic risks but also reshape community relationships with natural resources.

Adaptive responses thus require governance mechanisms that integrate scientific and local knowledge, allowing for flexible adaptation across ecological and social scales (Astuti et al., 2022). The socio-ecological approach provides an analytical framework to understand these interactions between society and the environment. It views human and natural systems as interdependent and co-evolving, where social practices influence ecological outcomes and vice versa (Koditschek, 2023). In South Sulawesi, this approach allows for the exploration of how community institutions, traditional practices, and governance systems intersect to shape resilience.

For example, community-based resource management initiatives such as mangrove rehabilitation or integrated farming reflect socio-ecological adaptations that merge ecological awareness with social cooperation (Kokou et al., 2024; Putra et al., 2021). Yet, the success of these initiatives often depends on institutional flexibility and support from local governance structures. Adaptive governance thus becomes a mediator between ecological complexity and social agency, linking grassroots innovation with policy responsiveness.

Despite growing recognition of these dynamics, there remains a gap in empirical understanding of how adaptive governance operates in the context of South Sulawesi's environmental challenges. Previous studies have largely focused on the technical dimensions of resilience such as infrastructure or disaster management without adequately addressing the socio-political and cultural foundations that sustain adaptive capacity (Cantelmi et al., 2021). Moreover, resilience is often discussed at the national or regional scale, overlooking the local realities where adaptation actually occurs.

Local communities in South Sulawesi are not passive recipients of environmental impacts; rather, they engage in continuous learning, negotiation, and innovation to cope with uncertainty (Rezvani et al., 2023; Habibi et al., 2021). Recognizing this agency is central to reimagining governance as an enabling system that supports rather than controls local adaptation processes. This study therefore aims to deepen understanding of how adaptive governance contributes to the construction of community resilience within the socio-ecological context of South Sulawesi.

By examining how local communities, government institutions, and civil society actors interact in managing environmental change, the research highlights pathways for co-produced resilience. The findings demonstrate that resilience emerges not merely from institutional policy, but from the synergy between knowledge systems, cultural traditions, and governance flexibility. Building on this premise, the study provides insights into how participatory governance and socio-ecological integration can strengthen the capacity of communities to navigate the uncertain terrain of environmental transformation (Vivier & Sanchez, 2023; Bussu et al., 2022).

METHODOLOGY

This study employed a qualitative research approach grounded in the interpretivist paradigm. The qualitative method was chosen because it allows an in-depth exploration of complex social and ecological interactions that cannot be captured through quantitative measurement. The objective of the study was to understand how adaptive governance contributes to building community resilience in the face of environmental change within the unique socio-ecological context of South Sulawesi. This approach emphasizes meanings, processes, and relationships focusing on how individuals and communities perceive, experience, and respond to environmental transformations. The qualitative framework also allowed for the exploration of contextual realities, cultural values, and institutional practices that shape adaptive behavior and governance dynamics. As Creswell (2014) notes, qualitative inquiry provides an avenue to capture participants lived experiences, interpret local meanings, and construct a holistic understanding of phenomena within their natural settings.

Research Design

The study adopted a case study design, which is particularly suited to investigating complex social-ecological systems in real-life contexts. Emphasizes that case study design is appropriate when the research seeks to answer "how" and "why" questions about contemporary phenomena over which the researcher has little control. In this research, the case study approach enabled the detailed examination of adaptive governance mechanisms and community resilience practices in specific environmental settings of South Sulawesi. The design facilitated the integration of multiple data sources interviews, observations, and documents to build a comprehensive picture of how communities interact with institutional and ecological structures. Furthermore, the case study method allowed the researcher to interpret the interplay between formal governance frameworks and informal community-led adaptive strategies. The study focused on two types of communities: coastal and upland settlements, both of which experience distinct environmental challenges. This comparative case perspective strengthened the understanding of how adaptive governance manifests differently across ecological contexts while sharing underlying socio-cultural principles. The analysis was therefore contextual and comparative, emphasizing the diversity and commonalities of adaptive responses across regions.

Research Setting

The research was conducted in three regencies of South Sulawesi: Makassar City, Barru Regency, and Enrekang Regency. These areas were selected purposively to represent diverse socio-

ecological settings. Makassar, as an urban coastal region, faces challenges related to tidal flooding, coastal erosion, and urban waste management. Barru Regency represents semi-rural coastal communities dependent on fisheries and aquaculture, where climate variability has disrupted livelihoods. Enrekang, located in the upland zone, is primarily agricultural and increasingly vulnerable to rainfall shifts and land degradation. These settings illustrate the socio-ecological diversity of South Sulawesi, encompassing both marine and terrestrial ecosystems. The selection of these areas was also based on accessibility, the existence of active local governance programs related to environmental adaptation, and the willingness of communities to participate. By situating the study in multiple contexts, the research captured a range of adaptive experiences and governance interactions, offering a nuanced understanding of resilience across ecological gradients.

