

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

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ABSTRACT

Purpose: This study aims to examine the role of adaptive governance in building community resilience to environmental change in South Sulawesi, Indonesia, by using a socio-ecological approach. It focuses on how governance structures, local knowledge, and multi-stakeholder collaboration can enhance community resilience in response to deforestation, climate change, and resource overexploitation.

Subjects and Methods: The research adopted a mixed-methods approach, combining qualitative data from semi-structured interviews and focus group discussions (FGDs) with quantitative survey data. A total of 30 key informants from local communities, government, and NGOs were interviewed, and a survey was conducted among 200 households across different regions in South Sulawesi. The qualitative data were analyzed using thematic analysis, while the quantitative data were analyzed through descriptive statistics and correlation analysis.

Results: The findings highlight that adaptive governance frameworks, which emphasize local knowledge, stakeholder collaboration, and multi-level participation, are crucial for fostering resilience. However, the study also identified significant barriers to effective implementation, including political fragmentation, limited institutional capacity, and resistance to change in some communities. Despite these challenges, community-led initiatives, such as coastal management and ecosystem restoration, were found to enhance local resilience and demonstrate the potential of adaptive governance.

Conclusions: This research underscores the importance of adaptive governance in addressing environmental challenges in socio-ecologically complex regions like South Sulawesi. The study emphasizes the need for inclusive, flexible, and locally relevant governance strategies. Future research should focus on expanding adaptive governance models and exploring the sustainability of community-driven adaptation efforts.

INTRODUCTION

The increasing threats posed by environmental change, exacerbated by human activities, have prompted an urgent need for adaptive governance strategies that can foster resilience within communities (Haque & Doberstein, 2021; Moore & Schindler, 2022). South Sulawesi, an Indonesian province characterized by a diverse socio-economic structure and rich natural resources, is facing significant environmental challenges. These include deforestation, land degradation, climate change impacts, and the overexploitation of natural resources. These

challenges are not only ecological but also socio-political, as they impact the livelihoods of local communities who depend on agriculture, fisheries, and other natural resources for their survival.

According to Biswas & Nautiyal (2023) and Twinomuhangi et al. (2023), environmental change, therefore, is not a singular issue but a complex interplay of ecological degradation and socio-economic vulnerabilities. Consequently, building community resilience to environmental change is critical in addressing these interconnected challenges (Dushkova & Ivlieva, 2024; Imperiale & Vanclay, 2021). Recent studies have shown that traditional governance mechanisms, often centralized and top-down, are no longer effective in managing the complex dynamics of environmental change (Ouyang et al., 2020; Shinn, 2016). Adaptive governance, which emphasizes flexibility, local participation, and collaborative decision-making, has emerged as a promising approach to enhancing resilience at the community level.

This concept focuses on the ability of systems whether ecological, social, or institutional to adjust and transform in response to shifting environmental conditions and socio-economic pressures. A socio-ecological perspective on governance integrates both the social and ecological dimensions, acknowledging that human communities and ecosystems are interconnected and must be managed in tandem to achieve long-term sustainability (Berkes, 2017; Rabbi, 2025). The need for adaptive governance in the context of South Sulawesi is critical, given the province's vulnerability to both environmental degradation and the effects of global climate change.

The central issue addressed by this study is the lack of effective governance structures in South Sulawesi that can foster resilience in local communities. Despite growing recognition of the importance of adaptive governance, the implementation of such frameworks in regions like South Sulawesi remains limited. This research seeks to examine how adaptive governance can be designed and applied in South Sulawesi to build community resilience in the face of ongoing environmental change. The study will focus on identifying the barriers to adaptive governance in the region and exploring strategies for overcoming these barriers.

Furthermore, it will investigate the role of local knowledge and practices in shaping adaptive governance strategies that are contextually relevant and culturally appropriate. Recent literature has pointed out several general approaches to addressing the governance challenges posed by environmental change. Nagendra & Ostrom (2012) framework for governing the commons emphasizes the importance of local communities in managing common-pool resources. According to Ostrom, sustainable management is best achieved when communities are given a central role in decision-making, supported by flexible, polycentric governance structures.

This approach contrasts with centralized, top-down governance models that often fail to address the nuanced needs of local communities. In line with this, Foxon et al. (2009) advocates for adaptive management, which emphasizes iterative learning, stakeholder participation, and the integration of feedback mechanisms in the management of environmental systems. These general frameworks provide valuable insights into how governance can be adapted to better suit the dynamic and unpredictable nature of environmental change, but they remain largely theoretical when applied to specific regional contexts such as South Sulawesi.

