GOVERNANCE IN THE IMPLEMENTATION OF DISASTER RISK EARLY WARNING POLICY ON COMMUNITY RESPONSE

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Abstract

The gap between the availability of early warning systems and the quality of community response to disasters in Indonesia shows a fundamental problem in the governance dimension of policy implementation. This study aims to analyze how governance shapes the pattern of community response to early warning by using George C. Edwards III's policy implementation theoretical framework which includes the dimensions of communication, resources, executive disposition, and bureaucratic structure. The Systematic Literature Review (SLR) approach is used to systematically identify and synthesize the findings of previous research. The results of the study show that the pattern of community response is not determined by the existence of an early warning system alone, but by the quality of governance in its implementation. Unclear and uncontextual communication, limited and inequitable resources, low commitment of implementers, and a fragmented bureaucratic structure simultaneously form a tendency for public responses to be weak, late, or ignore warnings. Instead, integrated, adaptive, and contextual governance contributes to the formation of faster and more effective responses. This study emphasizes the importance of comprehensive governance reform by integrating the four dimensions of policy implementation to improve the effectiveness of early warning systems in disaster risk reduction in Indonesia.

Keywords: governance, policy implementation, early warning system, community response, disaster risk management

1. Introduction

Natural disasters are a real threat faced by various regions in Indonesia, ranging from floods and landslides to volcanic eruptions, occurring with high frequency every year (Hakim et al., 2025). In an effort to reduce the impact of these events, the government has developed various early warning systems as disaster risk mitigation instruments (Aprianti et al., 2025). Early warning systems are understood as a mechanism to detect potential hazards and communicate information to the public for self-rescue measures (Trogrlić et al., 2022). The existence of technological infrastructure and early warning policies does not necessarily guarantee an adequate public response when an alert is issued (Pescaroli et al., 2025).

The phenomenon of the gap between the availability of early warning systems and the quality of community response is reflected in various disaster contexts in Indonesia. In coastal areas, fishing communities often ignore extreme weather warnings due to economic dependence on shipping activities (Kyren, 2024). Natural tourist destinations, visitors, and area managers

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show their unpreparedness to face warnings of geological and hydrometeorological disasters from the authorities (Ni'mah et al., 2021). The case of the relocation of people affected by the eruption of Mount Sinabung in Karo Regency shows that even though it was given early, the response to the evacuation of the community was hampered by various non-technical factors related to the implementation of local government policies (Ginting et al., 2022). Urban flooding: the implementation of early warning system in Jakarta has not resulted in an effective evacuation response for residents in vulnerable zones (Parameswari & Warsono, 2024),

The implementation of a community-based flood disaster preparedness early warning system faces obstacles in citizen participation and response readiness (Handayani et al., 2023). The effectiveness of the implementation of the early warning system in Malang City in floods has not been optimal due to weak coordination between technological devices, apparatus implementers, and the community (Maulana et al., 2025). This village has been designated as a Disaster Resilient Village (DESTANA); the design of early warning devices based on Internet of Things technology has not been followed by adequate community empowerment to respond to warnings quickly and appropriately (Azzududdin, 2025).

Demonstrating the failure of community responses to early warnings is not only due to unpredictable natural factors or individual misunderstandings, but is more fundamentally due to the governance dimension in disaster management policies (Ruchban et al., 2024). Central and local governments have a central role as key actors in disaster risk management through regulatory authorities, resource allocation, and institutional coordination (Alhadi et al., 2023). There is a significant gap between the written policies formulated and the realities of implementation on the ground (Sadiq et al., 2023).

The gap in the implementation of early warning policies reflects several crucial aspects. First, at the policy communication level, warning information conveyed through various technological channels such as the Internet of Things, Telegram Bots, and LoRa systems often does not reach the public effectively or is not understood by the recipient of the message (Hambali et al., 2022; Mardiatno et al., 2021; Sumardiono et al., 2025). The phenomenon of the "crying wolf effect" exacerbates this situation, as warnings that are too frequent or inaccurate lower people's confidence and readiness to respond (Sawada et al., 2021). Second, in terms of resources, many regions experience limitations in early warning infrastructure, system maintenance budgets, and human resource capacity to manage (Suryani et al., 2023). The landslide early warning system in Cililin Village, West Bandung, for example, revealed technical obstacles in data transmission due to dense vegetation and geographical conditions affecting signal quality (Fitriani et al., 2023). Third, the disposition or attitude of policy implementers at the government bureaucratic level determines the success of the early warning system in triggering a rapid community response (Helmi & Muthohharoh, 2024).

