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Analysis of Flood Disaster Mitigation Through Spatial and Environmental Policies for Flood Management in Bekasi City, West Java

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ABSTRACT

Flood risk in rapidly urbanizing areas such as Bekasi City continues to increase due to land-use change, weak spatial control, and limited policy integration. This study aims to analyze the effectiveness of spatial and environmental policy implementation in flood mitigation and to identify key supporting and inhibiting factors. This research employs a descriptive qualitative approach using in-depth interviews and Focus Group Discussions (FGDs) with government agencies, non-government organizations, and community representatives in flood-prone areas. Data were analyzed using NVivo through coding, thematic categorization, and pattern analysis based on the Mazmanian and Sabatier policy implementation model. The findings reveal that flood mitigation effectiveness is primarily constrained by weak regulatory enforcement, fragmented inter-agency coordination, and limited technical and financial capacity. These issues indicate that policy challenges are structural and governance-related rather than purely technical. The study highlights that ineffective integration between spatial planning and disaster risk management remains a critical barrier to reducing flood risk. This study concludes that improving flood mitigation requires strengthening collaborative governance, integrating risk-based spatial policies, and developing adaptive infrastructure supported by integrated disaster information systems. Compared to previous studies, this research offers a novel contribution by applying NVivo-based thematic analysis to systematically examine policy implementation dynamics, providing a more comprehensive and evidence-based understanding of urban flood governance.

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1. INTRODUCTION

Floods remain among the most prevalent hydrometeorological disasters in urban areas of Indonesia, particularly in rapidly growing metropolitan regions. In the Greater

Jakarta area, the increasing frequency and intensity of flood events are closely associated with urban expansion, land-use change, and environmental degradation. Bekasi City, as a downstream urban area connected to several upstream watersheds in Bogor and Depok, faces a high level of vulnerability due to its lowland topography, dense population, and uncontrolled spatial development. Data from the National Disaster Management Agency [1] indicate a significant increase in flood incidents in Bekasi over the past five years, both in frequency and inundation coverage. This condition reflects the limited adaptive capacity of urban systems in responding to hydrometeorological risks under climate change pressures [2].

In response, the Bekasi City Government has established various policy instruments, including the Regional Spatial Plan (RTRW) 2011–2031, the Regional Medium-Term Development Plan (RPJMD), and the Regional Environmental Action Plan (RAD-LH). However, policy implementation remains suboptimal. For instance, the realization of Green Open Space (RTH) has reached only approximately 14% of the mandated 30%, indicating weak spatial control and inconsistencies in land-use regulations. This situation highlights a critical gap between policy formulation and implementation, particularly in managing land conversion for residential and industrial purposes.

Previous studies have identified several structural challenges in flood mitigation in Bekasi. Research shows that river normalization programs are ineffective due to limited budgets and weak institutional coordination [3]. Other studies emphasize the importance of community participation but reveal low levels of disaster literacy among residents [4]. Additionally, spatial planning policies remain sectoral and insufficiently integrated with disaster risk reduction frameworks [5]. At a broader scale, governance-related issues such as overlapping authority among local governments in the Greater Jakarta region further hinder effective flood management [6]. Similar patterns are observed in other Southeast Asian cities, where institutional fragmentation and weak coordination reduce the effectiveness of flood mitigation strategies [7].

Despite these contributions, a significant research gap remains. Existing studies tend to focus separately on technical flood control measures, governance challenges, or community participation. Limited research integrates spatial policy analysis with qualitative thematic approaches, particularly using software-assisted methods such as NVivo, to systematically examine policy implementation dynamics in Bekasi City. Furthermore, prior research has not comprehensively linked spatial and environmental policy implementation with stakeholder-based empirical insights to identify dominant factors influencing policy effectiveness.

From a theoretical perspective, the effectiveness of public policy implementation can be analyzed using the Mazmanian and Sabatier policy implementation model, which emphasizes the importance of policy clarity, resource availability, inter-organizational communication, implementer disposition, and external environmental support [9]. This framework provides a comprehensive lens for understanding the complexity of flood mitigation governance, particularly in multi-actor, multi-level urban contexts such as Bekasi.