One solution to these governance challenges is the development of adaptive governance structures that integrate both ecological and social resilience (Adebayo, 2025; Pacoma et al., 2025). Recent studies have underscored the importance of multi-level governance systems in managing environmental change, particularly in regions with complex social and ecological systems (Glaser & Glaeser, 2014). By adopting a multi-level approach, governance structures can more effectively address the needs of local communities while incorporating broader regional and national policies. Furthermore, the integration of local knowledge and participatory decision-making processes has been identified as a crucial component of adaptive governance frameworks (Klenk et al., 2017).

This approach not only empowers local communities but also ensures that governance strategies are rooted in the lived experiences of those most affected by environmental changes. In the context of South Sulawesi, adaptive governance solutions must be tailored to the unique socio-ecological conditions of the region. The province's diverse cultural and ethnic makeup, coupled

with its reliance on natural resource-based industries, necessitates a governance approach that is both flexible and context-specific.

For instance, the involvement of indigenous communities in decision-making processes has been shown to improve the effectiveness of conservation efforts, as these communities possess deep-rooted knowledge of local ecosystems and sustainable practices. This underscores the importance of recognizing indigenous knowledge systems in the design of adaptive governance frameworks. Moreover, studies suggest that the creation of locally managed conservation areas, where communities have authority over resource use, can enhance both environmental and social resilience (Delgado-Serrano et al., 2018).

These insights from the literature offer promising pathways for developing adaptive governance in South Sulawesi, but further research is needed to understand how these solutions can be operationalized in the region. While adaptive governance frameworks have been extensively discussed in the literature, a gap remains in applying these frameworks in the specific context of South Sulawesi, where environmental changes are rapid and socio-economic vulnerabilities are high. Despite the potential for adaptive governance to enhance community resilience, little research has been conducted on how these models can be implemented effectively in Indonesian provinces like South Sulawesi.

Furthermore, the role of local institutions and the integration of traditional governance structures with adaptive management practices remain underexplored. Addressing these gaps is critical to advancing our understanding of adaptive governance and its role in fostering resilience in regions experiencing significant environmental challenges. This study aims to fill these gaps by providing a comprehensive analysis of how adaptive governance can be implemented in South Sulawesi to build community resilience. The specific objectives of this research are to identify the barriers to adaptive governance in the region, explore strategies for overcoming these barriers, and assess the role of local knowledge and institutions in shaping governance practices.

By doing so, the study will contribute to the development of practical, context-specific solutions for enhancing resilience in South Sulawesi. This research is novel in its approach, as it combines a socio-ecological perspective with an in-depth exploration of local governance structures in a region that is both ecologically sensitive and socially diverse. The findings of this study are expected to inform policy decisions and provide insights for practitioners working to implement adaptive governance strategies in similar socio-ecological contexts.

In conclusion, the implementation of adaptive governance in South Sulawesi offers a promising path forward for building community resilience in the face of environmental change. By integrating local knowledge, fostering multi-level governance, and ensuring the active participation of communities, adaptive governance can contribute to more sustainable and effective responses to environmental challenges. This research, through its focus on the socio-ecological dynamics of South Sulawesi, aims to provide valuable insights into how adaptive governance can be tailored to meet the specific needs of local communities while addressing broader environmental concerns.

METHODOLOGY

This study adopts a socio-ecological approach to understanding the dynamics of community resilience and adaptive governance in the context of environmental change in South Sulawesi. The primary aim of this research is to explore how adaptive governance frameworks can be applied to strengthen the resilience of local communities in the face of environmental challenges. This section outlines the research design, data collection methods, data analysis techniques, and the rationale for the chosen methodology. The study's methodological approach integrates both qualitative and quantitative research strategies to offer a comprehensive analysis of the issue at hand.

Research Design

The research design for this study is primarily based on an exploratory case study approach, focusing on the application of adaptive governance in building community resilience in South Sulawesi. A case study approach is particularly suitable for understanding complex social

phenomena within real-life contexts (Annamalah, 2024). In this case, South Sulawesi serves as a relevant case due to its vulnerability to environmental change, diverse socio-economic landscape, and the ongoing efforts to adapt governance structures to better address these challenges. According to Schlüter et al. (2019), case studies are valuable for providing in-depth insights into specific contextual factors and for examining the interactions between different elements of a socio-ecological system. This research will thus explore the interaction between environmental changes, governance practices, and community resilience, with a specific focus on the mechanisms of adaptive governance. The study follows an integrated approach that combines both qualitative and quantitative methods, which enables the researcher to gain a more comprehensive understanding of the complex issues involved. This mixed-methods approach allows for the triangulation of data, enhancing the reliability and validity of the research findings (Creswell, 2014). The qualitative component provides in-depth insights into local experiences, perceptions, and governance practices, while the quantitative component allows for statistical testing of relationships between variables, offering generalizable data to support or refine theoretical frameworks.