The study examined community-based early warning systems in three villages in East Nusa Tenggara, involving 20 key informants and six focus group discussions (FGDs) to explore implementation, government commitment, and community participation (Helmi & Muthohharoh, 2024). Fourth, the complex and often fragmented bureaucratic structure between agencies causes coordination in early warning management to be inefficient (Mardiatno et al., 2021). The governance of the Rawapening landscape involving various stakeholders shows that the absence

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of a clear coordination mechanism between government agencies hinders the effectiveness of the early warning system for environmental disaster risks (Mardiatno et al., 2021). The platform's collaborative governance innovation, Petabencana.id, demonstrates the potential to increase the effectiveness of early warning through active community participation in disaster information reporting and verification (Hidayat, 2020). The adoption and integration of this kind of innovation within the framework of government policy faces structural and bureaucratic cultural barriers (Heriyanto et al., 2025). Although adaptive governance frameworks for disaster risk reduction are conceptually developed, their implementation at the local level requires strengthening institutional capacity and contextual adjustment (Kyren, 2024).

Various studies examine early warning systems in the context of disasters; most studies focus on technical aspects such as technology development and system effectiveness. Research that examines community responses tends to see them as behavioral phenomena without being deeply associated with the policy governance dimension. In addition, studies that comprehensively integrate aspects of communication, resources, executive disposition, and bureaucratic structure in policy implementation are still limited.

Based on these gaps, this study offers novelty by analyzing the policy implementation of the early warning system through a comprehensive governance approach using the theoretical framework of George C. Edwards III. In contrast to previous research, which tended to be partial, this study integrates four main dimensions, namely communication, resources, disposition, and bureaucratic structure, in one systematic analysis. In addition, this study uses the Systematic Literature Review (SLR) approach to identify governance patterns that affect community responses. Thus, this research makes a theoretical and conceptual contribution to the study of disaster policy implementation in Indonesia.

2. Methods

This study uses a descriptive qualitative approach with the SLR method to examine governance in the implementation of disaster risk early warning policies and community response. A qualitative approach is used to understand the implementation of policies as well as the factors that affect their effectiveness (Braun & Clarke, 2021). SLR is conducted systematically to identify and synthesize relevant previous research (Astagisa, 2025). Literature searches were conducted through Garuda Portal and Google Scholar using the keywords "governance", "policy implementation", "disaster early warning", "disaster early warning", and "community response". Publication year range was 2020–2025. The selected literature consists of Indonesian or English-language scientific journals that are in accordance with the research focus. The selection was carried out through a study of titles, abstracts, and complete texts until the final article analyzed was obtained. The analysis uses the George C. Edward III (1980) Policy Implementation Theory Framework, which includes the dimensions of communication, resources, disposition, and bureaucratic structure (Makmur, 2023).

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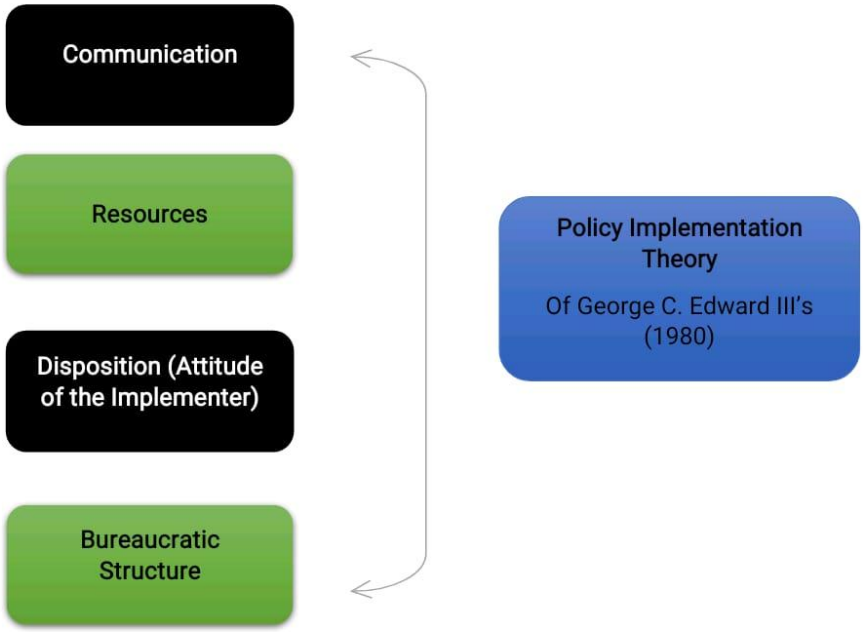

