Adaptive Governance Research

e-ISSN 3063-0878 (online)

Volume 1, Issue 2 2024
Page 41-56

https://doi.org/10.71435/685969

Adaptive Capacity of Local Governments to Socio-Ecological Challenges: A Case Study in Disaster-Prone Areas in Central Sulawesi

Hans Nayoan[1], Marlyn Silaen[1]

[1]Disaster Management Study Program, Budi Luhur University of Jakarta, Indonesia

ARTICLE INFO

Received: 11 August 2024
Revised: 15 October 2024
Accepted: 02 December 2024
Available online: 12 December 2024

Keywords:
Adaptive Capacity
Local Government
Disaster Management

Corresponding Author:
Hans Nayoan

Email:
hansnayoan@yahoo.co.id

ABSTRACT

Purpose: *This study examines the adaptive capacity of local governments in disaster-prone areas of Central Sulawesi, focusing on mechanisms, strategies, and constraints that shape institutional resilience through leadership, coordination, knowledge systems, and community participation.*

Subjects and Methods: *A qualitative case study was conducted in Palu, Sigi, and Donggala using semi-structured interviews, focus group discussions, and document analysis. Participants included government officials, community leaders, and NGO representatives. Thematic analysis was applied to identify patterns related to adaptive governance, learning processes, and collaborative practices.*

Results: *Adaptive capacity is shaped by effective coordination, strong leadership, and robust knowledge systems that support informed decision-making. Community engagement and collaboration with civil society enhance the relevance of adaptive strategies. However, fragmented coordination, weak institutional memory, inconsistent training, and unequal participation of marginalized groups limit the sustainability of adaptive governance and long-term resilience.*

Conclusions: *Strengthening local government adaptive capacity requires integrated, knowledge-based, and inclusive approaches that connect institutional, technical, and community dimensions. Institutionalizing learning, sustaining collaboration, and ensuring equitable participation can shift local governance from reactive disaster management to proactive resilience, offering important insights for policymakers and practitioners.*

INTRODUCTION

Indonesia's geographical and ecological characteristics render it one of the most disaster-prone countries in the world (Husein & Iuchi, 2025; Riyadi et al., 2026; Ayuningtyas et al., 2021). Situated along the Pacific "Ring of Fire," the archipelago is highly exposed to a wide range of natural hazards, including earthquakes, tsunamis, floods, volcanic eruptions, and landslides. In particular, the province of Central Sulawesi has been repeatedly affected by devastating events, most notably the 2018 earthquake and tsunami that caused severe socio-economic disruptions and environmental degradation. These recurring disasters reveal the urgent need for local governments to strengthen their adaptive capacity the ability to anticipate, prepare for, respond to, and recover from socio-ecological challenges in ways that reduce long-term vulnerability and enhance resilience.

In the Indonesian governance system, local governments are key actors in implementing disaster management and sustainable development policies (Uzorka et al., 2024; Putra & Matsuyuki, 2020). Since the enactment of Law No. 23 of 2014 on Regional Governance, decentralization has

granted local authorities' substantial responsibility for managing natural resources, spatial planning, and disaster risk reduction at the regional level. However, decentralization has also exposed disparities in institutional capacity, coordination, and resource allocation between regions (Khatter et al., 2024).

In many cases, local governments in disaster-prone areas such as Central Sulawesi struggle to translate national resilience frameworks into context-specific adaptive actions due to limited technical expertise, fragmented institutional arrangements, and insufficient budgetary support (Baker et al., 2021). This raises a fundamental governance problem: how can local governments effectively build adaptive capacity amid complex socio-ecological pressures? The concept of adaptive capacity encompasses not only institutional readiness but also social learning, leadership, community engagement, and the integration of environmental knowledge into policy processes (Bullock et al., 2022).

It is closely associated with the broader framework of socio-ecological resilience, which emphasizes the interconnectedness between human systems and ecological environments (Vossoughi et al., 2023; Hammond et al., 2023; Talubo et al., 2022; Refulio-Coronado et al., 2021). In the context of local governance, adaptive capacity refers to the ability of institutions to manage uncertainty and complexity through flexible decision-making, cross-sectoral collaboration, and iterative learning. This capacity is not static it evolves through experience, feedback, and interaction between various stakeholders, including government agencies, civil society organizations, and local communities.

In Central Sulawesi, socio-ecological challenges are particularly severe due to a combination of environmental degradation, rapid urbanization, and recurring disasters (Haque & Doberstein, 2021). The 2018 earthquake, followed by liquefaction and tsunami events, exposed weaknesses in spatial planning, infrastructure resilience, and coordination between local agencies. Post-disaster recovery efforts revealed both strengths and shortcomings in adaptive governance: while there was evidence of community-driven resilience and inter-agency cooperation, the processes were hindered by overlapping authorities, bureaucratic delays, and inconsistent policy implementation.

These dynamics illustrate how adaptive capacity is shaped not only by institutional structures but also by social capital, leadership, and local knowledge systems. Local governments are expected to integrate disaster risk reduction, environmental management, and climate adaptation into their regional development planning (Järvelä, 2023; Wamsler & Johannessen, 2020). Yet, the practical realization of this mandate remains a challenge. Many regional planning documents in Indonesia, including those in Central Sulawesi, often treat disaster management as a reactive rather than proactive function.

This reactive tendency limits long-term adaptation and undermines the integration of socio-ecological resilience into policy formulation. Additionally, the lack of participatory mechanisms in local governance constrains the inclusion of community-based knowledge, which is essential for effective adaptation in dynamic ecological contexts. Scholars argue that building adaptive capacity requires transforming governance systems to promote flexibility, transparency, and collaborative learning.

In decentralized systems like Indonesia's, local governments must not only comply with national frameworks but also innovate locally to respond to unique environmental and socio-economic conditions. However, limited financial autonomy and dependency on central government funding often restrict local innovation (Setiadi et al., 2021). The result is a governance paradox where local governments are mandated to lead adaptation but constrained by structural and institutional limitations.

The adaptive capacity of local governments in disaster-prone areas thus reflects the intersection of governance, environment, and community engagement. In Central Sulawesi, local authorities must address not only the technical dimensions of disaster risk but also socio-ecological interactions, such as land-use changes, ecosystem degradation, and social inequality. Addressing these challenges requires adaptive governance practices that bridge scientific knowledge and local wisdom, ensure inclusive participation, and enable continuous institutional learning.