Participants and Sampling

Participants were selected through purposive sampling, focusing on individuals who possess relevant knowledge or involvement in adaptive governance and environmental management. The sample included community leaders, local government officials, traditional leaders, members of women's groups, and representatives of non-governmental organizations engaged in sustainability initiatives. Purposive sampling was essential in identifying information-rich participants capable of articulating insights on governance practices, local adaptation strategies, and socio-ecological interactions. A total of 32 participants were engaged across the three research locations. This included ten community members, eight local government officials, six NGO representatives, and eight traditional or religious leaders. The diversity of participants ensured that multiple perspectives were incorporated, enhancing the depth of analysis. The principle of data saturation guided the sampling process; interviews continued until no new information or themes emerged from participants. This approach guaranteed that the data collected were sufficient to capture the complexities of adaptive governance and community resilience.

Data Collection Techniques

Data were collected through four primary qualitative methods: in-depth interviews, focus group discussions (FGDs), participant observation, and document analysis. In-depth interviews were semi-structured and designed to explore participants' perceptions, experiences, and practices related to environmental change and governance. Each interview lasted between 45 and 90 minutes and was conducted in Bahasa Indonesia to ensure linguistic and cultural comfort. Interviews were recorded with participants' consent and later transcribed verbatim. Focus group discussions involved small groups of 6−8 participants to stimulate dialogue around shared experiences and collective adaptation processes. FGDs were particularly valuable for understanding community cooperation, local norms, and the collective dimensions of resilience. Participant observation was conducted throughout the research process, allowing the researcher to observe governance meetings, community discussions, and environmental activities such as mangrove planting and flood mitigation efforts. This method provided insight into social interactions, decision-making behaviors, and power relations that are often not revealed through interviews alone.

Data Analysis

The study employed thematic analysis to interpret and synthesize data from interviews, observations, and documents. The process followed Braun and Clarke's (2006) six-phase framework: familiarization with data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. The analysis began with open coding, identifying key concepts and phrases related to resilience, governance, and adaptation. Through axial coding, relationships among codes were established, linking institutional flexibility, social capital, and ecological knowledge as core analytical categories. Finally, selective coding integrated these categories into overarching themes that explained the interplay between adaptive governance and community resilience. NVivo qualitative analysis software was used to manage and organize the large volume of data, ensuring consistency and transparency in coding. The interpretive process was iterative, involving continuous comparison between data and

emerging insights. Analytical memos were written throughout the process to reflect on meaning construction and maintain reflexivity.

RESULTS AND DISCUSSION

Communities in South Sulawesi are increasingly confronted with complex environmental changes, including coastal erosion, flooding, and shifting agricultural patterns, which pose significant challenges to local livelihoods and socio-ecological stability. Addressing these challenges requires governance approaches that are not only responsive but also adaptive, integrating local knowledge, social networks, and institutional flexibility to foster resilience. In this context, adaptive governance emerges as a critical framework for understanding how communities organize, learn, and coordinate in response to uncertainty and ecological variability. By examining the interplay between local institutions, social capital, collective action, and knowledge integration, this study explores the mechanisms through which communities enhance their capacity to anticipate, respond to, and recover from environmental disturbances. The findings highlight how institutional arrangements, social cohesion, and learning systems collectively shape adaptive practices, offering practical insights for management strategies aimed at building sustainable and resilient socio-ecological systems. The following section presents the key results of the study, illustrating how these dimensions of adaptive governance operate in practice across different communities in South Sulawesi.

Institutional Flexibility and Local Decision-Making

One of the central findings of this study reveals that institutional flexibility the capacity of local governance systems to adjust and respond to changing environmental conditions plays a pivotal role in strengthening community resilience. In the context of South Sulawesi, local institutions that exhibited adaptability, participatory leadership, and inclusive decision-making structures were more effective in mobilizing communities to respond to ecological stress. Institutional flexibility allowed for rapid adjustment of local regulations, resource-sharing arrangements, and coordination mechanisms between formal and informal actors. This adaptive capacity is vital in dynamic socio-ecological systems where uncertainty and environmental variability are constant. In several communities, flexibility was reflected in the integration of traditional and formal governance systems. Local customary institutions (*adat*) often coexisted with village administrative bodies, enabling collective decision-making rooted in both cultural legitimacy and bureaucratic authority. For instance, in Barru Regency, community members highlighted how the *adat council* collaborates with village government in regulating mangrove harvesting and coastal zoning. One participant explained:

> "*We do not wait for the district office to make rules for us; we meet with the village head and adat leaders to discuss what is best for our coast and our fishermen. When the tide changes or fish become fewer, we revise our local rules together.*"