Figure 1. Visualization of George C. Edward III's Policy Implementation Theory
Source: The author's visualization is based on the policy implementation theory of George C. Edward III (1980).

3. Results and Discussion

a) Communication

Communication of disaster early warning policies in Indonesia faces problems that are not only technical, but also related to social, cultural, and institutional aspects (Ida et al., 2025). Various studies show that weak coordination between technological devices, policy implementers, and the community causes warning information not to be delivered effectively, as seen in the implementation of the flood early warning system in Malang City (Maulana et al., 2025). This condition confirms that the availability of technological infrastructure does not guarantee the effectiveness of the system without being supported by a structured and coordinated communication mechanism (Sedyowati et al., 2024). Limited access and low digital literacy cause the use of technology such as the Internet of Things (IoT), Telegram Bots, and LoRa not to reach all levels of society evenly (Hambali et al., 2022). The development of technology-based systems in the Disaster Resilient Village shows that the effectiveness of early warning systems depends on the ability of communication to reach and be understood by the community (Azzududdin, 2025). Hambali et al. (2022) reported an average error of 0.48% in water-level measurements using an ultrasonic sensor in their flood early warning system in Gunungsari District. The level of public trust is an important factor in this context, where too frequent but inaccurate warnings cause a cry wolf effect and reduce people's readiness to respond to the next warning (Sawada et al., 2021). The situation shows that the accuracy and consistency of information are the main prerequisites in maintaining the credibility of the early warning system.

The socio-economic dimension shows a significant influence on the community's

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response. Fishermen in coastal areas continue to carry out sea activities despite extreme weather warnings due to economic pressure (Kyren, 2024), so risk communication cannot be separated from the livelihood of the community (Pienaah et al., 2023). In this context, communication effectiveness requires an approach that is not only informative, but also considers economic aspects through the provision of alternatives or compensation mechanisms (Silaban, 2023). Clarity and consistency of message are also decisive factors in decision-making. Information that is not integrated or overly technical creates confusion and delay in response (Trogrlić et al., 2022), while specific and easy-to-understand messages are more effective in encouraging evacuation; a review of 22 studies on mobile emergency alerts noted that evidence on public behavioral responses remained limited and was often of poor quality. (Mowbray et al., 2023). Diverse local conditions, including differences in literacy, language, and communication channel preferences, suggest that standardization of messaging needs to be accompanied by flexibility of implementation (Helmi & Muthohharoh, 2024).

Communication complexity is also seen in tourist areas and urban areas. The diversity of visitor backgrounds in tourist areas demands a multilingual and multi-channel communication system (Ni'mah et al., 2021) while in urban areas such as Jakarta there is a gap between the sophistication of technology and the ability of the community to understand the information conveyed (Parameswari & Warsono, 2024). Coordination problems between agencies, such as in Rawapening governance, also show that unintegrated communication is an obstacle in the delivery of disaster risk information (Mardiatno et al., 2021). The low participation of the community in community-based systems, such as SIBAT, shows that policy communication has not been running optimally due to the lack of sustainable socialization (Handayani et al., 2023). These findings show that the problem of early warning communication does not stand alone, but is interrelated in the form of limited access, low public trust, and incompatibility of messages with social conditions of the community. In such conditions, strengthening communication policies needs to be directed towards a more adaptive, inclusive, and community-based approach.

b) Resources

The availability of resources is a fundamental factor in determining the effectiveness of the implementation of disaster early warning policies in Indonesia. The resources in question not only include technological infrastructure, but also include operational budget support and human resource capacity in managing and operating the system by 2025 (Aprianti et al., 2025; Suryani et al., 2023). Various studies show that limitations in these three aspects are still a consistent problem in various regions. Technical obstacles often arise due to unfavorable geographical conditions. Landslide early warning systems in areas with dense vegetation show disruptions in data transmission, thus hindering the delivery of information in real-time (Fitriani et al., 2023). This condition shows that the effectiveness of technology depends heavily on conformity with environmental characteristics, not solely on the sophistication of the devices used.