Given these contextual complexities, this study examines how local governments in Central Sulawesi develop and exercise adaptive capacity in responding to socio-ecological challenges. It explores the mechanisms, constraints, and strategies that define adaptive governance at the local level, focusing on the experiences of institutions operating in disaster-prone districts such as Palu, Sigi, and Donggala. By analyzing local practices and institutional dynamics, the research contributes to a deeper understanding of resilience-building within Indonesia's decentralized governance framework.

This study provides empirical evidence that can inform policy reforms aimed at strengthening adaptive capacity and promoting socio-ecological sustainability across vulnerable regions. Ultimately, understanding the adaptive capacity of local governments in disaster-prone areas is essential for shaping resilient governance systems in Indonesia. Central Sulawesi, as a province that has experienced repeated environmental shocks, offers a compelling context for exploring how institutions adapt, learn, and transform in response to persistent socio-ecological challenges. The findings of this study are expected to enrich both academic discussions and practical strategies for adaptive governance, aligning with global priorities in disaster risk reduction, climate adaptation, and sustainable development.

METHODOLOGY

This study employed a qualitative research design with a case study approach to explore the adaptive capacity of local governments in responding to socio-ecological challenges in disaster-prone areas of Central Sulawesi. The qualitative design was chosen because it allows for an in-depth understanding of complex social and institutional dynamics that cannot be adequately captured through quantitative methods. qualitative research is particularly suitable for examining how people interpret and make sense of their experiences within specific contexts. In this study, the focus was on exploring processes, meanings, and interactions among local government actors, community stakeholders, and non-governmental organizations involved in disaster management and environmental governance. The case study approach, facilitates a detailed examination of a contemporary phenomenon within its real-life context. Central Sulawesi was selected as the case because of its repeated exposure to major natural disasters particularly the 2018 earthquake, tsunami, and liquefaction events and its ongoing efforts to strengthen local resilience.

Research Setting

The research was conducted in three disaster-prone districts within Central Sulawesi Province Palu City, Sigi Regency, and Donggala Regency. These areas were chosen purposively because they represent diverse administrative and ecological conditions, each having experienced significant disaster impacts and post-disaster recovery processes. Palu, as the provincial capital, plays a strategic administrative role and demonstrates institutional challenges typical of urban local governments. Sigi represents a semi-rural district with active agricultural and forest-dependent communities facing recurring landslides and floods, while Donggala illustrates a coastal region vulnerable to tsunamis and tidal surges. Conducting research in these three areas allowed for the comparison of institutional responses and adaptive mechanisms across different governance and ecological contexts within the same province.

Participants and Sampling Techniques

Participants were selected using purposive sampling, which is appropriate for qualitative research aimed at gaining rich, relevant, and diverse insights rather than statistical generalization. The inclusion criteria required participants to be directly involved in or knowledgeable about local disaster management, environmental planning, or community resilience initiatives. The study involved 25 key informants, comprising officials from the Regional Disaster Management Agency (BPBD), Regional Development Planning Agency (Bappeda), and Environmental Agency (DLH); local leaders from affected communities; representatives of non-governmental organizations (NGOs); and academic experts from Tadulako University. This composition ensured a balanced representation of institutional, professional, and community perspectives. The selection process was guided by the principle of information richness, meaning participants were chosen for their ability to provide deep insights into adaptive capacity processes. Sampling continued until data

saturation was reached when new interviews no longer produced novel information or emerging themes.

Data Collection Procedures

Data collection was carried out over a three-month period, from January to March 2024, using three primary qualitative methods: semi-structured interviews, focus group discussions (FGDs), and document analysis. The semi-structured interviews were designed to explore participants' experiences, perceptions, and reflections on how local governments develop and implement adaptive strategies. Each interview lasted between 45 and 90 minutes and was conducted either in person or via virtual communication platforms when physical meetings were not feasible. An interview guide was used to maintain consistency across sessions while allowing flexibility for probing questions and follow-up discussions. To complement individual perspectives, focus group discussions were held with community representatives and local government staff in Palu and Sigi. These sessions encouraged participants to collectively reflect on adaptive challenges, coordination mechanisms, and lessons learned during post-disaster recovery. FGDs helped uncover shared experiences and differing viewpoints, enriching the data through group interaction. In addition to interviews and FGDs, document analysis was performed on official policy documents, regional disaster management plans (RPB), environmental reports, and local development planning documents (RPJMD). These materials provided contextual and policy-level insights that supported the triangulation of primary data and enhanced the reliability of findings. Field observations were also conducted during visits to government offices and affected communities to capture environmental conditions, institutional arrangements, and community initiatives relevant to adaptive practices.

Data Analysis

Data analysis in this study used a thematic analysis approach, which involved systematically identifying and interpreting patterns in qualitative data. All interviews and FGDs were recorded with consent, transcribed verbatim, and repeatedly reviewed to ensure familiarity with the content. Both inductive and deductive coding were applied inductive to allow themes to emerge naturally from participants' narratives, and deductive to align findings with existing frameworks on adaptive capacity and socio-ecological resilience. The coding process proceeded through three stages: open coding to identify initial ideas, axial coding to link related categories, and selective coding to refine core themes. Major themes that emerged included institutional coordination, leadership and governance, community participation, knowledge sharing, and resource constraints. Data were organized and analyzed using NVivo 12 software to ensure systematic management.

RESULTS AND DISCUSSION

The following section presents the findings of this study on the adaptive capacity of local governments in disaster-prone areas of Central Sulawesi. The results are organized around key dimensions identified as critical to building resilience: institutional coordination and leadership, knowledge and learning systems, and community participation and collaboration. These dimensions capture how local governments respond to socio-ecological challenges, manage resources, and engage with communities in both preparedness and post-disaster contexts. By examining these themes, the study highlights not only the strengths and successes of local adaptive practices but also the challenges and constraints that limit their effectiveness. The presentation of results emphasizes the experiences and perspectives of government officials, community leaders, and other stakeholders, providing an in-depth understanding of the mechanisms that underpin adaptive governance in regions highly vulnerable to natural hazards.