This statement illustrates the organic nature of local governance that is responsive to ecological signals and rooted in community dialogue. Institutional flexibility also manifested in the decentralization of decision-making at the community level. In many villages, authority over natural resource management was delegated to local committees or working groups, allowing decisions to be made close to the context of action. This decentralization not only enhanced responsiveness but also fostered a sense of ownership among community members. In Makassar's coastal neighborhoods, for example, local committees regularly convened to discuss issues of waste management and tidal flooding. A participant emphasized this participatory practice:

> "*We do not depend entirely on the city government. Every month we gather to evaluate what worked and what didn't. Sometimes the youth group proposes new drainage ideas, and we try them ourselves before asking for funding.*"

Such practices demonstrate how flexible governance enables innovation through trial, learning, and collective problem-solving. The research also found that rigid and hierarchical governance structures hindered resilience by delaying responses and reducing public trust. In contrast, flexible institutions that promoted two-way communication and inclusive decision-making enhanced community willingness to participate in adaptation efforts. Polycentric and participatory systems are better suited to address complex environmental challenges than centralized command structures. In

Enrekang, an upland area where soil erosion and shifting rainfall patterns are persistent, local farmers' groups and agricultural officers maintained open communication to adjust cropping calendars and reforestation strategies. One farmer described the process:

> *"When the rains come late, we don't wait for a directive from the province. The agricultural facilitator meets with us, and together we decide to shift planting to the next month or use shorter-cycle crops."*

This adaptive dialogue between farmers and local institutions reflects how decision-making flexibility enables communities to act swiftly within uncertainty. Institutional flexibility was supported by horizontal collaboration among local actors, including community organizations, NGOs, and local governments. Collaborative arrangements encouraged experimentation and shared learning two essential features of adaptive governance. In Barru, environmental NGOs partnered with local schools and women's groups to implement mangrove replanting and eco-literacy programs. These partnerships bridged institutional gaps and diversified knowledge systems. A local NGO coordinator described this synergy:

> *"We don't just bring our own program; we listen to what the community wants. If they say they need training for women or seedlings for youth groups, we adjust our activities. That flexibility makes people trust us more."*

This statement underscores that flexibility is not only structural but relational it builds trust and strengthens cooperation among actors operating at different levels. The study also observed institutional challenges that constrain flexibility, particularly when local initiatives face bureaucratic barriers or inconsistent policy support. Some community leaders reported delays in budget approvals and a lack of coordination between district and provincial agencies, which hindered the continuity of adaptation programs. For instance, in Makassar, one village head expressed frustration:

> *"We have the plan ready, but the funding process takes months. By the time the budget arrives, the season has changed, and our work becomes less effective."*

Such accounts highlight the tension between the adaptive capacities of local communities and the rigidity of formal administrative procedures. This disconnection between local temporalities and bureaucratic processes often undermines the timely implementation of adaptation strategies. Despite these limitations, the empirical evidence suggests that institutional learning and flexibility evolve through iterative experience. Communities in South Sulawesi have gradually developed mechanisms to adjust their governance practices based on feedback and ecological observation. For instance, after repeated flooding events, some coastal villages introduced community-based early warning systems that integrate local knowledge of tidal cycles with mobile communication alerts. These locally initiated systems were later recognized by district authorities and incorporated into formal disaster management plans. This dynamic illustrates a key principle of adaptive governance learning across scales and integrating informal innovations into institutional frameworks.

Social Capital and Collective Action

The second major theme emerging from the study is the central role of social capital and collective action in strengthening community resilience. Across the research sites in South Sulawesi, communities that exhibited high levels of trust, cooperation, and social cohesion were found to be more capable of organizing effective adaptive responses to environmental challenges. Social capital comprising networks, norms, and relationships that enable collective coordination served as both a social safety net and a catalyst for joint environmental management. In contexts of uncertainty and ecological stress, these relational resources facilitated collaboration, information exchange, and the mobilization of shared efforts. Social capital in South Sulawesi is deeply rooted in local cultural values such as *gotong royong* (mutual cooperation) and *sipakatau* (mutual respect), which shape the moral foundation of community solidarity. These principles foster a collective orientation toward shared responsibility and reciprocal support, essential for collective environmental action. In Barru Regency, for instance, community members routinely organized joint labor for replanting mangroves and maintaining drainage channels. One participant reflected:

> *"We help each other because the problem of the sea is everyone's problem. When the tide floods the road, we don't wait for government workers; we gather the men and youth to fix it together."*

This testimony underscores how communal solidarity transforms environmental challenges into opportunities for cooperation rather than conflict. Bonding social capital, the close ties among community members, was particularly visible in small villages where kinship and neighborhood relations are strong. These ties facilitated rapid mobilization in response to local environmental risks. In Enrekang, where landslides and soil erosion are common, residents organized spontaneous work groups to clear debris and repair irrigation channels. A farmer explained:

