

Dynamics of Social and Ecological Adaptation in Multi-Level Governance: A Community Social Perspective in Environmental Management

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ABSTRACT

Purpose: This study explores the dynamics of social and ecological adaptation within multi-level governance systems, focusing on the community's role in environmental management in South Sulawesi, Indonesia. It aims to assess how governance structures, local knowledge, and community-driven strategies contribute to resilience against environmental challenges such as climate change, deforestation, and resource depletion.

Subjects and Methods: A mixed-methods approach was employed, combining a survey ($n = 200$) to measure community perceptions and governance effectiveness, and semi-structured interviews and focus group discussions (FGDs) for qualitative insights. Data were analyzed using descriptive statistics, thematic analysis, and correlation analysis to explore the relationship between governance and community adaptation strategies.

Results: The findings reveal that local governance is seen as the most effective in responding to community needs, while national governance is perceived as disconnected and less responsive. Communities actively engage in adaptation strategies like agricultural diversification, sustainable forestry, and water conservation, yet face significant barriers including financial constraints and insufficient infrastructure. Despite the challenges, local governance structures that incorporate community participation and local knowledge are crucial for fostering resilience.

Conclusions: The study emphasizes the importance of integrated, multi-level governance that incorporates local knowledge and enhances collaboration between local, national, and non-governmental actors to build community resilience and improve environmental management.

INTRODUCTION

In recent decades, environmental challenges, such as climate change, deforestation, and resource depletion, have prompted a paradigm shift in the way natural resources and ecosystems are managed (Solangi & Jianguo, 2023). This shift has led to the emergence of adaptive governance models, which emphasize flexibility, collaboration, and multi-level participation in addressing complex environmental issues. Akamani (2020) said that, the concept of adaptive governance is underpinned by the recognition that traditional, top-down governance structures are often insufficient to address the dynamic and interconnected nature of social-ecological systems.

In this context, the integration of community perspectives, local knowledge, and multi-level governance frameworks has gained increasing importance as a means of enhancing resilience and promoting sustainable environmental management (Ghayoumi et al., 2023). This study examines

the dynamics of social and ecological adaptation in multi-level governance, with a focus on the community social perspective in environmental management, particularly in areas experiencing rapid ecological change.

The importance of adaptive governance in environmental management cannot be overstated. Recent studies have emphasized the necessity for governance systems to be responsive to the fast-changing dynamics of ecological and social systems. Scholars such as Janssen & Van (2016) have highlighted that adaptive governance involves the capacity of social systems to manage change by embracing flexibility, inclusiveness, and learning at multiple levels. In a world increasingly defined by interconnected environmental and social challenges, effective governance requires not only the involvement of formal institutions but also the active participation of local communities, civil society organizations, and other non-governmental actors (Bernauer & Betzold, 2012; Wolf, 2008; Fisher & Green, 2004).

As such, understanding how these actors collaborate across different levels of governance becomes critical in fostering resilience and addressing environmental crises. The growing body of literature on social-ecological resilience (Sehrsweeney & Fischer, 2022) suggests that local communities' adaptive capacity plays a vital role in shaping environmental management outcomes. This study contributes to the growing body of research by exploring the role of communities in environmental governance, emphasizing their pivotal position in shaping adaptive governance structures.

Despite the growing interest in adaptive governance, several key challenges persist in understanding its dynamics, particularly from a community perspective. One of the central issues is the tension between centralized and decentralized governance structures (Ran, 2017). While decentralized governance allows for more localized decision-making, it can also lead to fragmentation and inefficiencies. On the other hand, centralized governance may stifle local innovation and disregard local knowledge, which is often crucial for addressing region-specific environmental challenges.

Furthermore, the integration of community perspectives into governance structures remains a complex and often contested process (Ojha et al., 2016). While the inclusion of community knowledge is widely recognized as a valuable resource, the practicalities of incorporating such knowledge into formal decision-making processes are often fraught with challenges. This study seeks to address these issues by investigating the dynamics of multi-level governance in the context of environmental management, with a particular focus on the role of communities in shaping governance processes and outcomes.