Budget limitations are also a significant obstacle in maintaining the sustainability of the system. Device maintenance, sensor calibration, and replacement of damaged components require ongoing financial support, which in many cases has not yet been a priority in local

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policies (Aprianti et al., 2025; Elizabeth, 2025). As a result, the systems that have been built cannot function optimally in the long term. In addition, the capacity of human resources is an equally important factor. The lack of training and capacity building for system operators causes the available technology to not be utilized to the fullest (Ruchban et al., 2024). This condition shows that the existence of technology without adequate competency support will not have a significant impact on the effectiveness of early warning systems.

The difference in conditions between urban and rural areas also shows an imbalance in the availability of resources. Urban areas such as Jakarta have better access to technology and infrastructure, but still face obstacles in integrating systems with community responses (Parameswari & Warsono, 2024). In contrast, rural areas experience limitations in basic infrastructure such as power grids and telecommunications, which hinder the adoption of technology-based systems (Helmi & Muthohharoh, 2024). The development of Internet of Things-based technology in the Disaster Resilient Village shows that investment in hardware needs to be balanced with the allocation of resources for community empowerment (Azzududdin, 2025). Without the capacity of the community to understand and respond to the systems in place, the technologies developed will not have a meaningful impact on disaster risk reduction (Ravazzoli et al., 2025).

These findings show that resource problems are not only related to availability, but also to management and conformity to local conditions. The use of technology that is not accompanied by infrastructure readiness, budget support, and human capacity tends to result in unsustainable systems (Elizabeth, 2025; Wahyu et al., 2021). In this context, the effectiveness of early warning systems is determined more by the integration between technology, institutional capacity, and community readiness than simply the existence of the technology itself (Asih et al., 2023; Kyren, 2024). This condition leads to the need to strengthen resources more comprehensively, not only through increased investment, but also through human capacity development and technological adaptation to the local context. An approach that places too much emphasis on technology adoption without considering resource limitations at the local level has the potential to result in ineffective systems that are difficult to maintain in the long term.

c) Disposition (Attitude of the Implementer)

The disposition or attitude of policy implementers is one of the determining factors for the successful implementation of the early warning system. This aspect reflects the level of commitment, motivation, and responsiveness of the implementer in carrying out tasks related to information delivery and system management. Various studies show that differences in the disposition of implementers contribute to variations in implementation effectiveness in different regions (Helmi & Muthohharoh, 2024). In practice, low commitment of implementers often has an impact on delays in delivering information to the public. This condition can be seen in the implementation of the flood early warning system in Malang City, where the lack of urgency and responsiveness of implementers causes information not to be delivered in a timely manner (Maulana et al., 2025). This situation shows that the success of the system depends not only on the design of policies or technologies, but also on the seriousness of the implementers in carrying out their roles.

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On the other hand, a high level of commitment tends to result in more effective implementation. Implementers who have an understanding of disaster risk and an orientation to community safety are more proactive in ensuring that the system runs well, including through cross-party coordination and community education efforts (Alhadi et al., 2023; Ruchban et al., 2024). This difference shows that the quality of implementation is influenced by the attitude of individual implementers at the field level. Resistance to innovation is one of the obstacles in the dimension of disposition. The implementation of new approaches, especially those based on technology or community participation, is not always well received by implementers who are accustomed to conventional work patterns (Hidayat, 2020). This condition shows that policy changes require readiness not only from the side of the system, but also from the side of the actors who run it.

In addition, the inconsistency in the implementation of operational procedures also affects the community's response. Inconsistency in the implementation of operational standards can cause confusion and reduce the level of trust in the early warning system (Sadiq et al., 2023). In emergency situations, such uncertainty has the potential to hinder quick and appropriate decision-making. Experience in the case of the relocation of communities affected by the eruption of Mount Sinabung shows that non-technical factors, such as the attitude and commitment of the implementers, can be the main obstacle in the evacuation process even though the warning system has been in place (Ginting et al., 2022). This reinforces that the gap between policies formulated and implementation on the ground often stems from the disposition of implementers who are not aligned with policy objectives.