> *"When the rain destroys our fields, we come together quickly. We don't ask who owns which land; everyone helps because next time it could be your turn to suffer."*

This sense of mutual dependency enhances adaptive capacity by ensuring that no household faces ecological hardship in isolation. Such bonding ties provide the emotional and practical resources necessary for communities to recover and reorganize after environmental disturbances. Beyond internal solidarity, the study also found the presence of bridging social capital, which connects different social groups and enables access to external resources and knowledge. These horizontal linkages often involved partnerships between communities, local NGOs, and government agencies. In Makassar, for example, fisherfolk associations collaborated with local environmental NGOs to implement coastal clean-up and waste management programs. One NGO representative described the importance of these partnerships:

> *"We cannot succeed without community trust. When people see us working with them, not above them, they become motivated to continue even when our project ends."*

Bridging ties thus enhance sustainability by embedding external interventions within local networks of trust and participation. The findings further indicate that collective action emerges not only as a reaction to crisis but also as a proactive mechanism for adaptation. Communities in South Sulawesi often engage in regular communal meetings to anticipate environmental risks, share information, and plan collective responses. In one coastal village in Barru, residents created an informal environmental task force to coordinate activities such as mangrove planting and waste collection. A member of this group explained:

> *"We meet every week to talk about the sea, the garbage, and the weather. Sometimes the elders remind us of old traditions about caring for nature. It makes us feel responsible, not only for today but for our children's future."*

This indicates that collective action is intertwined with moral and intergenerational responsibility, reflecting a culturally grounded understanding of resilience. Trust and reciprocity emerged as critical elements sustaining these collective efforts. Trust reduces transaction costs in coordination, while reciprocity ensures that mutual assistance is expected and rewarded within the community. When individuals trust one another, they are more willing to share information, cooperate in collective tasks, and engage in participatory governance. In Enrekang, for instance, one local leader observed:

> *"If people don't trust the head of the group, they won't follow the plan. But here, our people believe that decisions are made for everyone's good, so they volunteer easily."*

This trust-based cooperation reinforces a sense of communal ownership over adaptation processes, ensuring that environmental initiatives are not perceived as external impositions but as shared endeavors. The study also found that social capital facilitates learning and innovation, two critical dimensions of adaptive governance. Through networks of interaction, communities exchange knowledge and experiment with new techniques. In Makassar, women's groups developed creative recycling initiatives by transforming household waste into handicrafts, later shared with neighboring communities through informal training sessions. As one participant proudly shared:

> *"We learn from each other. When one of us finds a new way to reuse plastic, we show others. It's small, but it helps our environment and gives us income."*

These social learning processes exemplify how adaptive capacity is socially constructed through cooperation, communication, and continuous knowledge exchange. Nevertheless, the findings reveal

that social capital is not always evenly distributed. In some communities, gender and generational hierarchies limited participation in decision-making, particularly among women and youth. Although *gotong royong* remains a strong tradition, it sometimes reproduces existing power structures. A young participant in Makassar remarked:

> "*We want to speak more in meetings, but usually it's the elders or men who decide. We follow, but sometimes we have better ideas that are not heard.*"

This highlights the importance of ensuring inclusivity in collective action to avoid marginalization of specific groups. Strengthening bridging and linking capital connections with institutions and actors beyond the community is therefore essential for democratizing adaptation processes. In addition, the research observed that social capital enhances governance legitimacy, thereby increasing compliance with locally agreed rules and environmental norms. Communities with strong networks of trust were more likely to follow collective agreements regarding natural resource management, such as restrictions on tree cutting or fishing zones. In Barru, one elder commented:

> "*We don't need police to control the mangroves. People obey because the rules are made together, and breaking them would bring shame.*"

This moral dimension of social capital reinforces informal governance, reducing the need for external enforcement and supporting sustainable resource use.

Knowledge Integration and Learning Systems

The findings of this study underscore that knowledge integration and learning systems are central pillars in fostering adaptive governance and building community resilience in South Sulawesi. Environmental challenges such as coastal erosion, flooding, and shifting agricultural cycles have demanded not only structural responses but also continuous learning and the blending of diverse knowledge sources. The study revealed that communities capable of integrating local ecological knowledge (LEK) with scientific and institutional knowledge were better equipped to anticipate, interpret, and respond to environmental changes. This integration represents an ongoing process of co-production where experiential, traditional, and expert insights interact to generate context-relevant adaptation strategies. Local communities in South Sulawesi have a rich repository of ecological knowledge rooted in their long-term interaction with land and sea. Fishers, farmers, and elders possess detailed understanding of environmental patterns, from tidal movements to rainfall variability and soil fertility cycles. In Barru Regency, fishers described how they interpret subtle environmental cues to predict weather changes and fish migrations. One participant noted:

