

## Adaptive Governance as Strategic Management: Integrating Local Knowledge, Institutional Flexibility, and Social Capital in Socio-Ecological Resilience

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### ARTICLE INFO

**Received:** 14 August 2024  
**Revised:** 17 October 2024  
**Accepted:** 04 December 2024  
**Available online:** 12 December 2024

**Keywords:**  
Socio-Ecological Systems  
Institutional Flexibility  
Knowledge Integration

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### 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.

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 (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.

## **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.

Table 1. Institutional Flexibility and Adaptive Governance Indicators in South Sulawesi

Dimension	Indicator	Empirical Evidence (Field Findings)	Supporting Secondary Data (Indonesia Context)	Implication for Adaptive Governance
Decentralized Decision-Making	Local committees and community forums	Monthly community meetings in Makassar to evaluate environmental actions	Village Law No. 6/2014 promotes local autonomy and participatory governance	Enhances responsiveness and context-based decision-making
Institutional Integration	Collaboration between adat and formal governance	Adat leaders and village government jointly regulate mangrove use in Barru	BPS (2023): >60% rural communities still rely on customary institutions	Strengthens legitimacy and compliance through cultural alignment
Policy Flexibility	Local rule adjustments based on ecological changes	Communities revise fishing and planting rules based on environmental signals	Indonesia Climate Risk Index (BMKG, 2022) shows increasing climate variability	Enables rapid adaptation to environmental uncertainty
Multi-Actor Collaboration	NGO–community–government partnerships	Mangrove restoration programs involving NGOs and women's groups	KLHK (2023): Community-based restoration improves success rates by ~30–40%	Facilitates knowledge exchange and resource mobilization

Administrative Constraints	Delays in funding and bureaucratic rigidity	Delayed village budgets affecting adaptation timing in Makassar	World Bank (2022): Bureaucratic delays remain key barrier in local governance	Limits effectiveness of adaptive initiatives
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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. Instead, we hold discussions with the village head and adat leaders. Together, we decide what is best for our coastal resources and fishermen. When environmental changes occur, such as tides shifting or fish declining, we immediately review and adjust our local regulations. This allows us to respond quickly without relying on higher authorities. It also ensures that decisions reflect both local knowledge and shared agreement. Through this process, we feel more responsible for protecting our environment.”* (Community members-Participant P3, Barru Regency, 2024)

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 for solving problems. Every month, we gather as a community to evaluate ongoing issues. We openly discuss what has worked well and what needs improvement. Sometimes, youth groups propose new ideas, especially for drainage solutions. We test these ideas ourselves before requesting external funding. This approach helps us learn directly from our own experiences. It also increases participation and builds a sense of shared responsibility. In this way, we become more prepared to face recurring environmental challenges.”* (Community members- Participant P7, Makassar City, 2024)

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. 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:

*“In our community, adat leaders play an important role in decision-making. We work together with village authorities to regulate natural resources. Cultural values guide us in maintaining balance with the environment. When problems arise, we prioritize dialogue and collective agreement. This approach ensures that decisions are respected by all members. It also strengthens social cohesion within the community. We believe that*

*tradition and governance should support each other. That is how we sustain both our culture and our environment.”* (Traditional/religious leaders-Participant P18, Barru Regency, 2024)

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. 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.

Table 2. Social Capital, Collective Action, and Knowledge Integration

Dimension	Indicator	Empirical Evidence (Field Findings)	Supporting Data (Indonesia Context)	Governance Outcome
Bonding Social Capital	Community solidarity (gotong royong)	Collective mangrove planting and flood response activities	BPS Social Capital Index (2022): High rural cohesion in Sulawesi (>70%)	Rapid mobilization and mutual support
Trust and Reciprocity	Trust in local leaders and institutions	High participation in community-led environmental programs	LIPI Survey (2021): Trust increases participation by up to 45%	Enhances governance legitimacy
Collective Action	Regular community meetings and task forces	Weekly environmental discussions and local task groups	UNDP (2022): Community participation improves adaptation success	Strengthens proactive adaptation capacity
Bridging Social Capital	Collaboration with NGOs and external actors	Fisher groups working with NGOs in Makassar	World Bank (2021): Multi-stakeholder collaboration increases resilience outcomes	Expands access to knowledge and resources
Knowledge Integration	Local ecological knowledge + scientific input	Farmers adjust cropping patterns with facilitators	FAO (2022): Integration of local knowledge improves agricultural resilience by ~20–30%	Produces context-sensitive solutions

Social Learning	Learning through experimentation	Trial-and-error drainage and waste systems in Makassar	OECD (2021): Learning-based governance improves policy effectiveness	Supports continuous adaptation
Knowledge Barriers	Inequality in participation and access	Women and youth excluded in some decision-making processes	UN Women (2022): Gender gaps reduce governance effectiveness	Limits inclusivity and long-term sustainability

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 environmental problems affect all of us. When tidal flooding damages the road, we do not wait for government assistance. Instead, community members, especially men and youth, gather immediately. We work together to repair infrastructure and clean affected areas. This cooperation is part of our tradition of gotong royong. It strengthens our sense of shared responsibility. Through collective action, problems become easier to manage. It also keeps our community united in facing environmental challenges.”* (Community members-Participant P2, Barru Regency, 2024)

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. 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.”* (Farmer-Participant P16, Enrekang, 2024)

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. 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.”* (Community members – Participant P21, Barru, 2024)

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. 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. 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. 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.