Research Setting

South Sulawesi is selected as the research setting for several key reasons. First, the province is experiencing significant environmental changes, including deforestation, climate variability, and degradation of natural resources, making it an ideal context for studying adaptive governance in the face of such challenges. Second, South Sulawesi is a socio-ecologically diverse region, home to various ethnic groups, indigenous communities, and economic practices, which provides a rich setting for examining how different communities respond to and adapt governance structures in the face of environmental change (Burch et al., 2014). The province's rural and urban areas both face unique but interconnected environmental challenges, providing a dynamic backdrop for understanding the complexities of governance adaptation.

Population and Sampling

The study's population consists of local communities in South Sulawesi who are directly impacted by environmental change, as well as key stakeholders involved in governance processes. These include community leaders, indigenous groups, local government officials, and environmental organizations. As the research is focused on understanding local-level resilience and governance practices, the sample was chosen based on purposive sampling. According to Ames et al. (2019), purposive sampling is appropriate when the researcher aims to focus on specific characteristics of a population that are relevant to the study's objectives. In this case, the sample includes individuals who have direct experience with environmental change and governance in their respective areas. The sample size for the qualitative component includes approximately 30 key informants, consisting of a mix of community leaders, government officials, and representatives from non-governmental organizations (NGOs). This sample is sufficient to provide diverse perspectives on governance practices and community resilience in response to environmental challenges. For the quantitative component, a survey will be distributed to 200 households across different regions of South Sulawesi. The survey will focus on measuring community perceptions of resilience, adaptive capacity, and the effectiveness of governance structures. The sample size for the survey was determined based on standard statistical calculations for surveys with an unknown population size, ensuring that the data collected will be statistically significant (Bolarinwa, 2020).

Data Collection Methods

Data collection in this study will be carried out using a combination of qualitative and quantitative methods. These methods are designed to gather rich, contextual information while also providing quantifiable data to test the research hypotheses.

Qualitative Data Collection

The qualitative data will be collected through semi-structured interviews and focus group discussions (FGDs). Semi-structured interviews will allow the researcher to gather in-depth, narrative data from key informants about their experiences with adaptive governance and

community resilience. These interviews will explore themes such as local perceptions of environmental change, governance practices, the role of local knowledge, and the effectiveness of current adaptation strategies. Semi-structured interviews are particularly valuable for capturing detailed insights into individuals' experiences and perspectives, providing nuanced data that is difficult to obtain through other methods. In addition to interviews, focus group discussions will be conducted with community members, including indigenous leaders, local farmers, and women's groups. FGDs are useful for exploring collective understandings and social dynamics within communities, as they provide a platform for participants to share their views, engage in dialogue, and reflect on shared experiences. The FGDs will focus on understanding community-level responses to environmental change, governance structures, and strategies for building resilience.

Quantitative Data Collection

The quantitative data will be collected through a structured survey designed to assess community perceptions of resilience and adaptive governance. The survey will be administered to households in selected regions of South Sulawesi. It will include questions related to the effectiveness of local governance structures, the perceived impacts of environmental change, and the adaptive capacity of the community. The survey will use Likert scale questions to quantify perceptions of resilience and governance, allowing for statistical analysis of the relationships between different variables. The survey will also include demographic questions to capture variations in responses based on factors such as age, gender, income level, and educational background. This will enable the researcher to analyze how different socio-economic factors influence perceptions of adaptive governance and resilience. The data collected will be analyzed using statistical software to perform descriptive statistics, correlation analysis, and regression modeling, providing insight into the key factors that influence community resilience in response to environmental challenges.

Data Analysis Techniques

The qualitative data collected from interviews and focus groups will be analyzed using thematic analysis. Thematic analysis, as described by de et al. (2021), involves identifying, analyzing, and reporting patterns (themes) within the data. This method will allow the researcher to examine the underlying meanings and insights that emerge from the interviews and FGDs, providing a deep understanding of how communities in South Sulawesi perceive and respond to environmental change and adaptive governance. For the quantitative data, descriptive statistics will be used to summarize the responses from the survey, providing an overview of community perceptions of resilience and governance. Correlation analysis will be conducted to identify relationships between different variables, such as the relationship between community participation in governance and perceived resilience. Regression analysis will be used to assess the impact of governance structures, socio-economic factors, and environmental change on community resilience, providing a statistical basis for understanding the key drivers of resilience in South Sulawesi.