Institutional Coordination and Leadership

The findings of this study reveal that institutional coordination and leadership are central determinants of local governments' adaptive capacity in responding to socio-ecological challenges in Central Sulawesi. Effective coordination among local government agencies, non-governmental organizations (NGOs), and community institutions was identified as both a critical enabler and a persistent challenge in disaster management. The coordination process typically involves

multiple institutions such as the Regional Disaster Management Agency (BPBD), the Regional Development Planning Agency (Bappeda), the Environmental Agency (DLH), and local village administrations. However, despite formal structures being established, coordination was often fragmented and reactive rather than proactive. This was particularly evident during the post-disaster recovery phase following the 2018 earthquake and tsunami, when institutional responses were sometimes delayed due to overlapping responsibilities and communication gaps between agencies.

One official from BPBD Palu described this condition, stating,

> *"After the earthquake, many agencies worked on similar tasks, but without clear coordination. Sometimes we duplicated efforts while other critical needs were left unattended."* (Interview with BPBD Official, Palu, 2024)

This statement underscores a key issue of overlapping authority that weakens institutional synergy and limits the efficiency of response mechanisms. Such fragmentation reflects what Djalante et al. (2021) identified as a structural weakness in Indonesia's decentralized governance system where the devolution of power to local governments is not always accompanied by strong horizontal coordination mechanisms.

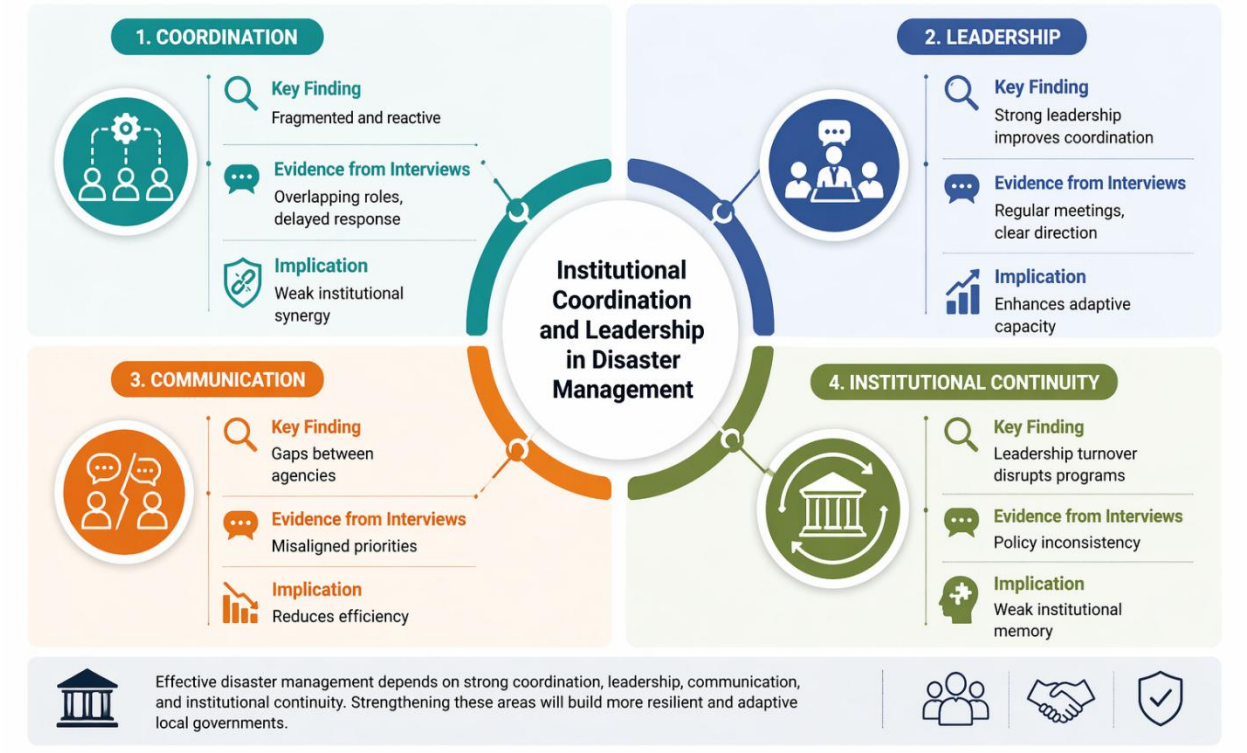

Figure 1. Summary of Institutional Coordination and Leadership Findings

Figure 1 presents a synthesized overview of key findings related to institutional coordination and leadership, which are central components of adaptive capacity in local governance. In the context of this study, titled "Adaptive Capacity of Local Governments to Socio-Ecological Challenges: A Case Study in Disaster-Prone Areas in Central Sulawesi," the table highlights how governance dynamics shape the ability of local institutions to respond effectively to complex socio-ecological risks. The findings demonstrate that coordination among local government agencies remains fragmented and reactive, often characterized by overlapping roles and delayed responses. This condition weakens institutional synergy and limits the effectiveness of disaster management efforts. Communication gaps between agencies further exacerbate inefficiencies, as misaligned priorities hinder collective action. Additionally, frequent leadership turnover disrupts institutional continuity, resulting in inconsistent policies and weakened institutional memory. These structural challenges indicate that adaptive capacity is not solely dependent on formal

institutional arrangements but is deeply influenced by the quality of governance processes and inter-organizational relationships.

The table also reveals that strong and proactive leadership plays a transformative role in overcoming these limitations. Effective leadership fosters coordination, facilitates communication, and aligns institutional priorities, thereby enhancing adaptive capacity. As illustrated in the case of Sigi Regency, leadership initiatives such as regular coordination meetings and inclusive decision-making processes contribute to improved inter-agency collaboration and reduced conflict. Moreover, leadership serves as a critical bridge between government institutions and local communities, ensuring that community knowledge and needs are incorporated into policy responses. There were also examples of effective collaboration when leadership played a decisive role in facilitating inter-agency cooperation. Strong and visionary leadership emerged as a pivotal factor that could mobilize resources, align institutional priorities, and create a sense of shared responsibility among diverse stakeholders. In Sigi Regency, for instance, leadership from the local disaster management office was praised for establishing regular coordination meetings with sectoral agencies and involving community representatives in planning sessions. As expressed by one respondent from Bappeda Sigi,

> *"Our head of BPBD always pushed for joint discussions before making any decision. This habit helped us understand each other's roles and reduced conflicts between departments."* (Bappeda, Sigi Regency, Interview 2024)

This practice not only enhanced institutional coordination but also fostered trust and mutual understanding across agencies a critical element in building long-term adaptive capacity. Leadership effectiveness was also closely tied to the ability to bridge communication gaps between government and community actors. In several cases, local leaders served as mediators who ensured that community feedback was integrated into policy responses, particularly in disaster preparedness and environmental management initiatives. For example, village leaders in Donggala often acted as intermediaries between the government and local residents, helping to interpret technical information and mobilize participation in early warning systems and evacuation planning.