Based on these problems, this study proposes a qualitative thematic approach using NVivo to analyze the effectiveness of spatial and environmental policy implementation in

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flood mitigation. This approach enables systematic identification of dominant themes, stakeholder perspectives, and critical barriers, thereby offering a more integrative understanding of policy performance. Therefore, this research aims to: (1) analyze the effectiveness of spatial and environmental policy implementation in flood mitigation in Bekasi City; and (2) identify the main supporting and inhibiting factors based on NVivo-based thematic analysis.

Accordingly, the research questions are as follows: How effective are spatial and environmental policies in flood mitigation in Bekasi City? And what are the key supporting and inhibiting factors influencing policy implementation?. This study is expected to contribute theoretically to the development of public policy implementation studies, particularly in disaster governance, and practically to provide policy recommendations for strengthening urban flood resilience through integrated, collaborative, and risk-based approaches.

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2. METHOD

This study employs a descriptive qualitative approach to analyze the dynamics of public policy implementation in urban flood mitigation. A qualitative design is appropriate to capture the complexity of institutional interactions, stakeholder perspectives, and socio-environmental factors influencing policy outcomes [10].

Data Sources and Participants

Primary data were collected through in-depth interviews and Focus Group Discussions (FGDs) involving 18 informants, consisting of 12 key stakeholders from government and non-government institutions and 6 community representatives from flood-prone areas. The institutional stakeholders included officials from the Bekasi City Environment Agency (DLH), the Department of Public Works and Spatial Planning (PUPR), the Regional Disaster Management Agency (BPBD), the Regional Development Planning Agency (Bappeda), and representatives from the Indonesian Forum for the Environment (WALHI).

The selection of informants used purposive sampling based on the following criteria:

1) direct involvement in flood mitigation policy formulation or implementation;
2) institutional authority or technical expertise in spatial planning, environmental management, or disaster management; and
3) experience or residence in flood-prone areas for community participants.

FGDs were conducted in two sessions, each comprising mixed stakeholder groups to encourage cross-sectoral discussion and to validate findings. Secondary data were obtained from official policy documents, including the Regional Spatial Plan (RTRW), Regional Environmental Action Plan (RAD-LH), Regional Medium-Term Development Plan (RPJMD), and annual reports from the BPBD and the National Disaster Management Agency (BNPB).

Data Analysis Technique

Data analysis followed the interactive model of data reduction, data display, and conclusion drawing [11]. All interview and FGD transcripts were processed using NVivo

software to facilitate systematic coding and thematic analysis. The analysis involved three main stages:

1) open coding to identify initial concepts from raw data;
2) thematic categorization to group codes into broader themes; and
3) pattern analysis to explore relationships among themes.

The analytical framework was guided by the Mazmanian and Sabatier policy implementation model, which highlights key determinants of policy implementation, including policy clarity, resource availability, inter-organizational communication, implementer disposition, institutional characteristics, and external environmental factors [9].

Based on this framework, the findings were organized into seven thematic areas: policies and regulations; institutional capacity; coordination and collaboration; resources and infrastructure; community participation; challenges and barriers; and recommendations for improvement.

Urgency Score Measurement

To assess the relative importance of each theme, this study employs an urgency score ranging from 0 to 100. The score is calculated based on a composite assessment of:

a. frequency of code occurrence in interview and FGD data;
b. intensity of discussion, reflected in the depth and emphasis of stakeholder responses; and
c. cross-source consistency, indicating how widely a theme is confirmed across different respondents and data sources.

The scoring process used normalization to convert these indicators into a standardized scale, enabling comparisons across themes to identify dominant and critical issues in policy implementation.

Validity and Reliability

To ensure the validity and reliability of findings, this study applies several triangulation strategies. Source triangulation was conducted by comparing information obtained from different stakeholder groups (government agencies, NGOs, and community members). Method triangulation was achieved by integrating data from interviews, FGDs, and document analysis.

In addition, member checking was carried out by confirming preliminary findings with selected participants to ensure interpretive accuracy. Cross-verification between data sources and the use of an audit trail in NVivo further enhance transparency and consistency in the analytical process. Through these procedures, the study ensures that the findings are credible, systematic, and reflective of the actual conditions of flood mitigation policy implementation in Bekasi City.