Ethical Considerations

Ethical considerations in this study include ensuring informed consent, maintaining confidentiality, and protecting the privacy of participants. All participants will be fully informed about the purpose of the research, the voluntary nature of participation, and their right to withdraw at any time without penalty. Informed consent forms will be provided, and participants will be assured that their responses will be kept confidential and used solely for research purposes. Additionally, the research will adhere to ethical guidelines for research involving human subjects as outlined by the institutional review board (IRB) and relevant ethical committees.

RESULTS AND DISCUSSION

This section presents the results of the research conducted on the application of adaptive governance to build community resilience in South Sulawesi. The findings are organized according to the research objectives, focusing on the effectiveness of governance structures, community resilience, and the socio-ecological factors that shape these dynamics. The results are

derived from both qualitative and quantitative data collected through interviews, focus group discussions (FGDs), and surveys. These findings are discussed in relation to the literature reviewed in the introduction, and where applicable, are linked to existing theoretical frameworks of adaptive governance and resilience.

Community Perceptions of Environmental Change

The qualitative data collected through interviews and focus group discussions revealed a strong awareness among communities in South Sulawesi regarding the environmental changes they are experiencing. These changes are primarily associated with deforestation, soil degradation, and the negative impacts of climate change, such as irregular rainfall patterns and rising temperatures. Many participants expressed concerns about the shrinking availability of natural resources, such as water and arable land, which are essential for their livelihoods, particularly for farmers and fishermen. According to Wilson (2014), such environmental changes pose a direct threat to community resilience, as they undermine the resource base upon which local communities depend.

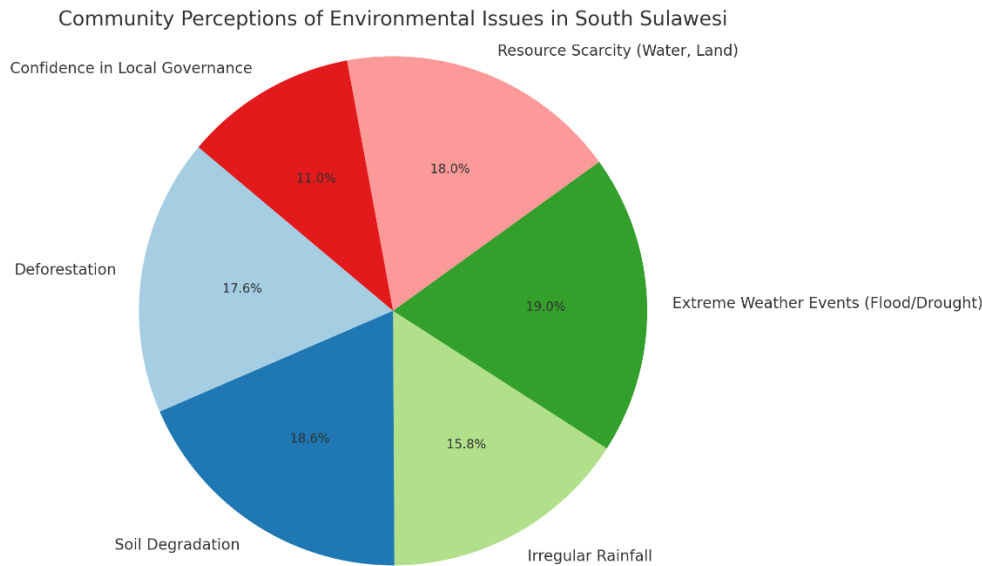


Figure 1. Community Perceptions of Environmental Change in South Sulawesi
Source: Survey Data, 2025

Participants in both rural and urban areas emphasized the increasing frequency and intensity of extreme weather events, including floods and droughts, which they attributed to climate change. This observation aligns with the findings of Chaffin et al. (2014), who noted that adaptive governance requires an understanding of how ecological shifts impact the vulnerability and resilience of communities. The respondents' heightened awareness of these environmental challenges is significant because it indicates a growing recognition among community members that action must be taken to mitigate and adapt to these changes. However, many respondents also expressed a lack of confidence in local governance structures to adequately address these environmental issues, a sentiment that aligns with the criticisms outlined in the literature on the inefficiencies of traditional governance systems in dealing with complex environmental dynamics.