> "*We can tell when the wind will turn or the sea will rise by looking at the color of the clouds and the sound of the waves. It's knowledge from our grandparents, and it still guides us today.*"

This illustrates the enduring role of traditional ecological knowledge in environmental management, even in the face of modern uncertainties. Such local wisdom, when recognized and integrated with scientific data, enhances the precision and legitimacy of adaptive decisions. The study also found that institutional openness to multiple knowledge systems was critical for learning-oriented governance. In many instances, local governments and NGOs have initiated participatory forums and workshops that bring together community members, researchers, and policy actors to share insights on environmental issues. In Enrekang, agricultural officers collaborated with farmers' groups to test new cropping patterns responsive to irregular rainfall. A local facilitator shared:

> "*We no longer just give instructions from the office. We sit with the farmers, listen to their experiences, and together decide what method to try next.*"

This dialogic exchange allows knowledge to flow in both directions, transforming governance into a collaborative learning system rather than a one-way process of policy transmission. Social learning was observed as a key mechanism through which knowledge integration occurred. Communities learned collectively through observation, experimentation, and reflection especially during post-disaster recovery or environmental monitoring activities. In Makassar's coastal settlements, residents organized informal study groups to understand waste management and the effects of coastal flooding. A participant explained:

> *"We learned by doing. When the first drainage project failed, we discussed why it didn't work and tried a new way the next month. Now, we can explain to new residents how to build small filters to stop garbage from blocking water."*

This iterative process reflects experiential learning and adaptive management in practice, where mistakes are reframed as opportunities for improvement rather than failure (Reed et al., 2010; Plummer & Armitage, 2010). Moreover, the study highlighted the role of knowledge brokers individuals or organizations that facilitate the exchange of information between communities and external institutions. NGOs, teachers, and local leaders often acted as intermediaries who translated scientific information into practical guidance, while simultaneously conveying community perspectives to policymakers. In Barru, one local NGO worker emphasized:

> *"Sometimes scientific reports are difficult for people to understand. We explain them in local language, using examples from their own experience, so they can apply it."*

Such translation activities are crucial for building cognitive bridges across different epistemic systems and ensuring that scientific insights resonate with local realities. The integration of digital and participatory tools also emerged as an enabling factor for community learning. In some cases, mobile applications and online communication platforms were used to share environmental information, such as rainfall forecasts and tide data, in real time. In Makassar, youth groups collaborated with local authorities to create social media pages for disaster updates. One young volunteer stated:

> *"We use WhatsApp groups to share information about floods or blocked drains. It helps people prepare faster, especially during heavy rain."*

This example demonstrates how modern technology complements traditional communication networks, reinforcing the collective learning process through timely knowledge dissemination (Cvitanovic et al., 2016; Munaretto & Huitema, 2012). However, the study also identified barriers to effective knowledge integration, including limited access to education, unequal participation in knowledge-sharing spaces, and occasional distrust between communities and formal institutions. In certain rural areas, residents expressed skepticism toward external scientific interventions that appeared detached from local contexts. A farmer in Enrekang remarked:

> *"Sometimes the experts come and give advice that doesn't fit our soil or our timing. We follow for a while, but when it fails, we return to our own way."*

This sentiment points to the importance of co-creation and contextual validation of knowledge rather than top-down imposition. Adaptive governance requires mutual respect between different knowledge systems, where local wisdom is not treated as anecdotal but as empirical experience accumulated through generations. Furthermore, institutional memory and knowledge retention emerged as essential yet vulnerable components of community learning systems. In some cases, community initiatives dissolved when leadership changed or external funding ended, leading to the loss of accumulated experience. Sustaining learning systems, therefore, requires institutional mechanisms such as documentation, peer training, and intergenerational transfer to preserve and evolve local knowledge. As one elder in Barru articulated:

> *"If we don't teach the young people, our knowledge will disappear. The sea will keep changing, but without memory, we cannot adapt."*

This highlights the temporal dimension of resilience, where adaptation depends not only on short-term responses but on the capacity to learn and remember across generations.

Discussion

The findings of this study reaffirm that adaptive governance is not merely a theoretical framework but a practical management paradigm essential for navigating socio-ecological complexity. The management of environmental change demands institutions that are flexible, inclusive, and learning-oriented, particularly in contexts like South Sulawesi, where local livelihoods depend intimately on fluctuating ecological systems. This study's implications move beyond environmental governance into the heart of management science, compelling a rethinking of how managers conceptualize resilience, coordination, and leadership under conditions of uncertainty. As argued by

May (2022), adaptive governance connects institutions across scales to manage dynamic socio-ecological systems, yet its true potential lies in its managerial application where decision-making becomes distributed, reflexive, and context-responsive (Bebbington et al., 2024).