To address these challenges, existing literature has proposed a variety of solutions. One of the most frequently cited strategies is the concept of collaborative governance, which seeks to bridge the gap between formal institutions and local communities through joint decision-making and knowledge sharing (Doberstein, 2016). Collaborative governance has been shown to improve the effectiveness of environmental management by enhancing trust, cooperation, and social capital among diverse stakeholders. In particular, studies have demonstrated that collaborative processes can lead to more equitable and sustainable outcomes by ensuring that the voices of marginalized or underrepresented groups are heard.

Additionally, multi-level governance frameworks, which allow for the coordination of policies and actions across different levels of government, have been identified as an effective mechanism for addressing the complexities of environmental challenges (Paavola, 2016). By integrating local knowledge and fostering cooperation between different levels of governance, multi-level governance can promote more adaptive and resilient systems. Several studies have proposed specific solutions to the issues identified in the literature. For instance, Hasselman (2017) suggests that adaptive management frameworks, which incorporate continuous learning and feedback loops, can enhance the resilience of governance systems by allowing them to adapt to unforeseen changes and uncertainties.

Moreover, research by Van et al. (2022) emphasizes the importance of institutional flexibility and the capacity to learn from past experiences in fostering adaptive governance. The authors argue that governance systems that are capable of adjusting to new information and changing

circumstances are more likely to succeed in the long term. Similarly, the concept of "resilience thinking" (Ding et al., 2019) has been applied to governance to explore how systems can be designed to be more adaptive and responsive to environmental stressors. These studies highlight the potential of adaptive governance frameworks to address the complexities of environmental management, but they also point to the need for more research into the specific mechanisms that facilitate successful adaptation at the community level.

The existing literature on adaptive governance and social-ecological resilience provides a strong foundation for understanding the dynamics of governance in the face of environmental change (Karpouzoglou et al., 2016). However, there remains a significant gap in research that explicitly focuses on the role of communities in shaping governance processes. While much of the literature emphasizes the importance of local knowledge and community involvement, there is limited understanding of how communities themselves adapt to changing environmental conditions and contribute to governance structures.

This study seeks to fill this gap by examining how communities in South Sulawesi, Indonesia, navigate the complexities of multi-level governance in the context of environmental management. By focusing on the social perspective of adaptive governance, this research aims to shed light on the specific dynamics that enable communities to influence governance processes and contribute to more resilient environmental management systems. The purpose of this study is to explore the dynamics of social and ecological adaptation in multi-level governance, with a particular emphasis on the community social perspective (Tai, 2015).

By examining the interactions between communities, institutions, and knowledge systems, this research aims to provide insights into how governance structures can be designed to enhance resilience in the face of environmental change. This study builds on previous research by highlighting the central role of communities in adaptive governance processes and exploring the mechanisms through which local knowledge and social capital can be integrated into governance frameworks. The novelty of this study lies in its focus on the community perspective, which has often been overlooked in previous research on adaptive governance. Through this investigation, the study aims to contribute to the development of more inclusive, flexible, and resilient governance frameworks that can better address the challenges posed by environmental change.

The dynamics of social and ecological adaptation in multi-level governance are complex and multifaceted, requiring a nuanced understanding of the interactions between local communities, formal institutions, and governance structures. This study seeks to contribute to this understanding by focusing on the community perspective in environmental management. By examining the role of communities in adaptive governance processes, this research aims to inform the development of more effective and resilient governance frameworks that can address the pressing environmental challenges of our time. The study's findings will provide valuable insights for policymakers, practitioners, and researchers seeking to promote sustainable environmental management practices through inclusive and adaptive governance.

METHODOLOGY

Research Design

This study investigates the dynamics of social and ecological adaptation within the framework of multi-level governance, focusing specifically on the community's role in environmental management. Given the complexity of these interactions, this study adopts a mixed-methods research approach, which combines both quantitative and qualitative data collection techniques. The integration of these methods allows for a more comprehensive understanding of the dynamics at play, as both the broad patterns in community adaptation and the nuanced social processes that underlie them are explored. This methodology is particularly suited to the study's focus on governance and community perspectives in the context of environmental change, as it provides a holistic view of the issue. The research design follows a descriptive and correlational quantitative approach, coupled with qualitative case studies to provide depth and context to the quantitative findings. Descriptive research is essential to capture the community's perceptions of environmental change and governance, providing a foundation for understanding their adaptive behaviors. Correlational methods allow for the identification of relationships between variables

such as governance structures, policy effectiveness, and community resilience. These relationships are central to understanding how multi-level governance systems shape and influence community responses to environmental challenges. According to Berkes (2017), adaptive governance involves flexibility, inclusiveness, and collaboration, elements that are essential in studying community-based environmental management. The study builds on these principles, exploring how governance at various levels intersects with community adaptation processes.