These findings show that the dimension of disposition cannot be seen as a supporting factor alone, but rather as a key element that determines the success of implementation. Strengthening the capacity of implementers through training, increasing motivation through incentives, and involvement in the policy planning process are important steps to build commitment and a sense of ownership of the system (Aprianti et al., 2025; Handayani et al., 2023). A participatory approach has also been proven to increase the positive disposition of implementers because they feel part of the process and the resulting solution (Helmi & Muthohharoh, 2024).

d) Bureaucratic Structure

The bureaucratic structure in the implementation of early warning policies in Indonesia shows complex characteristics and tends to be fragmented. This condition has an impact on the low effectiveness of inter-agency coordination, especially in situations that require a quick response such as disasters. Various studies show that the absence of a clear coordination mechanism between agencies is one of the main obstacles in information delivery and decision-making (Mardiatno et al., 2021). The involvement of village and sub-district governments, community disaster preparedness teams, and disaster management agencies highlights the importance of coordination across administrative levels in implementing community-based early warning systems (Helmi & Muthohharoh, 2024). Institutional fragmentation leads to overlapping tasks and unclear responsibilities between agencies. In the context of the flood early warning system in Malang City, for example, various work units have their own roles in the management of the system, but the lack of cross-sector integration hinders the effectiveness

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of implementation (Maulana et al., 2025).

In addition, a hierarchical and procedural bureaucratic structure also contributes to delays in the delivery of information. The lengthy process requires various stages of approval means that early warnings cannot be delivered quickly to the public (Aprianti et al., 2025). In emergency situations, such delays can increase the risks faced by the community. Another problem that arises is the lack of clarity on operational standards between institutions. This lack of clarity can cause confusion in the implementation of duties, and even has the potential to cause conflicts between agencies related to authority in decision-making (Helmi & Muthohharoh, 2024). This condition shows that the effectiveness of the system does not only depend on the organizational structure, but also on the clarity of the rules and work mechanisms applied.

On the other hand, efforts to strengthen coordination through a collaborative approach show the potential to increase the effectiveness of the system. The establishment of multi-stakeholder forums involving various parties, such as government, the private sector, and society, can encourage integration and synchronization in disaster risk management (Alhadi et al., 2023). Innovations such as Petabencana.id also show that collaborative governance models can improve responsiveness through real-time information exchange (Hidayat, 2020), although it still faces challenges in its integration with formal bureaucratic structures. In a broader context, rigid bureaucratic structures tend to find it difficult to adapt to the ever-changing dynamics of disaster risk. The adaptive governance approach emphasizes the importance of flexibility, decentralization, as well as the ability of organizations to learn and adapt based on experience (Kristian et al., 2025; Kyren, 2024). Experience in different countries also shows that the effectiveness of early warning systems is highly dependent on integrated cross-sectoral coordination capabilities (Teku & Tariku, 2025).

These findings show that the problem of bureaucratic structure is not only related to organizational complexity, but also concerns the way of working and coordination patterns between institutions. Simplifying procedures, clarifying the division of tasks, and strengthening coordination mechanisms are important steps to increase the effectiveness of the early warning system. In this case, bureaucratic reform does not mean eliminating control, but adjusting the structure to be more responsive to needs in emergency situations (Sadiq et al., 2023).

4. Conclusion

Governance forms a pattern of community response to early warning through the interaction between communication, resources, implementing disposition, and bureaucratic structure in policy implementation, where the quality of communication is unclear and uncontextual, resource limitations and inequalities, low commitment and consistency of implementers, and simultaneously fragmented bureaucratic structures produce a tendency for weak community response. being late or ignoring warnings; On the contrary, integrated, adaptive, and coordinated governance that is supported by effective coordination contributes to the formation of faster and more appropriate responses. The policy implications of these findings demand operational adjustments at the government level through strengthening context-based and multi-channel communication, sustainable resource allocation for maintenance and capacity building, strengthening the disposition of implementers through

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training and incentives, and simplifying bureaucratic structures and cross-agency coordination so that early warning systems can consistently drive effective community responses in dealing with disaster risks.

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