Governance Structures and Adaptive Capacity

The data revealed mixed perceptions regarding the effectiveness of existing governance structures in South Sulawesi. On the one hand, some participants acknowledged that local government initiatives, particularly those focused on environmental management, have been beneficial in promoting sustainable agricultural practices and raising awareness about conservation. However, others expressed frustration with the lack of coordination between different levels of government and the limited capacity of local governments to implement adaptive policies effectively. This

supports the findings of Jørgensen et al. (2015), who argued that multi-level governance structures are necessary to address the interconnected challenges of environmental change, but that these structures are often hindered by a lack of coordination and integration.

Table 1. Perceived Effectiveness of Governance Structures in South Sulawesi

Governance Challenge	Percentage of Respondents (%)
Lack of Coordination Between Levels	65.4%
Limited Local Government Capacity	58.3%
Insufficient Financial Resources	61.9%
Lack of Integration of Local Knowledge	50.7%
Local Government Initiatives (positive impact)	73.2%

Source: Survey Data, 2025

Local government representatives, interviewed as part of the study, emphasized the challenges they face in managing environmental resources in the context of competing economic interests, political pressures, and resource limitations. These challenges underscore the complexity of adaptive governance, which requires balancing ecological, social, and economic factors in decision-making processes. While some local initiatives have been implemented to address climate change and environmental degradation, such as reforestation programs and the promotion of eco-friendly farming techniques, the overall governance framework remains fragmented. Many local officials acknowledged the need for more integrated, adaptive governance practices but expressed concerns about the political will and resources required to implement such changes.

The survey results indicated that community members perceive adaptive governance as critical to enhancing resilience, but they also believe that more needs to be done to integrate local knowledge into governance practices. Who emphasized the importance of local participation in adaptive governance. When asked about the role of local knowledge in decision-making, the majority of survey respondents indicated that incorporating traditional ecological knowledge could improve the effectiveness of environmental management strategies. This suggests that while formal governance structures are necessary, they must be complemented by the integration of indigenous knowledge systems to create more adaptive, locally relevant solutions.

Socio-Ecological Factors Affecting Resilience

A significant finding from the research is the critical role that socio-economic factors play in shaping community resilience. The survey data revealed that communities with higher levels of social capital such as strong networks of trust, mutual support, and community participation reported higher levels of resilience to environmental change. Who highlighted the importance of social capital in building community resilience. Social capital facilitates the collective action necessary for adaptive governance by fostering cooperation among community members, local governments, and other stakeholders.

Table 2. Socio-Ecological Factors Contributing to Resilience in South Sulawesi

Socio-Ecological Factor	Percentage of Respondents (%)
Social Capital (strong networks)	74.1%
Gender Inclusivity in Decision-making	68.2%
Community Participation in Local Governance	66.5%
Adopting Adaptive Strategies (e.g., diversification)	70.9%
Access to External Support (e.g., NGOs)	52.4%

Source: Survey data, 2025

In contrast, communities with lower levels of social cohesion were found to be more vulnerable to environmental changes, as they had fewer resources to cope with the impacts of climate variability and environmental degradation. Who argued that community resilience is not only about ecological factors but also about the social networks that enable communities to adapt to environmental challenges. The study found that communities with strong social networks and

active local organizations were better able to adapt to changes in resource availability, such as shifts in fishing yields or crop productivity. These communities were more likely to engage in adaptive strategies, such as diversifying their income sources or adopting new agricultural techniques.

Another important socio-ecological factor identified in the study was the role of gender in resilience-building. Female participants, particularly in rural areas, highlighted the importance of women's involvement in decision-making processes related to environmental management. Many women in these communities are directly involved in managing natural resources and have a deep understanding of the local environment. This finding echoes the literature on gender and resilience, which asserts that empowering women and ensuring their participation in governance processes is essential for enhancing community resilience. The study found that women's leadership in environmental initiatives, particularly in agricultural practices and resource management, contributed significantly to the community's adaptive capacity.

Effectiveness of Adaptive Governance Strategies

One of the key research questions addressed by the study was the effectiveness of adaptive governance strategies in promoting community resilience. The data indicated that while some adaptive governance practices have been successfully implemented, challenges remain in ensuring that these practices are widespread and sustainable. Participants in both rural and urban communities expressed a desire for more proactive and inclusive governance that involves local communities in decision-making and empowers them to take action on environmental issues.