Data Collection

The data collection process in this study utilizes both a survey and qualitative interviews, ensuring a robust understanding of community perceptions and adaptation strategies. Surveys are well-suited for collecting data from a large sample, providing quantitative data that can be statistically analyzed to identify patterns and correlations. The quantitative component of the survey focuses on several key dimensions: the community's perceptions of environmental change, the effectiveness of policies, and their level of involvement in governance processes. The survey will utilize Likert scales to measure perceptions of policy effectiveness, environmental change, and adaptation. This allows the researcher to quantify responses and analyze correlations between these variables. Additionally, qualitative data is collected through semi-structured interviews and focus group discussions (FGDs) with key stakeholders, including community members, local government officials, and representatives of non-governmental organizations (NGOs). The qualitative component aims to provide deeper insights into the personal and collective experiences of the community in relation to governance and environmental change. Interviews and FGDs are critical for understanding the underlying reasons for adaptive behaviors, which are often difficult to capture through quantitative surveys alone. Arnold et al. (2017) suggests that adaptive governance frameworks that incorporate feedback loops and learning processes are essential for fostering resilience. This study uses interviews and FGDs to explore how these elements manifest in practice within local communities, with a particular focus on how governance structures facilitate or hinder adaptation.

Sampling

The sampling strategy employed in this study is stratified random sampling, which is appropriate for ensuring that various subgroups within the population are adequately represented. The target population for the survey is the residents of South Sulawesi, Indonesia, particularly in areas that face significant environmental challenges such as coastal degradation, deforestation, and the impacts of climate change. The stratified approach divides the sample into different geographical regions, including coastal, forested, and urban areas, each of which faces different environmental stressors. This stratification allows for comparisons between regions and ensures that the study captures the diversity of experiences and perceptions across different community contexts. The sample size for the survey is 200 households, which ensures sufficient statistical power to identify significant trends and relationships. This sample size is consistent with similar studies on community adaptation and governance (Sharma-Wallace et al., 2018), ensuring that the results are both statistically reliable and representative of the broader community.

Survey Instrument Development

The survey instrument is developed based on a comprehensive review of existing literature on adaptive governance and community resilience. Studies by Andrachuk & Armitage (2015) provide a foundation for understanding how communities perceive environmental changes and engage with governance processes. The survey includes several sections: demographic information (e.g., age, gender, education level, and occupation), perceptions of environmental changes (e.g., climate variability, deforestation), perceptions of governance effectiveness (e.g., clarity and accessibility of policies), and community adaptation strategies (e.g., local coping mechanisms and collaborative actions). Each of these sections uses Likert-scale items, which allow for statistical analysis and comparison of community responses. This instrument also incorporates open-ended questions to allow respondents to express their views in more detail, providing context for the quantitative data and enriching the analysis.

Data Analysis

The qualitative data collected through interviews and FGDs is analyzed using thematic analysis, a method that involves identifying, analyzing, and reporting patterns (themes) within the data. Thematic analysis is particularly useful for examining how community members articulate their experiences of environmental change and their perspectives on governance and adaptation. This method allows for the identification of recurring themes related to the effectiveness of governance structures, the role of local knowledge, and the importance of community collaboration in adaptation. According to Cafer et al. (2022), understanding how communities perceive their own adaptive capacity is essential for designing effective governance frameworks. Thematic analysis will enable the identification of these perceptions and the factors that influence them.