Table 2. Government and BPS Data Supporting Institutional Capacity and Disaster Governance in Central Sulawesi

Indicator	Data (Latest Available)	Source	Relevance to Findings
Disaster Events (Central Sulawesi)	>200 disaster events annually (floods, landslides, earthquakes)	BPS Sulawesi Tengah, 2023	Shows high exposure requiring strong coordination
Villages in Disaster-Prone Areas	±70% of villages categorized as disaster-prone	BPS (Village Potential/PODES)	Indicates need for adaptive governance at local level
Regional Budget Allocation for Disaster Management	<2% of total regional budget (APBD) in many districts	Ministry of Home Affairs / Bappenas Reports	Reflects limited institutional capacity
Local Government Performance Index (Disaster Management)	Moderate–low category in several districts	BNPB Performance Report	Indicates coordination and governance gaps
BPBD Institutional Coverage	All districts have BPBD, but capacity varies significantly	BNPB Indonesia	Shows structural presence but unequal effectiveness
Community Participation Index	Many villages in "developing" category (not "advanced")	BPS (IDM Data)	Reflects uneven participation and capacity

(Village Development Index/IDM)			
Post-Disaster Recovery Duration (Palu 2018)	>3–5 years for infrastructure and settlement recovery	Bappenas & World Bank Reports	Indicates coordination and policy continuity issues

As one community leader in Donggala noted,

> *"People here trust our village head because he communicates directly with us. When the government sends messages through him, we listen and act."* (Donggala Regency, Interview 2024)

This finding highlights the importance of leadership that is not only administrative but also relational anchored in social trust and accessibility. However, the study also found that leadership continuity remains a challenge. Frequent changes in local government personnel, especially following electoral cycles, disrupt institutional memory and weaken coordination structures. When leadership transitions occur without proper knowledge transfer, adaptive strategies often lose momentum. A senior official from the Environmental Agency in Palu reflected,

> *"Every time there is a new administration, we have to start again with new priorities and new policy directions. In many cases, programs that were previously running are discontinued before they can achieve meaningful results. This creates uncertainty within the institution and makes it difficult for us to maintain long-term planning. Staff also need time to readjust to new leadership styles and expectations, which slows down implementation. As a result, coordination with other agencies becomes less effective because everyone is adapting to changes at different speeds. Over time, this cycle weakens institutional consistency and limits our ability to build sustainable strategies for disaster management."* (Palu City, Interview 2024)

Such discontinuity undermines the institutional learning processes necessary for adaptive governance. Overall, the findings indicate that adaptive capacity in Central Sulawesi's local governments depends heavily on the quality of institutional coordination and the strength of leadership commitment. Coordination structures must evolve from ad hoc, event-driven arrangements into continuous, integrated systems that link government agencies, civil society, and communities. Meanwhile, leadership must move beyond hierarchical authority to embrace participatory and collaborative governance principles. As observed in this study, when coordination is consistent and leadership is inclusive, local governments are more capable of mobilizing resources, sustaining community trust, and fostering collective learning all of which are essential for building resilience in disaster-prone socio-ecological systems.

Table 3. Indicators of Institutional and Governance Challenges in Disaster Management

Governance Aspect	National/Regional Data	Interpretation	Link to Your Findings
Inter-agency Coordination	Often categorized as "sectoral" (not integrated)	Weak horizontal coordination	Matches fragmented coordination finding
Leadership Stability	Frequent rotation due to political cycles (every 5 years)	Disrupts policy continuity	Supports institutional continuity issue
Knowledge Management	Limited documentation systems at local level	Knowledge loss after staff transfer	Supports weak institutional memory
Training Frequency	Irregular and project-based	Lack of continuous learning	Matches reactive learning system

Community Involvement	Often consultative, not participatory	Tokenistic participation	Supports participation limitation

Data presented in Tables 2 and 3 further reinforce the findings of this study. Government and BPS data indicate that Central Sulawesi faces high disaster exposure, with more than 200 disaster events annually and a large proportion of villages categorized as disaster-prone. Despite the existence of formal institutions such as BPBD in all districts, variations in institutional capacity, limited budget allocation, and moderate performance levels highlight structural weaknesses in disaster governance. Governance indicators reveal persistent challenges in inter-agency coordination, leadership continuity, and knowledge management. The sectoral nature of coordination and frequent leadership turnover due to political cycles contribute to fragmented institutional responses and policy inconsistency. These conditions align with the interview findings, which emphasize overlapping roles, communication gaps, and weak institutional memory. Data on community participation and village development status suggest that adaptive capacity is uneven across regions, with many communities still lacking meaningful involvement in decision-making processes. This supports the study's argument that adaptive governance requires not only institutional strengthening but also inclusive and sustained collaboration between government and communities.

Knowledge and Learning Systems

The study found that knowledge and learning systems are vital components in strengthening the adaptive capacity of local governments facing socio-ecological challenges in Central Sulawesi. The effectiveness of disaster response and environmental management largely depends on how knowledge is acquired, shared, and applied within and across institutions. However, the research revealed that knowledge management in local governments remains largely informal and fragmented. Learning often occurs in response to crises rather than being embedded in continuous institutional processes. This reactive pattern reflects describe as a lack of institutionalized learning structures where lessons from past experiences are not systematically captured or transferred into policy frameworks. In many cases, local government officers relied heavily on personal experience and collective memory to guide decision-making. While these experiential insights are valuable, the absence of documentation and structured knowledge-sharing platforms limits their long-term usefulness.