3. RESULTS AND DISCUSSION

3.1. RESULT

NVivo-based thematic analysis identified seven dominant themes that determine the effectiveness of flood mitigation policy implementation in Bekasi City. Each theme was

evaluated using an urgency score ranging from 0 to 100, based on the frequency and depth of discussion in interviews and FGDs, as shown in Figure 1 below.

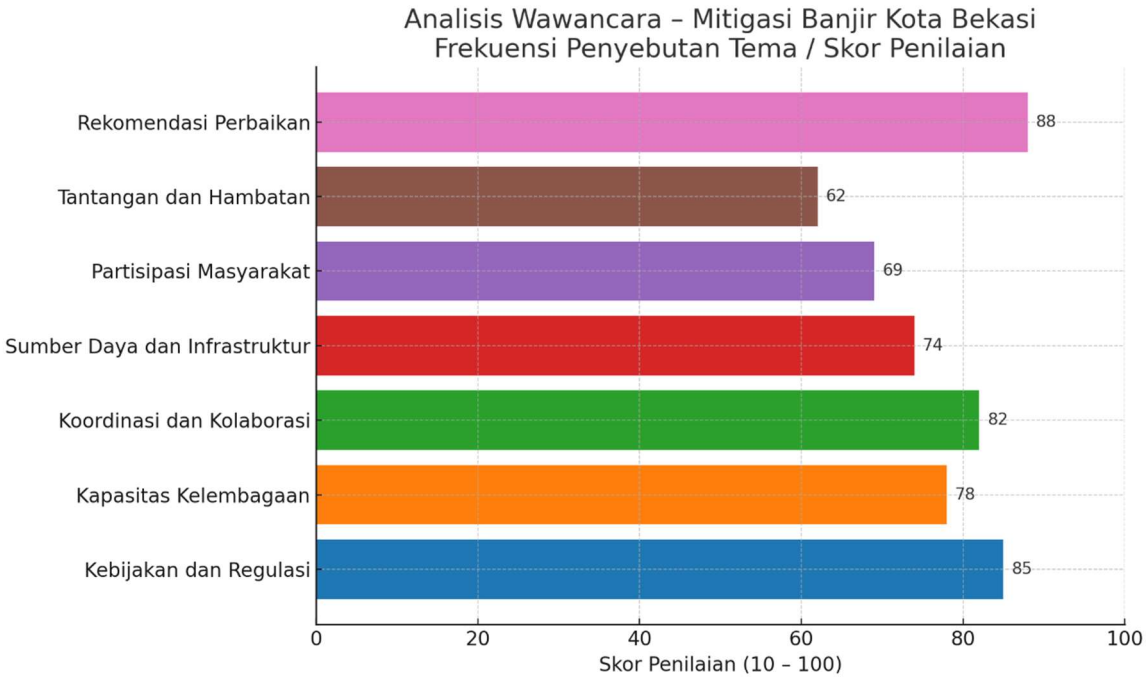

Figure 1. Results of NVivo Thematic Analysis for Flood Mitigation in Bekasi City
Source: Nvivo data processing, 2026

Policy and Regulation (Score 85)

The theme of policies and regulations obtained an urgency score of 85, showing that this aspect is a high priority in flood mitigation in Bekasi City. Normatively, the legal framework and regional planning documents are adequate and refer to national policies through the National Disaster Management Agency. However, its effectiveness is still hampered by weak spatial enforcement, inconsistency in the supervision of land use transfer, and coordination between OPDs that have not been integrated. Policy implementation tends to be reactive and not fully based on risk prevention. The success of flood mitigation depends heavily on the consistency and enforcement of the policy framework. Although local regulations such as the RTRW and RAD LH incorporate flood control principles, their implementation is often undermined by overlapping authorities and weak law enforcement. Thus, such high scores reflect the gap between regulation and practice. Strengthening supervision, harmonizing authority, and shifting to a preventive approach are key to increasing the effectiveness of flood mitigation.