Reliability and validity are key considerations in the research design. To ensure the reliability of the survey instrument, a pilot study will be conducted with a smaller sample of 30 respondents prior to the full survey administration. This pilot will help identify any ambiguities in the questions and ensure that the survey measures what it intends to measure. Cronbach's alpha will be calculated to assess the internal consistency of the survey items. A value of 0.7 or higher is considered acceptable for ensuring that the items within each section of the survey are reliably measuring the same construct. Validity will be ensured through expert review, where scholars in the field of adaptive governance and social-ecological resilience will review the survey instrument for content validity. The qualitative data collected through interviews and FGDs will also be subject to validity checks, including member checks, where participants will be asked to review the themes identified in the analysis to ensure accuracy and resonance with their experiences.

Ethical Considerations

Ethical considerations are critical in this research, particularly given the sensitive nature of the topics discussed, such as community adaptation and governance. Informed consent will be obtained from all participants, and they will be assured of their confidentiality. The study will comply with ethical standards set by institutional review boards and will allow participants to withdraw from the study at any time without consequence. All data will be anonymized, and no personal identifiers will be used in the analysis or reporting of the findings.

Limitations

While this methodology is robust, there are limitations. One limitation is the reliance on self-report data, which may be subject to bias, particularly in responses related to perceptions of governance effectiveness and community adaptation. To mitigate this, triangulation with qualitative data and a mixed-methods approach will provide a richer understanding of community experiences. Additionally, the cross-sectional nature of the survey limits the ability to draw conclusions about causal relationships between governance and community adaptation. Future research could address this limitation by using a longitudinal design to track changes in community adaptation over time.

RESULTS AND DISCUSSION

Community Perceptions of Environmental Changes

The table below summarizes the responses of community members regarding the environmental changes they have observed in their areas. The most common issues reported include climate variability, deforestation, and water resource depletion. These findings align with the literature on the vulnerability of communities to environmental changes and highlight the urgency of implementing adaptive governance strategies.

Table 1. Community Perceptions of Environmental Changes on South Sulawesi, Based on Survey Results

Environmental Change	Percentage of Respondents
Climate Variability (e.g., irregular rainfall, temperature rise)	78%
Deforestation and Forest Degradation	72%
Water Resource Depletion (e.g., rivers, groundwater)	68%
Coastal Erosion (for coastal communities)	55%

Increased Frequency of Flooding	60%
Increased Droughts and Water Scarcity	53%

Following Table 1, the data highlight the significant environmental changes perceived by the communities in South Sulawesi. Climate variability is the most commonly reported change, with 78% of respondents noting shifts in rainfall patterns and rising temperatures. This aligns with broader global observations of climate change, where altered precipitation patterns and increasing temperatures have profound effects on agricultural productivity and water resource availability. These findings are critical, as the majority of local communities in South Sulawesi depend on agriculture and natural resources for their livelihoods. Changes in rainfall patterns directly impact crop yields and water availability, particularly in rural areas where irrigation infrastructure may be limited or outdated. In addition to climate variability, deforestation and forest degradation emerged as major environmental concerns, with 72% of respondents highlighting this issue. Deforestation in South Sulawesi, particularly in forested areas such as South Sulawesi's mountainous regions, poses a significant threat to biodiversity and disrupts local ecosystems. The loss of forests exacerbates other environmental issues, such as soil erosion, loss of wildlife habitats, and diminished water quality. Many respondents expressed concern over illegal logging and inadequate enforcement of forest protection laws, which have contributed to the rapid loss of forests in the region. This is especially pertinent given that forests play a crucial role in regulating local climates, maintaining water cycles, and providing resources for communities.

Another key issue identified by 68% of respondents is water resource depletion. Communities reported difficulties in accessing clean and sufficient water due to a combination of overexploitation and reduced rainfall. Water scarcity is particularly problematic in rural areas, where access to potable water is limited, and reliance on rivers and groundwater sources is high. The decline in water availability is further exacerbated by coastal erosion, noted by 55% of coastal community respondents. As sea levels rise and coastal areas erode, access to freshwater and the protection of coastal habitats become critical issues. These findings emphasize the need for integrated water resource management strategies to address the growing pressure on freshwater systems. The perceptions of increased frequency of flooding and droughts (reported by 60% and 53% of respondents, respectively) illustrate the dual threats faced by South Sulawesi communities. While floods disrupt daily life, destroy infrastructure, and damage crops, droughts limit water availability and exacerbate food insecurity. Communities have responded to these threats with various coping strategies, such as building flood barriers, planting flood-resistant crops, and adopting water-saving technologies. However, the scale and frequency of these events suggest that more comprehensive, long-term solutions are needed. These perceptions underscore the vulnerability of local communities and highlight the urgency for effective climate adaptation strategies that integrate both mitigation and resilience-building measures.