### **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 observing natural signs such as cloud patterns and wave sounds. This knowledge has been passed down from our grandparents and continues to guide our daily activities as fishers. Even with modern technology, we still rely on these traditional indicators because they are closely tied to our environment. It helps us prepare for changes and avoid risks at sea. We also share this knowledge with younger generations so they can understand the environment better. Without this knowledge, it would be difficult for us to adapt to changing conditions.”*  
(Community members-Participant P4, Barru Regency, 2024)

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 rely only on instructions from the office when working with farmers. Instead, we sit together with them and listen to their experiences and observations. Through these discussions, we decide collectively which farming methods are most suitable for current conditions. Sometimes we test new cropping patterns based on both scientific recommendations and local practices. This collaborative approach allows us to learn from each other and reduce the risk of failure. It also builds trust between farmers and government officers in managing environmental changes.”* (Local government officials-Participant P9, Enrekang Regency, 2024)

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, especially when facing problems like drainage failure in our area. After the first attempt did not work, we discussed together what went wrong and tried a different solution the following month. Through this process, we gradually improved our understanding of waste management and flood prevention. Now, we are able to teach new residents how to build simple systems to prevent blockages. This kind of learning is continuous and based on shared experience. It helps us become more prepared and independent as a community.”* (Community members-Participant P13, Makassar City, 2024)

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 information is difficult for local communities to understand directly. Our role is to translate these concepts into simple language and connect them with everyday experiences. We use examples from local contexts so that people can apply the knowledge in practical ways. This approach helps bridge the gap between scientific knowledge and local understanding. It also encourages communities to trust and use the information provided. By doing this, we support more effective collaboration between communities and institutions.”* (NGO representatives-Participant P17, Barru Regency, 2024)

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 digital tools such as WhatsApp groups to share information about environmental risks like floods and blocked drainage. This allows us to quickly inform residents, especially during heavy rainfall. Young people are usually responsible for managing these communication platforms. It helps the community respond faster and prepare in advance. At the same time, we combine this with traditional communication methods to reach everyone. This integration of technology and local practices strengthens our collective preparedness.”* (Community members-Participant P22, Makassar City, 2024)

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.

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.

## **Discussion**

### ***Institutional Flexibility and Adaptive Governance in Practice***

The findings demonstrate that institutional flexibility constitutes a foundational element of adaptive governance in socio-ecological systems (McKay et al., 2020; Akther & Evans, 2024). In the context of South Sulawesi, governance structures that allow iterative decision-making and contextual adjustment are more capable of responding to environmental variability. This reflects the interpretivist orientation of the study, where governance is understood not as a fixed system but as a socially constructed process shaped by interactions, meanings, and lived experiences. Institutional flexibility emerges as a dynamic capacity that enables communities and local authorities to navigate uncertainty through continuous adaptation. Empirical evidence from the case study sites reveals that flexibility is embedded in both formal and informal institutional arrangements. Ahmad et al. (2023) said that, the coexistence of administrative governance and customary systems demonstrates how multiple layers of authority interact to produce adaptive outcomes. This hybridity enables decision-making processes that are culturally legitimate while remaining responsive to ecological changes. Such arrangements highlight that adaptive governance is not dependent on institutional uniformity but rather on the ability to integrate diverse governance logics into a coherent system of action.

Decentralized decision-making plays a critical role in operationalizing institutional flexibility. Local committees, community groups, and informal networks function as decision-making units that are closely connected to environmental realities (Zurba et al., 2020; Parikh et al., 2020). This proximity allows actors to interpret ecological signals and respond without delays associated with hierarchical bureaucracies. The findings suggest that adaptive capacity increases when authority is distributed across multiple actors who possess contextual knowledge and practical experience. The study also indicates that institutional flexibility enhances innovation through experimentation and iterative learning. Communities frequently engage in trial-and-error approaches to address environmental challenges, adjusting strategies based on feedback and outcomes (Hukkinen et al., 2022). This process aligns with adaptive management principles, where learning is embedded within action. The ability to experiment without rigid constraints fosters locally relevant solutions that are more sustainable over time.