These findings are in line with the results of research [5] entitled Spatial planning policy evaluation for flood control in Bekasi City, which found that spatial planning policies in Bekasi are still fragmented and less integrated with the disaster mitigation framework. Similarly, the research [6] titled "Governance challenges in flood management in the Jabodetabek area" noted that overlapping institutions and conflicting priorities among regional institutions in Greater Jakarta have created fragmented policy outcomes and reduced coordination efficiency.

Institutional Capacity (Score 78)

The thematic institutional capacity obtained an urgency score of 78, which shows that institutional capacity in flood mitigation in Bekasi City is in the medium category, but still needs continuous strengthening. Structurally, institutional tools through the Regional Disaster Management Agency are available, and some apparatus have basic disaster certification. This indicates a sufficient organizational foundation.

However, the main challenge lies in the limitations of advanced technical competence, particularly in data-driven risk analysis, the use of early warning technologies, and the management of complex emergency coordination. Existing capacity is still dominant in administrative aspects and emergency response, but is not fully strong in preventive mitigation and risk-based planning.

The urgency score of 78 indicates that capacity building is not a crisis but rather a strategic, long-term endeavor. A periodic technical competency improvement program, the development of disaster specialist training, and the strengthening of the organizational learning system are needed to enable institutions to adapt to the increasingly complex dynamics of flood risk.

Institutional capacity emerges as an important factor in determining the quality of policy implementation. Interviews reveal that most local government agencies face a shortage of personnel with adequate expertise in disaster risk reduction and spatial-based mitigation. Technical training and certification remain limited, resulting in an inconsistent understanding of policy mandates.

This supports the statement [9] in the research Implementation and public policy, which states that the success of policies depends on the institutional capacity, communication, and commitment of implementers. Furthermore, it is also in line with [12] in their research, Integrating disaster mitigation in urban spatial planning: Lessons from Bekasi and Tangerang, which observes that intersectoral coordination between technical departments in Bekasi and Tangerang is still limited, especially in harmonizing urban planning and flood control measures.

Data management and spatial mapping remain another obstacle. Hydrological maps and flood risks from DLH, BPBD, and PUPR are often inconsistent or outdated. This lack of an integrated data system leads to fragmented planning and slower emergency response operations.

Coordination and Collaboration (Score 82)

The coordination and collaboration theme received an urgency score of 82, indicating that this aspect is a strategic factor in the effectiveness of flood mitigation in Bekasi City. Structurally, a coordination mechanism across Regional Apparatus Organizations (OPD) has been available through coordination meeting forums, emergency command centers, and work networks with vertical agencies. However, the implementation has not been fully optimal.

The findings show that there are obstacles in including sectoral egos, overlapping authority, and less responsive communication flows in emergencies. This condition causes slow information exchange, misaligned decision-making, and a lack of real-time, integrated

disaster data. In metropolitan areas connected to upstream areas such as Bogor and Depok, weak cross-regional coordination further complicates systemic flood control.

From a collaborative governance perspective, the effectiveness of disaster mitigation requires clarity of roles, integration of information systems, and coordinated leadership that can cross sectoral boundaries. The urgency score of 82 indicates that although a formal coordination structure already exists, the quality of interactions and the synergy among actors still need strengthening.

Strengthening coordination and collaboration should focus on harmonizing authority, developing technology-based, integrated communication systems, and fostering a collaborative work culture across institutions. Without solid integration, risk mitigation policies remain fragmented and less effective in sustainably reducing flood risk.

Resources and Infrastructure (Score 74)

The theme of resources and infrastructure received an urgency score of 74, indicating that this aspect is of medium-high importance in flood mitigation in Bekasi City. In general, budget support and basic infrastructure are available, but they are still insufficient to address the increasing complexity of urban flood risk.

Limited funding is a major obstacle, especially since budget allocations are more focused on emergency response than on preventive mitigation and long-term risk reduction. This condition indicates that the risk-based budgeting approach in regional planning is not optimal. As a result, the development of flood control infrastructure, such as integrated drainage systems, retention ponds, and normalization of waterways, has not been fully integrated within the framework of sustainable development.