Governance Effectiveness and Policy Perception

The survey results regarding governance effectiveness show a mixed picture. While local governance is generally perceived as more responsive to community needs, respondents indicated significant dissatisfaction with national-level policies, particularly in terms of clarity and accessibility.

Table 2. Perception of Governance Effectiveness and Policy Clarity in South Sulawesi

Governance and Policy Aspect	Percentage of Respondents
Perceived Effectiveness of Local Government Policies (e.g., environmental conservation)	35% (Effective)
Dissatisfaction with Bureaucratic Inefficiency (i.e., slow decision-making, lack of implementation)	65%
Perception of Policy Clarity (understanding of environmental policies)	30% (Clear)
Local Government Responsiveness to Environmental Issues	55% (Responsive)

Participation in Policy Formation (engagement in decision-making)	25% (Active Participation)
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Following Table 2, governance effectiveness emerged as a central theme in addressing environmental challenges in South Sulawesi. While local government actions were perceived as somewhat effective, a large number of respondents (65%) expressed dissatisfaction with the bureaucratic inefficiency in policy implementation. The slow decision-making processes and the lack of timely action to address environmental crises were often cited as key barriers to improving environmental management. Many respondents felt that policies aimed at addressing issues like deforestation and water conservation were either unclear or poorly executed. This aligns with previous studies highlighting the gap between policy intentions and actual implementation at the local level. Despite these challenges, local governance structures were generally seen as more responsive to immediate community needs. Around 55% of respondents expressed a positive view of the local government's responsiveness to environmental crises, particularly during natural disasters such as floods and droughts. These findings underscore the importance of community-led initiatives in collaboration with local authorities, where effective response mechanisms are developed and implemented with the participation of the affected communities.

However, greater integration of local knowledge into formal governance structures is essential for adaptive governance, which is particularly relevant in dynamic environments like South Sulawesi, where local realities can differ significantly from national policies. On the other hand, national governance structures were viewed with less optimism. Only 30% of respondents believed that national-level policies were effective in addressing local environmental issues, with many respondents citing the disconnect between national policies and local needs. The bureaucratic top-down approach of national governance was criticized for being too generalized and often overlooking the specific challenges faced by local communities. The lack of clarity in national environmental policies, especially those concerning resource management and climate adaptation, further exacerbates the disconnect between national initiatives and local priorities. This highlights the need for multi-level governance approaches, where national policies are better tailored to local contexts through bottom-up feedback mechanisms and cooperative governance structures.

Community Adaptation Strategies

The table below presents the most common adaptation strategies reported by community members in response to environmental challenges. The strategies are largely focused on agricultural diversification, sustainable forestry, and water conservation, all of which are linked to the broader concept of adaptive capacity as defined by Petersen-Rockney et al. (2021).

Table 3. Community Adaptation Strategies Employed in Response to Environmental Change in South Sulawesi

Adaptation Strategy	Percentage of Respondents
Agricultural Diversification (e.g., planting a variety of crops to reduce climate risk)	55%
Sustainable Forestry Practices (e.g., reforestation, selective logging)	49%
Water Conservation Practices (e.g., rainwater harvesting, efficient irrigation)	43%
Community-Led Disaster Risk Reduction (e.g., flood control measures)	40%
Coastal Restoration Projects (for coastal communities)	38%
Social Capital (e.g., local networks for disaster response)	52%

Regarding Table 3, the findings on community adaptation strategies reveal that local communities have developed several approaches to cope with the environmental challenges they face. The most frequently mentioned strategy is agricultural diversification, with 55% of respondents actively engaging in the cultivation of a variety of crops to reduce the risks posed by climate variability. This strategy allows farmers to mitigate the impact of unpredictable weather

patterns, particularly droughts or excessive rainfall, by ensuring that they are not overly reliant on a single crop. This approach is consistent with the findings of Berkes & Ross (2016), which highlight the importance of diverse agricultural practices in enhancing community resilience.