Table 4. Government and BPS Data Supporting Knowledge and Learning Systems in Disaster Governance

Indicator	Data (Latest Available)	Source	Relevance to Interview Findings
Frequency of Disaster Events in Central Sulawesi	>200 events/year (floods, landslides, earthquakes)	BPS Sulawesi Tengah, 2023	Frequent disasters trigger reactive learning patterns
Availability of Disaster Risk Documents (RPB/RPJMD integration)	Not fully integrated across districts	BNPB & Bappenas Reports	Indicates weak institutionalized knowledge systems
Training and Capacity Building Programs	Mostly project-based and irregular	BNPB Indonesia	Supports lack of continuous learning structures
Disaster Education & Simulation Coverage	Limited and uneven across regions	BNPB & Ministry of Social Affairs	Shows knowledge not systematically disseminated
Data Management Systems in Local Government	Many regions lack integrated disaster databases	Bappenas	Confirms weak documentation and knowledge storage

Human Resource Rotation in Local Government	Frequent rotation every 3–5 years	Ministry of Home Affairs	Leads to institutional memory loss
Village Disaster Preparedness Programs (Destana)	Not all villages covered	BNPB (Destana Program Data)	Indicates uneven knowledge transfer at community level

As a planning officer in Sigi explained,

> *"Sometimes we learn more effectively by discussing with colleagues from other districts. They share their experiences, what worked and what failed, so we can avoid repeating the same mistakes. But often, this knowledge is not formally documented, so when staff change, the knowledge is lost. We also try to learn from local communities, because they have long understood environmental signs better than us."* (Sigi Regency, 2024)

These interactions foster social learning, which enhances cross-sectoral understanding and builds trust among institutions key elements for adaptive capacity development. The study also revealed that community-based knowledge and local wisdom contribute significantly to adaptation strategies in disaster-prone regions. Traditional ecological knowledge, passed down through generations, provides valuable insights into early warning signs, environmental changes, and sustainable land practices. BPBD has started recognizing and integrating this traditional knowledge into its preparedness and awareness programs, showing progress toward hybrid learning systems that blend local wisdom with scientific data. However, the integration between local and scientific knowledge remains limited by institutional silos and weak collaboration between governments, communities, and academia. Universities such as Tadulako University have supported risk mapping and training initiatives, yet these efforts are often short-term and project-based.

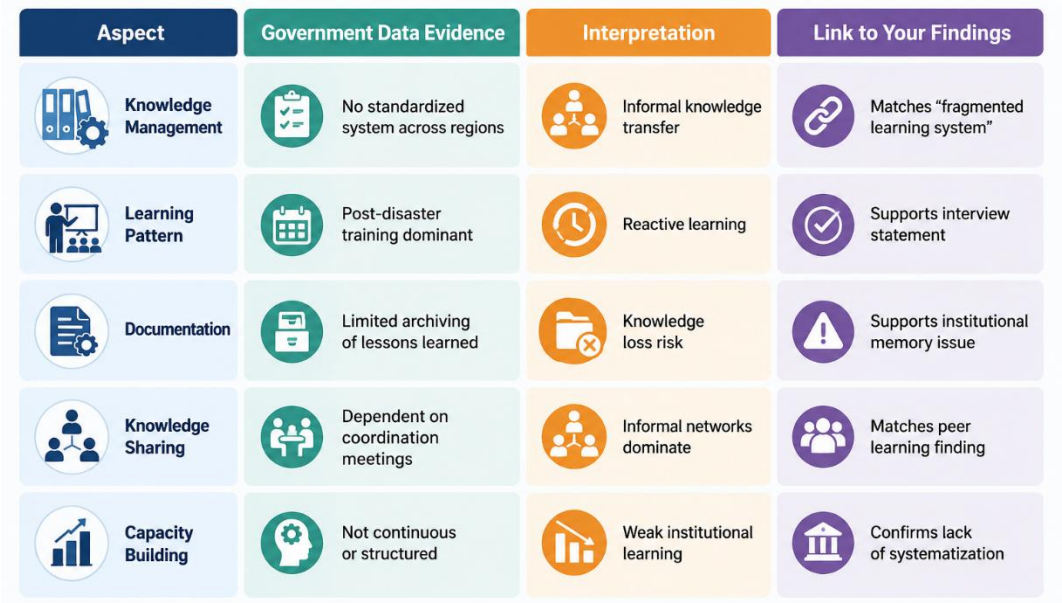

Figure 2. Indicators of Knowledge Gaps and Learning System Challenges

The figure above further support the findings of this study regarding the limitations of knowledge and learning systems in local governance. Government and BPS data indicate that disaster events in Central Sulawesi occur frequently, with more than 200 incidents annually, which reinforces the tendency for learning processes to be reactive rather than institutionalized. The lack of integration of disaster risk documents into regional planning and the absence of standardized knowledge management systems highlight structural weaknesses in capturing and transferring institutional knowledge. Capacity-building programs, which are often project-based and irregular, further contribute to the absence of continuous learning mechanisms within local government institutions. Frequent rotation of government personnel exacerbates the loss of institutional memory, as knowledge is not systematically documented or retained.

This aligns with the interview findings, where respondents emphasized reliance on personal experience and informal knowledge exchange. Limited coverage of community-based disaster preparedness programs (such as *Desa Tangguh Bencana*) indicates that knowledge dissemination remains uneven across regions. Overall, these data confirm that while informal learning networks play an important role, the absence of structured and sustainable knowledge systems significantly constrains the adaptive capacity of local governments. This gap prevents the institutionalization of knowledge transfer and hinders the establishment of adaptive learning systems that evolve continuously. Moreover, the study identified that training and capacity-building programs are still sporadic, with limited focus on reflective learning and evaluation. Many local officials expressed the need for regular technical training, scenario simulations, and after-action reviews to evaluate past responses and improve future performance.

Community Participation and Collaboration

The findings of this study indicate that community participation and collaboration are crucial factors shaping the adaptive capacity of local governments in disaster-prone areas of Central Sulawesi. The research demonstrates that effective adaptation does not rely solely on institutional capabilities; it also depends on active engagement of local communities in decision-making, disaster preparedness, and recovery processes. Community involvement fosters shared ownership, enhances trust between citizens and government, and ensures that adaptive strategies are relevant to local needs and socio-cultural contexts.