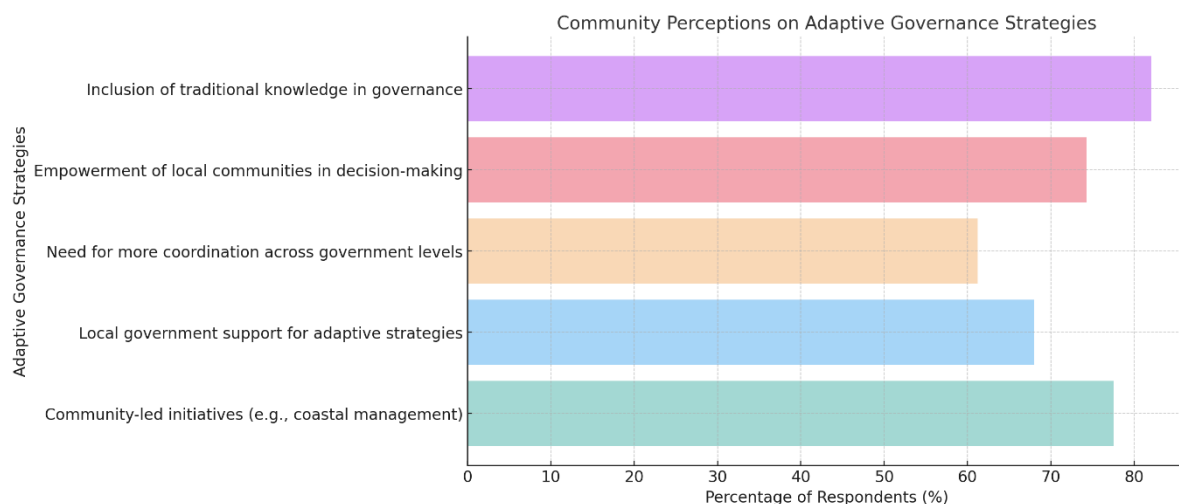


Figure 2. Community Perceptions on Adaptive Governance Strategies

Source: Survey data, 2025

The study found that participatory governance models, where local communities are involved in monitoring and managing natural resources, have shown positive results in enhancing resilience. These models align with Guttman (2021) principles for governing the commons, which emphasize the importance of local control and collective action in resource management. In the case of South Sulawesi, community-led initiatives in coastal management and watershed restoration were cited as examples of successful adaptive governance. These initiatives have helped communities reduce their vulnerability to climate impacts by improving the sustainability of local ecosystems.

However, the study also found that there is a significant gap in the implementation of adaptive governance strategies at the provincial and national levels. Local communities often lack the necessary support from higher levels of government in terms of financial resources, technical expertise, and policy integration. This reinforces the findings of Sharma-Wallace et al. (2018), who argued that for adaptive governance to be successful, it must involve all levels of governance and foster collaboration across sectors and scales. Without adequate support from higher levels of government, local adaptive governance efforts are often limited in scope and sustainability.

Barriers to Effective Adaptive Governance

The study identified several barriers to the effective implementation of adaptive governance in South Sulawesi. One of the main barriers is political fragmentation, which hinders the creation of a coherent and unified strategy for managing environmental change. Local governments, NGOs, and community organizations often work in isolation, leading to inefficiencies and missed opportunities for collaboration. This fragmentation is compounded by limited resources and competing political interests, which prevent the full implementation of adaptive governance strategies.

Table 3. Barriers to Effective Adaptive Governance in South Sulawesi

Barrier	Percentage of Respondents (%)
Political Fragmentation	67.4%
Lack of Institutional Capacity	58.9%
Limited Resources for Local Governance	60.3%
Inadequate Coordination Across Sectors	63.5%

Source: Survey data, 2025

The barriers to effective adaptive governance in South Sulawesi, as highlighted in Table 3, reflect significant challenges that hinder the successful implementation of adaptive governance frameworks in the region. One of the most prominent barriers identified is political fragmentation, with 67.4% of respondents recognizing it as a major issue. Political fragmentation refers to the lack of coordination and cooperation between various levels of government, including local, regional, and national authorities. This fragmentation can lead to inconsistent policies and a fragmented approach to environmental management, where different stakeholders may pursue conflicting goals or fail to work together effectively. This finding aligns with previous studies, such as those by Ogunbanjo et al. (2022), which emphasize the importance of multi-level governance systems to address complex socio-ecological issues. Political fragmentation, therefore, undermines the potential for cohesive and comprehensive governance strategies. Another key barrier is the lack of institutional capacity, with 58.9% of respondents pointing to this issue. Local government institutions often lack the necessary technical expertise, financial resources, and organizational infrastructure to implement adaptive governance strategies effectively.