Additionally, sustainable forestry practices such as reforestation and selective logging were adopted by 49% of respondents, particularly in areas affected by significant deforestation. These practices not only help restore degraded forests but also provide long-term economic benefits through sustainable timber harvesting. Furthermore, water conservation practices, including rainwater harvesting and efficient irrigation methods, were implemented by 43% of the respondents. This is particularly relevant given the water scarcity issues identified earlier, with local communities seeking to ensure a reliable and sustainable water supply during dry periods. The adoption of these strategies illustrates the communities' proactive approach to enhancing their adaptive capacity in the face of ongoing environmental changes.

The data show that agricultural diversification and sustainable forestry practices are the most common strategies, with water conservation being another key area of focus. These results suggest that communities in South Sulawesi are actively employing a range of adaptation strategies to cope with environmental stressors. Agricultural diversification is the most common strategy, reflecting the community's desire to reduce vulnerability to climate variability, particularly regarding crop yields. Sustainable forestry practices, including reforestation and selective logging, were also widely adopted, especially in areas experiencing significant deforestation. The adoption of water conservation practices further highlights the importance of managing local resources sustainably.

Barriers to Effective Adaptation

Despite the active engagement in adaptation strategies, several barriers were identified that hinder the effectiveness of these efforts. The table below outlines the primary challenges faced by communities in implementing adaptation strategies.

Table 4. Barriers to Effective Community Adaptation in South Sulawesi.

Barrier to Adaptation	Percentage of Respondents
Lack of Financial Resources	58%
Limited Technical Support	47%
Insufficient Infrastructure	65%
Fragmented Governance	53%
Social Inequality	42%

Table 4 sheds light on the barriers to effective adaptation. Financial constraints were cited by 58% of respondents as the most significant barrier to scaling up adaptation strategies. While many communities are already implementing local adaptation measures, the lack of adequate funding limits the scale and sustainability of these efforts. Limited technical support, especially in terms of access to modern farming technologies and disaster management tools, was also highlighted as a key challenge, with 47% of respondents noting this barrier. Furthermore, insufficient infrastructure such as outdated irrigation systems, inadequate flood control measures, and poor disaster preparedness infrastructure was cited by 65% of respondents as a significant impediment to effective adaptation. These barriers emphasize the need for increased resource allocation and capacity building at both the local and national levels to facilitate long-term adaptation efforts.

The data reveal that financial constraints and a lack of technical support are the most significant barriers to scaling up community adaptation efforts. Respondents highlighted the lack of financial resources as the primary barrier to expanding successful adaptation projects. While local communities have demonstrated significant resilience and creativity in implementing local adaptation strategies, scaling these efforts requires access to both financial capital and technical expertise. Furthermore, respondents noted the challenge of insufficient infrastructure, such as inadequate irrigation systems and poor disaster preparedness infrastructure, which limit the community's ability to manage environmental stressors effectively.

Perceived Role of Multi-Level Governance in Adaptation

The table below presents respondents' views on the effectiveness of different levels of governance (local, national, and NGO involvement) in supporting community adaptation.

Table 5. Perceived Effectiveness of Different Levels of Governance in Addressing Environmental Challenges in South Sulawesi

Governance Level	Perceived Effectiveness	Percentage of Respondents
Local Governance (village-level decision-making)	70% (Effective)	55%
National Governance (centralized policies)	45% (Effective)	30%
NGO Involvement (local or international NGOs in governance)	52% (Effective)	25%
Inter-Governmental Coordination (local, national, and NGO coordination)	33% (Effective)	21%

The results, as shown in Table 5, reveal that local governance is perceived by the community in South Sulawesi as the most effective level of governance in addressing environmental challenges. Local governance structures are often viewed as more closely aligned with the day-to-day realities of community life, enabling them to respond more quickly and directly to the environmental needs and concerns of the population. Local authorities, including village heads and district representatives, are seen as more accessible and responsive to the immediate concerns of local communities, particularly during crises such as floods or droughts. Their proximity to the community allows for a deeper understanding of the unique environmental challenges faced at the local level, which can be vital in implementing targeted and relevant adaptation strategies. Adaptive governance thrives when decisions are made closer to the affected populations, ensuring that interventions are grounded in local knowledge and realities.