In addition, the use of disaster technologies, such as CCTV-based monitoring systems and early warning devices, remains partial and is not yet integrated into in single information system. These integration weaknesses lead an delays in early detection and suboptimal data-driven responses.

The urgency score of 74 indicates that strengthening resources and infrastructure is not at a crisis level but remains a strategic priority for improvement. Increased investment in prevention-based mitigation, the integration of disaster information technology, and adaptive infrastructure planning are needed to make flood mitigation systems more effective and sustainable.

The success of the river normalization project in Bekasi depends on a consistent technology monitoring system and data sharing [3]. To improve sustainability, the study recommends prioritizing green-blue infrastructure, an approach that integrates ecological water systems and urban green spaces to improve water uptake, reduce surface runoff, and strengthen the resilience of urban ecosystems.

Community Participation (Score 69)

The thematic community participation received an urgency score of 69, indicating that public involvement in flood mitigation in Bekasi City falls in the adequate but not optimal category. The local government has initiated participatory programs, such as the Disaster Preparedness Village (KELANA) and the Disaster Resilience Village (KATANA),

which aim to strengthen community-based preparedness. This program reflects a commitment to a community-based disaster risk reduction approach.

However, the effectiveness of participation is still limited by the low literacy level regarding community disasters. The low level of disaster literacy among Bekasi residents hinders the implementation of early prevention measures [4]. Risk awareness, the ability to read early warnings, and early reporting of potential floods are not evenly distributed throughout vulnerable areas. The participation that forms tends to mobilize during disasters rather than engage in active involvement in the mitigation and prevention stages. Public involvement remains concentrated in the emergency response phase, with limited involvement in prevention and planning.

An urgency score of 69 indicates that this aspect is not at a critical level, but still requires strategic intervention. Strengthening disaster education, increasing local volunteers' capacity, and integrating communities in risk-based planning are important steps toward building a risk-aware society. Without increased literacy and collective awareness, participatory programs may not achieve long-term impact in reducing flood risk.

Challenges and Barriers (Score 62)

The thematic challenges and obstacles received an urgency score of 62, indicating that the obstacles faced in flood mitigation in Bekasi City are structural but can still be managed through strengthened governance. The main obstacles include budget constraints, uneven human resource capacity, and spatial conflicts arising from pressure to convert land. Although multi-sectoral participatory programs such as KELANA and KATANA have been underway, low community disaster literacy limits the effectiveness of community-based interventions. Participation that is not entirely risk-conscious makes programs more responsive than preventive.

From an institutional perspective, budget constraints have an impact on priorities that are more inclined towards emergency handling than long-term mitigation. HR constraints, especially in technical and managerial competence, also affect the quality of planning and coordination. Meanwhile, spatial conflicts, such as development in catchment areas and river borders, show a lack of synchronization between spatial planning policies and disaster risk reduction.

A score of 62 reflects that the challenge is not in the absence of programs, but in the consistency of implementation and integration across sectors, so that it is necessary to harmonize spatial policies, strengthen human resource capacity, and optimize risk-based funding so that structural obstacles do not continue to reduce the effectiveness of flood mitigation sustainably. The main challenge in implementing flood mitigation policies lies in the weak collaborative governance between institutions. The Bekasi City Government needs to improve policy coherence between planning documents and establish a formal coordination mechanism that integrates provincial and national agencies.

In the book [13] titled Toward more resilient flood risk governance and the article [14] titled Exploring the scope of public and private responsibilities for climate adaptation, argue that effective disaster risk management requires multi-stakeholder collaboration, data-driven decision-making, and socio-ecological integration. Adopting a green-blue

infrastructure framework offers a transformative path to balancing structural interventions with ecosystem-based and community-centered adaptation.