Table 5. Government and BPS Data Supporting Community Participation in Disaster Governance

Indicator	Data (Latest Available)	Source	Relevance to Interview Findings
Villages with Disaster Risk Exposure	±70% villages in disaster-prone areas	BPS (PODES Data)	Requires strong community involvement
Desa Tangguh Bencana (Destana) Coverage	Not all villages covered (limited implementation)	BNPB Indonesia	Indicates uneven community preparedness
Village Development Index (IDM)	Many villages still “developing” status	BPS (IDM Data)	Reflects limited participation capacity
Community Participation in Village Meetings (Musrenbang)	Participation exists but often consultative	Ministry of Villages (Kemendesa)	Supports “tokenistic participation” finding
Number of NGOs/CBOs in Disaster Areas	Increasing but uneven distribution	BPS & Ministry of Social Affairs	Shows role of intermediaries
Disaster Preparedness Training Participation	Limited and not continuous	BNPB Reports	Indicates gaps in community engagement
Early Warning System Coverage	Not fully community-based in all regions	BMKG & BNPB	Shows partial involvement of communities

In practice, the study found varying levels of participation across districts. In Palu, formal mechanisms such as community forums and village meetings are often used to solicit input on disaster risk management plans. However, the depth and quality of engagement differ depending on the leadership and capacity of local officials. One village leader emphasized,

> *“We are invited to meetings about disaster planning, but sometimes our opinions are not taken seriously. The government writes the plan first, then asks us to approve it.”* (Palu City, 2024)

This statement highlights a common challenge in top-down approaches, where participation exists in form but not always in substance. Despite these limitations, even limited participation

has provided opportunities for communities to voice their experiences, share local knowledge, and contribute to early warning systems. Collaboration between local governments and community organizations was found to be a key driver for successful adaptive initiatives. NGOs, religious groups, and community-based organizations often act as intermediaries, bridging gaps between government programs and local populations. In Sigi, a representative from an NGO explained,

> *"We work with the government to organize disaster drills and awareness campaigns. Communities trust us more than officials, so our involvement helps ensure people follow the guidance."* (Sigi Regency, 2024)

Such partnerships enhance both the legitimacy and effectiveness of adaptive measures, particularly in mobilizing resources and coordinating emergency responses. Collaborative networks also facilitate knowledge sharing and collective learning, enabling communities and government agencies to jointly reflect on past experiences and improve preparedness for future hazards. The study also found that community participation is strengthened when local residents are given clear roles and responsibilities. The empowerment of community members fosters a sense of ownership and accountability, which reinforces adaptive governance. However, the research highlighted several barriers to meaningful participation and collaboration. Limited awareness of disaster risks, social inequalities, and hierarchical power dynamics often restrict marginalized groups from engaging effectively. When local governments actively engage residents, integrate community knowledge, and collaborate with civil society organizations, adaptive strategies are more context-sensitive, sustainable, and effective. Strengthening these participatory mechanisms, addressing social barriers, and fostering long-term collaboration between government and communities are essential steps for building resilient socio-ecological systems in disaster-prone regions of Central Sulawesi.

Table 6. Indicators of Community Participation and Collaboration Challenges

Aspect	Government Data Evidence	Interpretation	Link to Your Findings
Participation Level	Mostly consultative (Musrenbang)	Formal but limited influence	Matches "top-down participation"
Inclusiveness	Marginal groups underrepresented	Unequal participation	Supports inequality finding
Collaboration	NGOs active but not fully integrated	Partial collaboration	Matches intermediary role
Community Capacity	Many villages not yet "independent"	Limited local capacity	Affects adaptive capacity
Preparedness Programs	Destana not evenly distributed	Uneven resilience	Matches variation across districts

Government and BPS data indicate that a large proportion of villages in Central Sulawesi are located in disaster-prone areas, highlighting the critical need for strong community engagement in adaptation processes. However, the implementation of community-based programs such as *Desa Tangguh Bencana (Destana)* remains uneven, indicating disparities in preparedness and participation across regions. Participation mechanisms such as *Musrenbang* (village development planning forums) are widely implemented, yet they are often consultative in nature, where community input does not always influence final decision-making. This aligns with the interview findings that participation is sometimes procedural rather than substantive. Data on village development status further suggest that many communities still have limited capacity to engage effectively in governance processes. In addition, while NGOs and community-based organizations play an important role in bridging communication gaps between government and communities, their involvement is not yet fully integrated into formal governance systems. These data reinforce the conclusion that while community participation exists, it remains uneven, often symbolic, and constrained by structural and institutional limitations. Strengthening inclusive and meaningful participation is therefore essential for enhancing adaptive capacity in disaster-prone regions.

Discussion

Implications for Enhancing Adaptive Capacity in Local Disaster Management

This study provides critical insights into the adaptive capacity of local governments in Central Sulawesi, Indonesia, emphasizing the pivotal role of institutional coordination, leadership, knowledge systems, and community collaboration in disaster resilience. The findings underscore the necessity for a paradigm shift in disaster management moving from reactive, siloed approaches to integrated, proactive strategies that leverage both institutional and community strengths (Cid & Lerner, 2023; Cedergren & Hassel, 2024). The research highlights that effective disaster management hinges on robust institutional coordination and visionary leadership. As noted by the World Bank, strengthening disaster resilience in Indonesian cities necessitates improved coordination among government agencies, NGOs, and community organizations to minimize loss of life and reduce damage to assets (Fuady et al., 2025). However, the study reveals persistent challenges in achieving seamless coordination, often due to overlapping responsibilities and communication gaps between agencies. This fragmentation can lead to duplicated efforts and missed opportunities for synergy.

Leadership emerges as a critical factor in overcoming these challenges. Strong, inclusive leadership can bridge institutional divides, align diverse stakeholders, and foster a shared vision for disaster resilience. The study's findings align with previous research by Djalante et al., which emphasizes the importance of leadership in facilitating adaptive governance and ensuring that disaster management strategies are both effective and equitable (Salvador & Sancho, 2023). The study also underscores the importance of institutionalizing knowledge and learning systems within local governments (Omweri, 2024; Igalla et al., 2021). While experiential learning plays a significant role, the lack of formalized mechanisms for knowledge documentation and dissemination hampers long-term adaptive capacity, integrating disaster risk reduction and climate change adaptation into spatial planning requires systematic data collection, analysis, and plan formulation. The absence of such systems in Central Sulawesi indicates a critical gap that needs to be addressed to enhance resilience (Salvador & Sancho, 2021).

The integration of traditional ecological knowledge with scientific data can enrich disaster preparedness and response strategies (Hermans et al., 2022; Wu & Chen, 2023; Vasileiou et al., 2022; Pandey & Basnet, 2022). As observed in Donggala, local communities' reliance on indigenous indicators for hazard prediction provides valuable insights that, if systematically incorporated, could improve early warning systems and community engagement in disaster risk management. Community participation and collaboration are essential for building trust and ensuring that disaster management strategies are contextually relevant (Bonfanti et al., 2023). The study reveals that while formal mechanisms for community engagement exist, their effectiveness is often compromised by superficial involvement and lack of genuine empowerment. Mercer et al. argue that meaningful participation requires not only the inclusion of communities in decision-making processes but also the empowerment of local actors to take ownership of disaster resilience initiatives (Shmueli et al., 2021; Kangana et al., 2024).