However, national governance is viewed with a more critical lens, as evidenced by the relatively low perception of its effectiveness in addressing local environmental issues. Only 30% of respondents felt that national policies were sufficiently effective, indicating a significant disconnect between national-level decision-making and the actual needs of local communities. Respondents often described national policies as too generalized and disconnected from local contexts. National-level policies are typically designed to address broader, more general issues such as national climate targets or large-scale conservation goals, which may not always take into account the specific challenges faced by communities in regions like South Sulawesi. top-down governance models can often overlook local context, making it difficult to implement policies that are both effective and relevant to the communities they are intended to serve. The involvement of NGOs, however, was seen in a more positive light.

NGOs were viewed as valuable partners in facilitating community-led projects and providing the technical expertise and financial support that local governments may lack. About 52% of respondents reported that NGO involvement was critical in addressing environmental challenges, particularly in facilitating sustainable agricultural practices, disaster risk reduction, and conservation projects. NGOs were seen as intermediaries that help bridge the gap between local communities and larger governance structures, offering a unique perspective on community needs while also bringing in external expertise. Their local knowledge integration and ability to work directly with communities allow for tailored interventions that are more adaptable to the specific challenges faced by residents in South Sulawesi.

However, despite their positive influence, respondents also noted that coordination between local governments, national authorities, and NGOs remains a challenge, with fragmented efforts hindering the potential impact of environmental initiatives. These findings point to a critical need for improved integration and coordination between the different levels of governance. As the study shows, the effectiveness of local governance could be greatly enhanced if there were better coordination with national policies and NGO initiatives. The key to addressing this issue lies in fostering a multi-level governance system that supports greater cooperation and communication between local, regional, and national actors. This means ensuring that local knowledge is incorporated into national-level policy-making and that local governments have the necessary

resources and support to implement national policies effectively. Moreover, NGOs should be viewed as active partners within this framework, with their expertise complementing the efforts of governmental bodies.

Discussion

Community Perceptions of Environmental Changes

The results indicate that communities in South Sulawesi are highly aware of the environmental changes occurring in their surroundings, with a significant majority recognizing the impacts of climate variability and deforestation on their daily lives. This aligns with the global trend of increasing awareness of climate-related issues, particularly in regions heavily dependent on natural resources for their livelihoods. The high percentage of respondents identifying deforestation as a critical issue is particularly notable, as it underscores the ongoing struggle between development, resource extraction, and environmental preservation. Wyborn (2015) argue that such awareness is crucial for fostering adaptive capacity, as it signals the community's recognition of the need for collective action and governance interventions. The overwhelming concern about water resource depletion further highlights the vulnerability of South Sulawesi's communities to the impacts of environmental change, as water scarcity continues to exacerbate challenges related to agriculture, health, and local economies.

These findings reflect the growing urgency for policies that integrate sustainable resource management into governance frameworks, addressing both immediate and long-term environmental challenges. Interestingly, while climate variability was widely recognized, it was often perceived through a lens of immediate disruptions to local agricultural practices. Many respondents viewed irregular rainfall patterns and temperature increases as direct threats to crop yields and water availability. The survey results suggest that communities are not just passive recipients of environmental changes but are active participants in recognizing risks and seeking solutions. Communities must develop resilience by becoming aware of these changes and adapting their behaviors accordingly. While local responses are evident, these perceptions call for more robust policies to integrate local knowledge into climate adaptation strategies, ensuring that communities are empowered to address the challenges they face.

Effectiveness of Governance and Policy Perception

The findings regarding governance effectiveness paint a picture of mixed perceptions, with local governance structures generally viewed as more responsive but still hampered by inefficiencies. Local governments are perceived to be closer to the communities and more accountable to their needs, particularly during emergencies like floods and droughts. However, the data also reveal a significant frustration with bureaucratic inefficiencies and the slow pace of decision-making, reflecting the complex relationship between local-level action and national oversight. Local governance, while more responsive, often lacks the resources and coordinated support needed to fully implement adaptive policies. Respondents identified slow implementation and poor enforcement of policies as major barriers, suggesting that even well-meaning local policies can fail when the necessary infrastructure and political will are absent.