Adaptive governance requires institutions that are capable of managing complexity, uncertainty, and evolving environmental challenges. The absence of these capabilities can result in poorly executed policies, ineffective monitoring, and a lack of meaningful engagement with local communities. This limitation hinders the ability of local governments to respond adequately to environmental changes and to incorporate adaptive strategies that are both sustainable and contextually relevant. Limited resources for local governance, identified by 60.3% of respondents, exacerbate the challenges of institutional capacity. Insufficient funding, inadequate staffing, and a lack of technological support limit the ability of local governments to manage natural resources, implement adaptation measures, and coordinate with other stakeholders. These resource constraints can prevent the full implementation of adaptive governance frameworks, as critical activities such as capacity-building, community engagement, and monitoring are sidelined due to financial limitations.

Finally, inadequate coordination across sectors, identified by 63.5% of respondents, points to the need for better integration of policies and actions across different sectors such as agriculture, forestry, water management, and disaster risk reduction. Without cross-sectoral coordination, efforts to address environmental challenges may be fragmented or duplicated, leading to inefficiencies and missed opportunities for synergy. Effective adaptive governance requires a holistic approach that links different sectors and encourages collaboration between diverse stakeholders to address complex socio-ecological issues. These barriers highlight the systemic challenges in implementing adaptive governance in South Sulawesi. Addressing these obstacles will require strengthening institutional capacity, enhancing coordination across government levels and sectors, and ensuring that adequate resources are allocated to support sustainable governance practices.

Discussion

In recent years, the concept of community resilience has gained significant attention in the context of environmental change, particularly in regions experiencing rapid socio-ecological transformations such as South Sulawesi. This study aimed to explore the role of adaptive governance in building community resilience to environmental change through a socio-ecological approach. The findings underscore the crucial link between governance mechanisms, community involvement, and environmental adaptation. This discussion highlights key insights derived from the research, contextualizes the results within the existing literature, and provides an analysis of the implications for policy and practice.

Adaptive Governance and Community Resilience

Adaptive governance has emerged as a vital framework for managing complex socio-ecological systems, especially in the face of environmental changes that are unpredictable and often beyond the control of local communities. As noted by Ojha et al. (2019), adaptive governance emphasizes flexibility, learning, and collaboration among multiple stakeholders to manage natural resources effectively. The findings of this study align with this notion, demonstrating that adaptive governance structures that include diverse community stakeholders are better equipped to respond to environmental challenges in South Sulawesi. Local communities involved in the governance process were found to exhibit a higher degree of resilience, not only through direct interventions but also by fostering a shared sense of responsibility and collective action.

Furthermore, the study revealed that governance processes in South Sulawesi are often influenced by both local knowledge systems and external policy frameworks. This dynamic relationship underscores the importance of incorporating indigenous knowledge alongside modern governance practices, the role of traditional ecological knowledge in adaptive management. In South Sulawesi, local communities' understanding of their environment has allowed them to develop context-specific strategies for resilience, such as sustainable land management practices and community-based disaster risk reduction efforts. These strategies align with the principles of adaptive governance, where local knowledge serves as a critical tool for anticipating and mitigating environmental risks.

Socio-Ecological Systems and Environmental Change

A central theme in the study was the interconnectedness of social and ecological systems in shaping community resilience to environmental change. Socio-ecological systems are complex and dynamic, where the interactions between human and ecological components can either enhance or undermine resilience. In South Sulawesi, the resilience of communities is deeply intertwined with the health of local ecosystems, such as mangroves, forests, and agricultural lands. The degradation of these ecosystems, often caused by unsustainable practices and external pressures, has significantly impacted the ability of communities to adapt to climate change and other environmental stresses.

The research findings indicate that environmental degradation, particularly deforestation and the depletion of water resources, has weakened the resilience of several communities in South Sulawesi. That environmental degradation exacerbates vulnerability to climate change and reduces the capacity of communities to respond effectively. However, the study also highlights examples of community-led restoration projects, where local communities, empowered through adaptive governance structures, have taken the lead in rehabilitating degraded ecosystems. These initiatives are in line with the socio-ecological resilience framework, which posits that social and ecological resilience must be viewed as two sides of the same coin.