The role of community-based organizations and NGOs in facilitating collaboration between local governments and communities is also critical (Abiddin et al., 2022; Nederhand, 2021). These intermediaries can bridge gaps in communication and trust, ensuring that community knowledge and needs are adequately represented in disaster management planning. The study's findings align with previous research by Dwirahmadi, which emphasizes the importance of collaborative governance in enhancing community resilience to disasters (Ngulube et al., 2024). The findings of this study have several policy and institutional implications. First, there is a need for the development and implementation of comprehensive disaster management frameworks that promote inter-agency coordination and integrate community perspectives. Such frameworks should include clear roles and responsibilities, standardized communication protocols, and mechanisms for joint planning and decision-making (Rashidfarokhi, 2024; Aldunce et al., 2021; Kristian & Ikhsan, 2024).

Second, local governments should invest in building institutional memory through the establishment of knowledge management systems that facilitate the documentation, sharing, and

application of lessons learned from past disasters (Elvegård et al., 2024; Lansing et al., 2023). This includes creating databases, conducting regular training sessions, and fostering a culture of continuous learning within disaster management agencies. Third, policies should be enacted to promote inclusive participation, ensuring that marginalized groups, including women, youth, and indigenous communities, have a voice in disaster management processes. This can be achieved through targeted outreach, capacity-building initiatives, and the establishment of platforms for dialogue and collaboration. Finally, fostering partnerships between local governments, academic institutions, and civil society organizations can enhance the effectiveness of disaster management strategies. Collaborative research, joint training programs, and shared resources can strengthen the evidence base for decision-making and improve the overall resilience of communities.

CONCLUSION

This study demonstrates that the adaptive capacity of local governments in disaster-prone areas of Central Sulawesi is shaped by the interplay of institutional coordination, leadership, knowledge and learning systems, and community participation. Effective disaster governance requires not only strong organizational structures and visionary leadership but also the systematic integration of experiential, scientific, and local knowledge to inform decision-making. Community engagement and collaborative networks further enhance resilience by ensuring that policies are contextually relevant and socially accepted. However, persistent challenges such as fragmented coordination, limited institutional memory, inconsistent knowledge management, and unequal participation underscore the need for comprehensive, inclusive, and sustained approaches to capacity building. By addressing these gaps, local governments can move from reactive disaster management toward proactive, knowledge-driven, and adaptive governance, ultimately strengthening socio-ecological resilience and safeguarding communities against recurrent hazards.

REFERENCES

Abiddin, N. Z., Ibrahim, I., & Abdul Aziz, S. A. (2022). Non-governmental organisations (NGOs) and their part towards sustainable community development. *Sustainability*, *14*(8), 4386. https://doi.org/10.3390/su14084386

Aldunce, P., Beilin, R., Handmer, J., & Howden, M. (2021). Stakeholder participation in building resilience to disasters in a changing climate. In *Environmental hazards and resilience* (pp. 164-179). Routledge.

Ayuningtyas, D., Windiarti, S., Hadi, M. S., Fasrini, U. U., & Barinda, S. (2021). Disaster preparedness and mitigation in Indonesia: A narrative review. *Iranian journal of public health*, *50*(8), 1536. https://doi.org/10.18502/ijph.v50i8.6799

Baker, J. J., Kearney, T., Laud, G., & Holmlund, M. (2021). Engaging users in the sharing economy: individual and collective psychological ownership as antecedents to actor engagement. *Journal of service management*, *32*(4), 483-506. https://doi.org/10.1108/JOSM-08-2020-0300

Bonfanti, R. C., Oberti, B., Ravazzoli, E., Rinaldi, A., Ruggieri, S., & Schimmenti, A. (2023). The role of trust in disaster risk reduction: a critical review. *International journal of environmental research and public health*, *21*(1), 29. https://doi.org/10.3390/ijerph21010029

Bullock, R. C., Diduck, A., Luedee, J., & Zurba, M. (2022). Integrating social learning, adaptive capacity and climate adaptation for regional scale analysis: a conceptual framework. *Environmental Management*, *69*(6), 1217-1230. https://doi.org/10.1007/s00267-022-01630-x

Cedergren, A., & Hassel, H. (2024). Building organizational adaptive capacity in the face of crisis: Lessons from a public sector case study. *International Journal of Disaster Risk Reduction*, *100*, 104235.

Cid, A., & Lerner, A. M. (2023). Local governments as key agents in climate change adaptation: challenges and opportunities for institutional capacity-building in Mexico. *Climate Policy*, *23*(5), 649-661.

Elvegård, R., Andreassen, N., & Badu, J. (2024). Building collaboration and trust in emergency preparedness: a model for planning collaboration exercises. *Safety in Extreme Environments*, *6*(4), 319-331. https://doi.org/10.1007/s42797-024-00107-w

Fuady, M., Buraida, Kevin, M. A., Farrel, M. R., & Triaputri, A. (2025). Enhancing urban resilience: Opportunities and challenges in adapting to natural disasters in Indonesian cities. *Sustainability*, *17*(4), 1632. https://doi.org/10.3390/su17041632

Hammond, S. P., Polizzi, G., & Bartholomew, K. J. (2023). Using a socio-ecological framework to understand how 8–12-year-olds build and show digital resilience: A multi-perspective and multimethod qualitative study. *Education and Information Technologies*, *28*(4), 3681-3709. https://doi.org/10.1007/s10639-022-11240-z

Haque, C. E., & Doberstein, B. (2021). Adaptive governance and community resilience to cyclones in coastal Bangladesh: Addressing the problem of fit, social learning, and institutional collaboration. *Environmental Science & Policy*, *124*, 580-592. https://doi.org/10.1016/j.envsci.2021.08.007

Hermans, T. D., Šakić Trogrlić, R., van den Homberg, M. J., Bailon, H., Sarku, R., & Mosurska, A. (2022). Exploring the integration of local and scientific knowledge in early warning systems for disaster risk reduction: a review. *Natural Hazards*, *114*(2), 1125-1152. https://doi.org/10.1007/s11069-022-05468-8