At the same time, the findings reveal tensions between adaptive local practices and rigid administrative procedures. Bureaucratic delays, funding constraints, and fragmented coordination across governance levels often limit the effectiveness of local initiatives. This mismatch between institutional tempos highlights the need for alignment between formal governance systems and community-based adaptive practices. Without such alignment, the potential of adaptive governance remains constrained by structural barriers. Institutional flexibility, therefore, should be understood as both a structural and relational phenomenon (Aksom, 2022). It involves not only the capacity to modify rules and procedures but also the ability to foster dialogue, trust, and collaboration among actors. This dual dimension reinforces the idea that adaptive governance requires a shift from rule-based control toward process-oriented management that prioritizes responsiveness, inclusivity, and continuous learning.

### ***Social Capital and Collective Action as Drivers of Resilience***

The findings underscore that social capital is a central mechanism through which adaptive governance is enacted at the community level (Dressel et al., 2020; Bullock et al., 2022). Trust, reciprocity, and shared norms form the social infrastructure that enables collective action in the face of environmental uncertainty. In South Sulawesi, these relational dynamics are deeply embedded in cultural values, shaping how communities organize and respond to ecological challenges. Social capital thus operates as both a resource and a process that strengthens resilience. The presence of strong bonding social capital facilitates rapid mobilization and mutual assistance within communities. Close-knit relationships allow individuals to coordinate actions efficiently, particularly during environmental disturbances such as flooding or landslides (Chatterjee & Adhikari, 2024). This internal cohesion reduces reliance on external intervention and enhances the capacity for self-

organization. The findings suggest that communities with strong internal ties are better equipped to absorb shocks and reorganize collectively.

Bridging social capital further expands the adaptive capacity of communities by connecting them to external actors and resources. Turin et al. (2022) said that, partnerships with non-governmental organizations, local authorities, and other communities enable the exchange of knowledge, skills, and material support. These connections create opportunities for innovation and broaden the scope of adaptive strategies. The interplay between bonding and bridging capital illustrates the multi-layered nature of social resilience. Collective action emerges as an expression of social capital in practice. Community-based initiatives such as environmental monitoring, resource management, and disaster response demonstrate how shared responsibility is translated into coordinated efforts (Maat et al., 2021; Imperiale & Vanclay, 2024; Walker et al., 2023). Participation in these activities is often driven by moral obligations and intergenerational considerations, reflecting a long-term orientation toward sustainability. Collective action, therefore, is not merely reactive but also anticipatory in nature.

The study also reveals that social capital contributes to governance legitimacy. Trust in local leaders and institutions increases compliance with collectively agreed rules and enhances participation in decision-making processes. When governance is perceived as fair and inclusive, communities are more willing to engage in adaptive practices. Legitimacy thus becomes a key factor linking social relationships to governance effectiveness. Despite its strengths, social capital is not uniformly distributed. Power relations, gender dynamics, and generational hierarchies can influence participation and access to decision-making spaces. These inequalities highlight the need for inclusive governance approaches that ensure broader representation. Strengthening social capital requires deliberate efforts to bridge social divides and create opportunities for marginalized groups to contribute to adaptive processes.

### ***Knowledge Integration and Learning Systems in Adaptive Governance***

The findings indicate that knowledge integration is a critical component of adaptive governance, enabling communities to respond effectively to complex environmental changes. The combination of local ecological knowledge and scientific knowledge creates a more comprehensive understanding of socio-ecological systems (Das et al., 2022; Rounsevell et al., 2021; Chapman & Schott, 2020; Núñez-Regueiro et al., 2020). This integration reflects the interpretive nature of the research, where knowledge is co-constructed through interaction and shared experience rather than imposed from a single source. Local ecological knowledge plays a vital role in informing adaptive practices. Communities possess detailed, experience-based understanding of environmental patterns that guide decision-making. This knowledge is continuously refined through observation and interaction with the environment, making it highly relevant for local adaptation. The study demonstrates that such knowledge remains indispensable even in the presence of modern scientific information.

The interaction between local and scientific knowledge systems occurs through participatory processes that facilitate dialogue and mutual learning. Workshops, community meetings, and collaborative initiatives create spaces where different perspectives can be shared and negotiated. These interactions enable the translation of abstract scientific concepts into practical applications that align with local realities. Knowledge integration, therefore, is both a cognitive and social process. Learning systems emerge from these interactions as communities engage in cycles of experimentation, reflection, and adaptation. According to Padthar et al. (2024) and Nordin et al. (2022), the findings highlight that learning is embedded in everyday practices, from agricultural adjustments to waste management innovations. This continuous learning process enhances the capacity of communities to adapt over time, transforming past experiences into future strategies.

Knowledge brokers play an important role in facilitating integration and learning. Individuals and organizations that bridge different knowledge systems help translate information and build understanding across diverse actors (Latour & van, 2024). Their presence ensures that knowledge flows effectively between communities and formal institutions, reducing gaps in communication and interpretation. Barriers to knowledge integration remain evident, particularly in relation to unequal access to information and limited institutional support. Distrust toward external knowledge sources can also hinder collaboration when interventions are perceived as disconnected from local contexts.

Strengthening adaptive governance requires addressing these barriers by fostering mutual respect, improving access to education, and supporting inclusive knowledge-sharing platforms.

## 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.

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