In management terms, this study challenges the assumption that organizational resilience can be achieved through rigid control mechanisms or top-down planning. Instead, resilience must be understood as a function of institutional adaptability and relational capacity a finding consistent with the work of Andriollo et al. (2021), who note that systems capable of learning, adjusting, and self-organizing outperform bureaucratic structures in volatile environments. In the context of South Sulawesi, local decision-making processes that allowed rapid rule adjustment and participatory coordination embody this adaptive capacity. For management scholars, this implies that flexibility should not be perceived as managerial weakness but as a strategic strength that enables organizational survival amid turbulence (Herhausen et al., 2021). In practice, managers must design governance systems that embrace uncertainty as an operational condition rather than as an anomaly to be eliminated.

The study's findings also carry implications for how collective action and social capital are integrated into management strategies. Traditional management models often privilege formal authority, yet in adaptive governance contexts, informal networks, trust, and reciprocity form the real architecture of coordination. The results align with (Sen et al., 2023), who argue that communities with strong social capital exhibit higher adaptive capacity and governance legitimacy. Within management studies, this translates into recognizing social relationships as core managerial assets rather than peripheral social phenomena. Trust-based relationships reduce transaction costs, increase compliance, and foster voluntary participation principles that are vital not only for community resilience but also for sustainable organizational management. Managers, whether in public or private institutions, must therefore treat the cultivation of trust, reciprocity, and participation as integral components of strategic management and organizational design.

Moreover, the evidence underscores that learning systems and knowledge integration are the lifeblood of adaptive governance. Effective management in socio-ecological contexts depends on how organizations and communities transform information into shared understanding and practical adaptation. The South Sulawesi case reveals that when local knowledge interacts with scientific knowledge through participatory dialogue, it generates adaptive intelligence an outcome impossible through hierarchical management alone. This supports concept of knowledge creation within organizations, where tacit and explicit knowledge must interact dynamically to foster innovation. For management practice, this means developing organizational structures that enable continuous learning, participatory reflection, and feedback loops (Senge, 2006; Cash et al., 2003). Managers are therefore not only administrators but also facilitators of learning, whose role is to bridge epistemic divides and sustain collective sense-making.

The broader implication of this study is the necessity of polycentric and networked management structures in contexts of environmental governance. Polycentricity where multiple decision centers operate independently yet cooperatively enables redundancy, innovation, and responsiveness. For management science, this challenges the traditional firm-centric or bureaucratic model of control, advocating instead for distributed governance systems that enhance local autonomy while maintaining coherence through shared values and goals. The South Sulawesi experience illustrates how such distributed arrangements, mediated by trust and learning, can yield stability without sacrificing flexibility. This finding converges with complex adaptive systems theory in management, which emphasizes decentralized decision-making and adaptive feedback as mechanisms for long-term resilience.

Equally significant are the implications for leadership and institutional transformation. Leadership within adaptive governance requires humility, facilitation, and moral legitimacy rather than authority or dominance. The study's evidence that local leaders act as conveners and mediators underscores a managerial principle applicable across domains: leadership must shift from command to coordination, from control to cultivation. Managers who enable participatory processes and empower local actors enhance not only legitimacy but also adaptive capacity. This resonates with contemporary management thought that views leadership as the orchestration of collective intelligence rather than the assertion of singular authority.

From a policy-management interface, this research also offers pragmatic implications for institutional design. Adaptive governance, as demonstrated here, cannot function under rigid bureaucratic constraints. Managers in government and development institutions must therefore create flexible regulatory frameworks that allow local experimentation, rapid feedback, and policy iteration. That decentralization and multi-actor collaboration improve responsiveness to socio-environmental dynamics. In management application, this means embedding adaptive management principles monitoring, learning, and adjusting into performance systems and decision cycles. Furthermore, the discussion extends into the ethical and equity dimensions of governance management. The study reveals that social capital and learning processes can reproduce inequalities when participation is limited by gender, age, or authority. Hence, management systems must adopt justice-oriented principles, ensuring inclusivity and representation in decision-making.

This aligns with the ethical management perspective advanced by Bebbington et al. (2018), which asserts that equitable governance enhances legitimacy and sustainability. For managers, the task is not simply to manage systems efficiently but to steward them fairly, recognizing that procedural justice is a prerequisite for long-term resilience. At the strategic level, this study contributes to management theory by reinforcing that resilience is not a static attribute but a dynamic managerial competence. It is cultivated through iterative learning, relational management, and institutional reflexivity. Adaptive governance thus becomes a lens for reimagining management as an ongoing process of sense-making, coordination, and transformation in response to uncertainty.