The Role of Institutional Frameworks and Stakeholder Collaboration

Institutional frameworks play a pivotal role in shaping the capacity of communities to adapt to environmental change. The study revealed that adaptive governance in South Sulawesi is heavily influenced by both formal institutions, such as government agencies and NGOs, and informal institutions, such as local community groups and traditional leaders. The interaction between these institutional levels is crucial for fostering effective responses to environmental challenges.

As Ostrom (2009) notes, polycentric governance systems, which involve multiple levels of authority, are particularly effective in managing complex, multi-scale environmental problems.

The findings underscore the importance of stakeholder collaboration in enhancing adaptive governance. Successful resilience-building efforts in South Sulawesi were often characterized by strong partnerships between local communities, governmental bodies, and external organizations. These partnerships facilitated the exchange of resources, knowledge, and support, enabling communities to address challenges more effectively. Adaptive governance requires continuous dialogue and collaboration between stakeholders to address uncertainties and evolving environmental conditions. In South Sulawesi, such collaborative efforts were instrumental in implementing community-based adaptation strategies, such as early warning systems, sustainable agricultural practices, and ecosystem-based disaster risk reduction.

Challenges and Barriers to Adaptive Governance

While the study highlights the potential of adaptive governance in building community resilience, it also identifies several challenges that hinder the full realization of its benefits. One of the key barriers is the limited capacity of local institutions to manage and coordinate adaptive governance efforts effectively. This challenge is compounded by issues such as political instability, lack of resources, and insufficient technical expertise. The success of adaptive governance relies heavily on the capacity of local institutions to manage change and facilitate collaboration. In South Sulawesi, many local governments struggle to provide the necessary support for adaptive governance processes, particularly in remote areas where access to resources and information is limited.

Another challenge identified in the study is the resistance to change among some community members, particularly those who are deeply entrenched in traditional practices that may not be aligned with modern environmental governance approaches. The effectiveness of adaptive governance initiatives if not addressed through inclusive and participatory processes. In South Sulawesi, the involvement of traditional leaders and respected community figures has been critical in overcoming this barrier, as they have helped to bridge the gap between modern governance structures and local cultural practices.

Implications for Policy and Practice

The findings of this study have important implications for policy and practice, both within South Sulawesi and in other regions facing similar challenges. Policymakers should prioritize the integration of adaptive governance mechanisms into environmental policy frameworks, ensuring that local communities are central to the decision-making process. This approach is consistent with the recommendations of the Intergovernmental Panel on Climate Change (IPCC), which calls for governance systems that are flexible, inclusive, and capable of responding to the complexities of environmental change.

Moreover, there is a need for greater investment in capacity-building initiatives that strengthen the abilities of local institutions to manage adaptive governance processes. This includes providing technical training, fostering leadership skills, and enhancing access to information and resources. By building the capacity of local institutions, policymakers can help ensure that adaptive governance mechanisms are more effective and sustainable in the long term.

Finally, the study emphasizes the importance of fostering a culture of collaboration and knowledge exchange among stakeholders. Policy initiatives should support the creation of platforms that facilitate communication and cooperation between local communities, government agencies, and external organizations. These platforms can play a critical role in sharing best practices, coordinating actions, and leveraging resources to address environmental challenges.

CONCLUSION

This study explored the role of adaptive governance in building community resilience to environmental change in South Sulawesi, emphasizing the integration of socio-ecological systems in governance processes. The findings reveal that adaptive governance, which incorporates local knowledge, flexible decision-making, and stakeholder collaboration, is vital for enhancing

resilience in the face of environmental degradation and climate change. Community participation and multi-level governance structures were found to be critical in addressing local challenges and ensuring effective responses to environmental threats. The study identified key barriers to the implementation of adaptive governance, including limited institutional capacity, political fragmentation, and resistance to change among some community members. However, it also highlighted the positive impact of community-led initiatives, particularly in coastal management and ecosystem restoration, which demonstrated the potential for local adaptation. The findings contribute to the broader understanding of how adaptive governance frameworks can be applied in regions with complex socio-ecological dynamics, such as South Sulawesi. By incorporating indigenous knowledge and fostering collaboration across various governance levels, adaptive governance provides a viable solution to the challenges posed by environmental change. Future research should focus on expanding the implementation of adaptive governance frameworks in other regions with similar socio-ecological conditions. Investigating the long-term sustainability of community-led adaptation projects and exploring the integration of digital tools for governance could further enhance the effectiveness of adaptive governance strategies.

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