Husein, R., & Iuchi, K. (2025, December). Towards Sustainable Disaster Prevention: Strengthening Environment-based Disaster Governance in Indonesia. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1566, No. 1, p. 012010). IOP Publishing. https://doi.org/10.1088/1755-1315/1566/1/012010

Igalla, M., Edelenbos, J., & van Meerkerk, I. (2021). Institutionalization or interaction: Which organizational factors help community-based initiatives acquire government support?. *Public Administration*, *99*(4), 803-831. https://doi.org/10.1111/padm.12728

Järvelä, M. (2023). Dimensions of cultural sustainability—Local adaptation, adaptive capacity and social resilience. *Frontiers in Political Science*, *5*, 1285602. https://doi.org/10.3389/fpos.2023.1285602

Kangana, N., Kankanamge, N., De Silva, C., Goonetilleke, A., Mahamood, R., & Ranasinghe, D. (2024). Bridging community engagement and technological innovation for creating smart and resilient cities: A systematic literature review. *Smart Cities*, *7*(6), 3823-3852. https://doi.org/10.3390/smartcities7060147

Khatter, A., Thalaachawr, K., & Blyth, M. (2024). Student engagement and fostering ownership of learning. *Journal of Applied Learning and Teaching*, *7*(1), 291-302. https://doi.org/10.37074/jalt.2024.7.1.38

Kristian, I., & Ikhsan, O. M. F. (2024). Integrating community-based approaches into national disaster management policies: Lessons from recent natural disasters. *The International Journal of Law Review and State Administration*, *2*(4), 115-125.

Lansing, A. E., Romero, N. J., Siantz, E., Silva, V., Center, K., Casteel, D., & Gilmer, T. (2023). Building trust: Leadership reflections on community empowerment and engagement in a large urban initiative. *BMC Public Health*, *23*(1), 1252. https://doi.org/10.1186/s12889-023-15860-z

Nederhand, J. (2021). Evaluating the role of government collaboration in the perceived performance of community-based nonprofits: Three propositions. *Journal of Public Administration Research and Theory*, *31*(4), 634-652. https://doi.org/10.1093/jopart/muaa059

Ngulube, N. K., Tatano, H., & Samaddar, S. (2024). Toward participatory participation: A community perspective on effective engagement in post-disaster recovery and reconstruction. *Community Development*, *55*(6), 895-915. https://doi.org/10.1080/15575330.2024.2382169

Omweri, F. S. (2024). A systematic literature review of e-government implementation in developing countries: examining urban-rural disparities, institutional capacity, and socio-cultural factors in the context of local governance and progress towards SDG 16.6. *International Journal of Research and Innovation in Social Science*, *8*(8), 1173-1199. https://dx.doi.org/10.47772/IJRISS.2024.808088

Pandey, C. L., & Basnet, A. (2022). Managing disasters integrating traditional knowledge and scientific knowledge systems: a study from Narayani basin, Nepal. *Disaster Prevention and Management: An International Journal*, *31*(4), 361-373. https://doi.org/10.1108/DPM-04-2021-0136

Putra, D. I., & Matsuyuki, M. (2020). The disaster-management capabilities of local governments: a case study in Indonesia. *Journal of Disaster Research*, *15*(4), 471-480. https://doi.org/10.20965/jdr.2020.p0471

Rashidfarokhi, A. (2024). Resilience by whom and for whom? Empowering local communities for community-led resilience-building. *Real Estate and Sustainable Crisis Management in Urban Environments*, *39*.

Refulio-Coronado, S., Lacasse, K., Dalton, T., Humphries, A., Basu, S., Uchida, H., & Uchida, E. (2021). Coastal and marine socio-ecological systems: A systematic review of the literature. *Frontiers in Marine Science*, *8*, 648006. https://doi.org/10.3389/fmars.2021.648006

Riyadi, D. S., Rustiadi, E., Widiatmaka, & Fauzi, A. (2026). Assessing Environmental Carrying Capacity and Disaster Risk in Spatial Utilization: A GIS-Based Study of East Java Province, Indonesia. *Land*, *15*(4), 537. https://doi.org/10.3390/land15040537

Salvador, M., & Sancho, D. (2021). The role of local government in the drive for sustainable development public policies. An analytical framework based on institutional capacities. *Sustainability*, *13*(11), 5978. https://doi.org/10.3390/su13115978

Salvador, M., & Sancho, D. (2023). Local governments facing turbulence: robust governance and institutional capacities. *Social Sciences*, *12*(8), 462. https://doi.org/10.1016/j.ijdrr.2023.104235

Shmueli, D. F., Ozawa, C. P., & Kaufman, S. (2021). Collaborative planning principles for disaster preparedness. *International Journal of Disaster Risk Reduction*, *52*, 101981. https://doi.org/10.1016/j.ijdrr.2020.101981

Talubo, J. P., Morse, S., & Saroj, D. (2022). Whose resilience matters? A socio-ecological systems approach to defining and assessing disaster resilience for small islands. *Environmental Challenges*, *7*, 100511. https://doi.org/10.1016/j.envc.2022.100511

Uzorka, A., Akiyode, O., & Isa, S. M. (2024). Strategies for engaging students in sustainability initiatives and fostering a sense of ownership and responsibility towards sustainable development. *Discover Sustainability*, *5*(1), 320. https://doi.org/10.1007/s43621-024-00505-x

Vasileiou, K., Barnett, J., & Fraser, D. S. (2022). Integrating local and scientific knowledge in disaster risk reduction: A systematic review of motivations, processes, and outcomes. *International Journal of Disaster Risk Reduction*, *81*, 103255. https://doi.org/10.1016/j.ijdrr.2022.103255

Vossoughi, S., Marin, A., & Bang, M. (2023). Toward just and sustainable futures: Human learning and relationality within socio-ecological systems. *Review of Research in Education*, *47*(1), 218-273.

Wamsler, C., & Johannessen, Å. (2020). Meeting at the crossroads? Developing national strategies for disaster risk reduction and resilience: Relevance, scope for, and challenges to, integration. *International journal of disaster risk reduction*, *45*, 101452. https://doi.org/10.1016/j.ijdrr.2019.101452

Wu, J. Y., & Chen, L. C. (2023). Traditional indigenous ecological knowledge to enhance community-based disaster resilience: Taiwan mountain area. *Natural Hazards Review*, *24*(1), 05022014. https://doi.org/10.1061/NHREFO.NHENG-1673