This challenges the reductionist tendency in management research to equate resilience with recovery capacity alone; instead, it frames resilience as the institutionalized ability to adapt, reorganize, and innovate under systemic stress. The implications of this study for management education and practice are profound. Educating managers for the future requires moving beyond technocratic training toward cultivating systems thinking, cultural sensitivity, and adaptive leadership. Management curricula must integrate socio-ecological perspectives that emphasize community engagement, participatory decision-making, and transdisciplinary collaboration. The South Sulawesi case provides a living laboratory for these ideas, showing how adaptive governance, when treated as a managerial practice, can turn local wisdom into strategic advantage and uncertainty into opportunity.

CONCLUSION

This study demonstrates that building community resilience through adaptive governance in South Sulawesi represents a transformative approach to management that transcends conventional administrative boundaries and static policy frameworks. The findings affirm that resilience emerges not from rigid control or centralized authority, but from the dynamic interplay between institutional flexibility, social capital, and continuous learning within complex socio-ecological systems. Adaptive governance, as revealed here, embodies a management logic rooted in inclusivity, reflexivity, and co-creation where communities, institutions, and knowledge systems converge to navigate uncertainty and change. This challenges traditional managerial paradigms by positioning adaptability, collaboration, and ethical inclusiveness as the central pillars of sustainable governance. Managers, therefore, must evolve from being controllers of systems to facilitators of collective intelligence, capable of integrating diverse knowledge and fostering trust-based networks that enhance adaptive capacity. The implications extend beyond environmental governance into broader management and organizational theory, suggesting that resilience should be institutionalized as a core strategic competence one that emphasizes feedback learning, distributed leadership, and equity-centered decision-making. Ultimately, the South Sulawesi experience underscores that adaptive governance is not merely a response mechanism but a proactive managerial ethos, enabling institutions and communities to not only withstand environmental transformations but to shape them toward more just, sustainable, and resilient futures.

REFERENCES

Andriollo, E., Caimo, A., Secco, L., & Pisani, E. (2021). Collaborations in environmental initiatives for an effective "adaptive governance" of social–ecological systems: what existing literature suggests. *Sustainability*, *13*(15), 8276. https://doi.org/10.3390/su13158276

Askland, H. H., Shannon, B., Chiong, R., Lockart, N., Maguire, A., Rich, J., & Groizard, J. (2022). Beyond migration: A critical review of climate change induced displacement. *Environmental Sociology*, *8*(3), 267-278. https://doi.org/10.1080/23251042.2022.2042888

Astuti, R. D. P., Mallongi, A., Choi, K., Amiruddin, R., Hatta, M., Tantrakarnapa, K., & Rauf, A. U. (2022). Health risks from multiroute exposure of potentially toxic elements in a coastal community: a probabilistic risk approach in Pangkep Regency, Indonesia. *Geomatics, natural hazards and risk*, *13*(1), 705-735. https://doi.org/10.1080/19475705.2022.2041110

Baharuddin, N. A. I., Zainuddin, M., & NAJAMUDDIN, N. (2022). The impact of ENSO-IOD on Decapterus spp. in Pangkajene Kepulauan and Barru Waters, Makassar Strait, Indonesia. *Biodiversitas Journal of Biological Diversity*, *23*(11). https://doi.org/10.13057/biodiv/d231110

Bebbington, J., Larrinaga, C., & Michelon, G. (2024). A socio-ecological approach to corporate governance. In *Handbook on corporate governance and corporate social responsibility* (pp. 359-370). Edward Elgar Publishing. https://doi.org/10.4337/9781802208771.00038

Bussu, S., Golan, Y., & Hargreaves, A. (2022). Understanding developments in participatory governance: A report on findings from a scoping review of the literature and expert interviews.

Cafer, A., Green, J., & Goreham, G. (2022). A community resilience framework for community development practitioners building equity and adaptive capacity. In *Community development for times of crisis* (pp. 56-74). Routledge.

Cantelmi, R., Di Gravio, G., & Patriarca, R. (2021). Reviewing qualitative research approaches in the context of critical infrastructure resilience. *Environment Systems and Decisions*, *41*(3), 341-376. https://doi.org/10.1007/s10669-020-09795-8

Choudhury, M. U. I., Haque, C. E., Nishat, A., & Byrne, S. (2021). Social learning for building community resilience to cyclones: role of indigenous and local knowledge, power, and institutions in coastal Bangladesh. *Ecology & Society*, *26*(1). https://doi.org/10.5751/ES-12107-260105

Habibi Rad, M., Mojtahedi, M., & Ostwald, M. J. (2021). Industry 4.0, disaster risk management and infrastructure resilience: a systematic review and bibliometric analysis. *Buildings*, *11*(9), 411. https://doi.org/10.3390/buildings11090411

Haldon, J., Binois-Roman, A., Eisenberg, M., Izdebski, A., Mordechai, L., Newfield, T., ... & Wnęk, K. (2021). Between resilience and adaptation: A historical framework for understanding stability and transformation of societies to shocks and stress. In *COVID-19: Systemic risk and resilience* (pp. 235-268). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-71587-8_14

Herhausen, D., Morgan, R. E., Brozović, D., & Volberda, H. W. (2021). Re-examining strategic flexibility: a meta-analysis of its antecedents, consequences and contingencies. *British Journal of Management*, *32*(2), 435-455.