Recommendations for Improvement (Score 88)

The thematic recommendations for improvement received the highest urgency score (88), indicating that reformulating flood mitigation strategies in Bekasi City is very urgent. This score reflects concrete proposals from stakeholders, but their implementation requires strong, consistent cross-sectoral commitments. The recommendations emphasized strengthening the integration of risk-based spatial policies, increasing institutional technical capacity, optimizing preventive mitigation funding, and developing an integrated disaster information system. Conceptually, this step is in line with a risk-informed governance approach that places mitigation as an integral part of development planning, not just a response to disasters. However, the main challenge lies in commitment and synchronization between actors, both between OPDs and across metropolitan areas. Without solid coordination and collaborative leadership, strategic recommendations can stop at the normative level. Therefore, performance-based monitoring and evaluation mechanisms, harmonization of authority, and strengthening pentahelix partnerships are needed to ensure sustainable implementation. The urgency score of 88 confirms that flood mitigation governance reform is no longer an option but a strategic need to increase cities' resilience to increasingly complex flood risks.

3.2. DISCUSSION

Effectiveness of Spatial and Environmental Policy Implementation in Urban Flood Mitigation

The effectiveness of spatial and environmental policy implementation in Bekasi City reflects a complex interaction between normative regulatory frameworks and practical enforcement constraints in rapidly urbanizing areas. Formally, the Regional Spatial Plan (RTRW) 2011–2031 and related environmental policy instruments provide a legal basis for integrating flood control into development planning [15]. However, statistical data indicate a consistent increase in flood frequency and inundation coverage over the past five years [1]. This discrepancy suggests that regulatory instruments have not been sufficiently translated into effective spatial control mechanisms. From a global disaster risk perspective, such conditions illustrate limited adaptive urban capacity amid accelerating climate change and land-use transformation [2]. Consequently, the effectiveness of policy implementation cannot be assessed solely through regulatory availability but must consider enforcement performance and spatial compliance.

Spatial policy implementation in Bekasi continues to pose persistent challenges in controlling land conversion, particularly in water catchment and riparian buffer zones. Empirical evaluation shows that spatial planning policies remain partially fragmented and insufficiently integrated with disaster mitigation frameworks [5]. Similarly, comparative research on Bekasi and Tangerang confirms that mitigation principles are often weakly embedded within urban planning processes [12]. The increasing intensity of rainfall extremes, combined with land cover changes, has significantly exacerbated major flood

events in the region [16]. These findings indicate that policy effectiveness is strongly dependent on the alignment between ecological carrying capacity and spatial development trajectories. Without rigorous land-use monitoring and enforcement, regulatory frameworks risk remaining symbolic rather than transformative.

From a policy implementation perspective, the analytical framework developed by Mazmanian and Sabatier [9] highlights clarity of objectives, resource adequacy, inter-organizational communication, and implementer commitment as central determinants of success. In Bekasi, coordination across governmental agencies remains constrained by overlapping mandates and sectoral fragmentation [6]. Such fragmentation weakens integrated watershed-based planning and reduces institutional responsiveness to systemic flood risks. Similar governance patterns have been observed across Asian metropolitan regions facing urban flood challenges [17]. Therefore, policy effectiveness is intrinsically linked to governance coherence and institutional integration. Strengthening vertical and horizontal coordination mechanisms is essential to translating spatial regulations into measurable risk-reduction outcomes.

4. CONCLUSION

This study concludes that the effectiveness of flood mitigation policy implementation in Bekasi City is primarily determined by governance capacity, particularly the ability to integrate spatial planning, institutional coordination, and risk-based decision-making within a fragmented urban system. The findings highlight that policy challenges are fundamentally rooted in structural and institutional dimensions rather than purely technical limitations, emphasizing the need for a shift toward collaborative, data-driven, and preventive governance approaches. The implications of this study suggest that urban flood mitigation policies must prioritize regulatory enforcement, integrated inter-agency coordination, and investment in adaptive infrastructure and information systems, which are also relevant for other rapidly urbanizing cities facing similar risks. However, this research is limited by its qualitative design and case-specific focus on Bekasi City, which may restrict the generalizability of findings across different governance contexts. Therefore, future research is recommended to adopt comparative or mixed-methods approaches, expand the geographic scope, and incorporate quantitative measures of policy effectiveness to strengthen empirical validation. Overall, this study contributes to the development of public policy and disaster governance literature by offering a systematic, NVivo-based thematic analysis framework and practical insights for policymakers and stakeholders in enhancing urban resilience and sustainable flood risk management.

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