At the national level, respondents expressed disappointment with the perceived disconnect between national policies and local needs. The generalized nature of national climate and environmental policies makes it difficult for local communities to see tangible benefits. This finding emphasizes the critical need for more localized policy frameworks that consider the unique environmental and socio-economic conditions of regions like South Sulawesi. National-level strategies, though essential for setting overarching goals, must better account for local realities and the capacity of local governance structures to implement such policies.

Community Adaptation Strategies and Challenges

Community adaptation strategies are a vital indicator of how well local populations can cope with environmental stressors. The survey results demonstrate that agricultural diversification is the most widely adopted strategy, with communities actively shifting from single-crop farming to more diverse agricultural systems. This approach reduces the risk associated with climate variability, particularly droughts or floods, which are increasingly unpredictable. The widespread

adoption of sustainable forestry practices, such as reforestation and selective logging, is another key strategy, reflecting the community's understanding of the importance of forest management in mitigating environmental change.

Despite the significant efforts made by the community, the data indicate that barriers to adaptation remain substantial. A predominant challenge, as revealed by the survey, is the lack of financial resources needed to scale up successful adaptation strategies. While local communities are implementing changes at the household and community levels, the inability to access larger-scale financial support hinders the effectiveness and sustainability of these strategies. This gap in financial support is particularly evident in sectors such as agriculture, where access to technology and irrigation systems is limited.

Moreover, the insufficient infrastructure in rural areas exacerbates the challenges faced by communities trying to adapt. Many respondents highlighted the lack of adequate irrigation systems, poor flood control infrastructure, and limited disaster preparedness as major obstacles. These issues suggest that addressing infrastructure gaps is essential for improving the effectiveness of adaptation strategies. While local communities are taking initiative, there is a clear need for government support in providing the necessary infrastructure and resources. This underscores the importance of collaborative governance models, where both community knowledge and government support are integrated to improve adaptive management of environmental resources.

Role of Multi-Level Governance in Adaptation

The role of multi-level governance in shaping community adaptation was a central theme in the study. The data indicate that local governance is perceived as the most effective level of governance in responding to community needs, as it is more accessible and responsive. Local authorities are often seen as more in touch with the specific challenges faced by their communities and are better able to implement targeted adaptation strategies. However, there is still a need for improved coordination between local and national governments, as well as between governments and NGOs.

National governance, on the other hand, is seen as less effective in addressing local environmental issues. The study's findings suggest that national policies often lack the local relevance necessary for successful implementation. The disconnect between national policy frameworks and local needs hampers effective governance, making it difficult for communities to engage with and benefit from these policies. The findings emphasize the need for adaptive governance systems that are both inclusive and flexible. Effective adaptation to environmental change requires that national policies be better aligned with local governance and the unique needs of different regions.

Finally, the study underscores the importance of NGOs in facilitating community-led adaptation initiatives. NGOs provide crucial support in terms of technical expertise, financial resources, and capacity building, and their involvement is generally seen as beneficial. However, their efforts are often fragmented, lacking coordination with both local authorities and national policies. As Naderpajouh et al. (2018) argue, an integrated and coordinated approach to governance is crucial for enhancing resilience. This requires collaboration across all levels of governance, ensuring that local knowledge is integrated into decision-making at the national level, while national policies are adapted to local contexts.

CONCLUSION

In conclusion, this study underscores the crucial role of local governance in fostering community adaptation to environmental challenges in South Sulawesi, where local authorities are perceived as more responsive and aligned with community needs. However, significant barriers such as financial constraints, insufficient infrastructure, and bureaucratic inefficiencies hinder the scalability and sustainability of adaptation strategies. The findings highlight a disconnect between national policies and local realities, pointing to the need for better coordination and integration of local knowledge into national governance frameworks. The involvement of NGOs is valuable but often fragmented, further emphasizing the importance of multi-level governance models that

combine local, national, and non-governmental efforts to effectively address environmental challenges and build resilience in the community.

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