Kasri, K., Hasani, M. C., Baso, A., Amiluddin, A., & Arief, A. A. (2024). Small-scale Fishermen's Adaptation to Climate Change Impacts in Coastal Areas and Small Islands in Pangkep Regency. *Torani Journal of Fisheries and Marine Science*, *8*(1), 63-82. https://doi.org/10.35911/torani.v8i1.42163

Koditschek, T. (2023). Human Social Evolution via Four Coevolutionary Paths. In *Evolutionary Thinking Across Disciplines: Problems and Perspectives in Generalized Darwinism* (pp. 227-284). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-33358-3_11

Kokou, K., Syampungani, S., Chirwa, P. W., & Makhubele, L. (2024). Socio-ecological Management of Multifunctional Landscapes. In *Trees in a Sub-Saharan Multi-functional Landscape: Research, Management, and Policy* (pp. 267-304). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-69812-5_12

Maurischa, S. D., Fahmi, F. Z., & Abi Suroso, D. S. (2023). Transformative resilience: Transformation, resilience and capacity of coastal communities in facing disasters in two Indonesian villages. *International Journal of Disaster Risk Reduction*, *88*, 103615. https://doi.org/10.1016/j.ijdrr.2023.103615

May, C. K. (2022). Complex adaptive governance systems: a framework to understand institutions, organizations, and people in socio-ecological systems. *Socio-ecological practice research*, *4*(1), 39-54. https://doi.org/10.1007/s42532-021-00101-7

Poddar, A. K. (2024). Climate Change and Migration: Developing Policies to Address the Growing Challenge of Climate-Induced Displacement. *International Journal of Climate Change: Impacts & Responses*, *16*(1). https://doi.org/10.18848/1835-7156/CGP/v16i01/149-170

Putra, A. K., Wiksono, H., & Sumarmi, S. (2021). Community-Based Mangroves Forest Management: Socio-Ecological Recovery Movement for Coastal Areas of Pasuruan-Indonesia. *Sustainability: Theory, Practice and Policy*, *1*(1), 1-15.

Resolute, P. (2024). Applying cultural perspective in Indonesia municipal solid waste management process towards a grounded climate concept and action: A mini-review of opportunities and challenges. *Waste Management & Research*, *42*(10), 873-881. https://doi.org/10.1177/0734242X241262711

Rezvani, S. M., Falcão, M. J., Komljenovic, D., & de Almeida, N. M. (2023). A systematic literature review on urban resilience enabled with asset and disaster risk management approaches and GIS-based decision support tools. *Applied Sciences*, *13*(4), 2223. https://doi.org/10.3390/app13042223

Sen, S., Savitskie, K., Mahto, R. V., Kumar, S., & Khanin, D. (2023). Strategic flexibility in small firms. *Journal of Strategic Marketing*, *31*(5), 1053-1070. https://doi.org/10.1080/0965254X.2022.2036223

Shantiko, B., Liswanti, N., Bourgeois, R., & Laumonier, Y. (2021). Land-use decisions in complex commons: Engaging multiple stakeholders through foresight and scenario building in Indonesia. *Environmental Management*, *68*(5), 642-664. https://doi.org/10.1007/s00267-021-01470-1

Supriatna, J., & Lenz, R. (2022). *Sustainable environmental management: lessons from Indonesia*. Yayasan Pustaka Obor Indonesia.

Vivier, E., & Sanchez-Betancourt, D. (2023). Participatory governance and the capacity to engage: A systems lens. *Public Administration and Development*, *43*(3), 220-231. https://doi.org/10.1002/pad.2012

Widayati, A., Louman, B., Mulyoutami, E., Purwanto, E., Kusters, K., & Zagt, R. (2021). Communities' adaptation and vulnerability to climate change: Implications for achieving a climate-smart landscape. *Land*, *10*(8), 816. https://doi.org/10.3390/land10080816

Wilkinson, E., Kirbyshire, A., Mayhew, L., Batra, P., & Milan, A. (2022). *Climate-induced migration and displacement: closing the policy gap*. ODI. https://doi.org/10.3390/cli13040081

Wurarah, R. N. (2024). Indonesia's economic and environmental resilience in the face of climate change: Analysis and implementation strategies. *Calamity: A Journal of Disaster Technology and Engineering*, *2*(1), 1-16. https://doi.org/10.61511/calamity.v2i1.2024.940