

URBAN TRANSPORTATION AND SUPPLY CHAIN RESILIENCE FOR ACCELERATING FLOOD DISASTER MITIGATION AND HUMANITARIAN PREPAREDNESS

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Abstract. Accelerating flood disaster mitigation is crucial to reducing loss of life, economic damage, and system disruption by strengthening preparedness, resilience, and risk reduction before floods occur. This study analyzes the effectiveness of logistics and supply chain management in supporting humanitarian preparedness to accelerate flood mitigation efforts in Bekasi City, Indonesia. A qualitative literature analysis used VOSviewer to map and cluster themes from 960 scientific publications to identify sub-criteria relevant to accelerating flood mitigation. The findings obtained from the qualitative approach were further developed through the Analytical Hierarchy Process in a quantitative approach to prioritize strategic factors, supported by a comprehensive sensitivity analysis. The results indicate that transportation network resilience is the most important priority for accelerating flood mitigation, followed by social and community resilience, and transportation disruption. These priorities highlight connectivity, community capacity, and disruption control in ensuring effective logistics and supply chain operations during floods. Strengthening logistics preparedness through resilient transportation networks and community-based approaches is crucial for enhancing humanitarian preparedness and accelerating flood mitigation. These findings provide insights to support policy formulation and strategic decision-making in disaster risk reduction and sustainable development efforts in flood-affected areas.

Keywords: Flood Disaster; Logistic and Supply Chain Management; Disaster Risk Reduction; Transportation Network Resilience; Social and Community Resilience

[Judul: KETAHANAN TRANSPORTASI PERKOTAAN DAN RANTAI PASOKAN UNTUK MEMPERCEPAT MITIGASI BENCANA BANJIR DAN KESIAPSIAGAAN KEMANUSIAAN]. Mempercepat mitigasi bencana banjir sangat penting untuk mengurangi korban jiwa, kerusakan ekonomi, dan gangguan sistem dengan memperkuat kesiapsiagaan, ketahanan, dan pengurangan risiko sebelum banjir terjadi. Studi ini menganalisis efektivitas manajemen logistik dan rantai pasokan dalam mendukung kesiapsiagaan kemanusiaan untuk mempercepat upaya mitigasi banjir di Kota Bekasi, Indonesia. Analisis literatur kualitatif menggunakan VOSviewer untuk memetakan dan mengelompokkan tema dari 960 publikasi ilmiah untuk mengidentifikasi sub-kriteria yang relevan dengan percepatan mitigasi banjir. Temuan yang diperoleh dari pendekatan kualitatif dikembangkan lebih lanjut melalui Analytical Hierarchy Process dalam pendekatan kuantitatif untuk memprioritaskan faktor-faktor strategis, yang didukung oleh analisis sensitivitas yang komprehensif. Hasil menunjukkan bahwa ketahanan jaringan transportasi merupakan prioritas terpenting untuk mempercepat mitigasi banjir, diikuti oleh ketahanan sosial dan masyarakat, serta gangguan transportasi. Prioritas ini menyoroti konektivitas, kapasitas masyarakat, dan pengendalian gangguan dalam memastikan operasi logistik dan rantai pasokan yang efektif selama banjir. Penguatan kesiapan logistik melalui jaringan transportasi yang tangguh dan pendekatan berbasis komunitas sangat penting untuk meningkatkan kesiapan kemanusiaan dan mempercepat mitigasi banjir. Temuan ini memberikan wawasan untuk mendukung perumusan kebijakan dan pengambilan keputusan strategis dalam upaya pengurangan risiko bencana dan pembangunan berkelanjutan di daerah yang terkena banjir.

Kata Kunci: Bencana Banjir; Manajemen Logistik dan Rantai Pasokan; Pengurangan Risiko Bencana; Ketahanan Jaringan Transportasi; Ketahanan Sosial dan Komunitas

1. INTRODUCTION

The importance of accelerating flood disaster mitigation is crucial for countries with high levels of vulnerability to flooding, the most frequent hydrometeorological disaster with a broad impact on human safety, economic stability, and sustainable development. The increasing intensity and frequency of extreme rainfall due to climate change (Shenkut et al., 2025), coupled with rapid urbanization (Xu et al., 2025), environmental degradation (Sadeghi et al., 2025), and weak spatial governance (Li & Chen, 2025), have significantly increased flood risk. Vulnerable countries will continue to face a recurring cycle of losses in the form of loss of life (Kasahun et al., 2025), damage to vital infrastructure (Clark & Collins, 2025), disruption of public services (Son et al., 2025), decreased economic productivity (Shan et al., 2025), ultimately increasing the fiscal burden and delaying the achievement of national development goals if mitigation is not accelerated. Flood risk can be reduced before it becomes a recurring humanitarian and economic crisis by accelerating mitigation by governments and stakeholders to reduce exposure and vulnerability early on. Furthermore, accelerated flood mitigation has strategic added value in building long-term resilience and supporting the global sustainable development agenda. High concentrations of population and economic activity in low-lying and coastal areas in flood-prone countries have the potential to delay mitigation, which can increase social disparities and poverty due to disasters in the long term. Early warning systems (Piadeh et al., 2026), risk-based spatial planning (Ignacy, 2025), and community capacity building are among the early investments in flood mitigation through flood control infrastructure (Neves & Espling, 2025), proven to be more effective and efficient than emergency response and post-disaster recovery costs (Shevchenko et al., 2025). Accelerating mitigation reflects a commitment to disaster risk reduction, climate change adaptation, and the protection of vulnerable groups in countries with high levels of vulnerability to maintain social

stability, increase public trust, and strengthen international cooperation in addressing the challenges of transboundary disasters.

Various problems in logistics and supply chain management in flood mitigation efforts are related to limited planning, coordination, and preparedness of distribution systems before a disaster occurs. Inadequate integrated disaster supply chain planning (Sumrit & Jongprasittiphol, 2025), such as flood control infrastructure materials (Zhou et al., 2025), early warning equipment (Gómez et al., 2025), and emergency supplies (Yang et al., 2026), is lacking in various countries and flood-prone areas (Deopa & Mohanty, 2025). Delays in the procurement, deployment, and maintenance of mitigation facilities arise from reliance on reactive logistics systems (Nawazish & Padhi, 2025; Wen et al., 2025), limited spatial risk data (Yue & Yao, 2026), and weak synchronization between agencies (Cui et al., 2022). Furthermore, the increased risk of supply chain disruption during emergencies can be caused by geographic conditions, transportation infrastructure that is vulnerable to flood damage, and the concentration of logistics warehouses in vulnerable areas (Lu et al., 2024; Mizumura & Nakamura, 2025). Other problems can be identified in aspects of supply chain governance and sustainability, which trigger budget constraints, rigid procurement mechanisms, and minimal involvement of the private sector and local communities. The lack of disaster logistics standards leads to inaccuracies in the type, quantity, and timing of distribution, while cumbersome bureaucratic procedures often hinder the accelerated distribution of mitigation resources. On the other hand, the availability of raw materials and mitigation equipment could be affected by climate uncertainty and global market dynamics.

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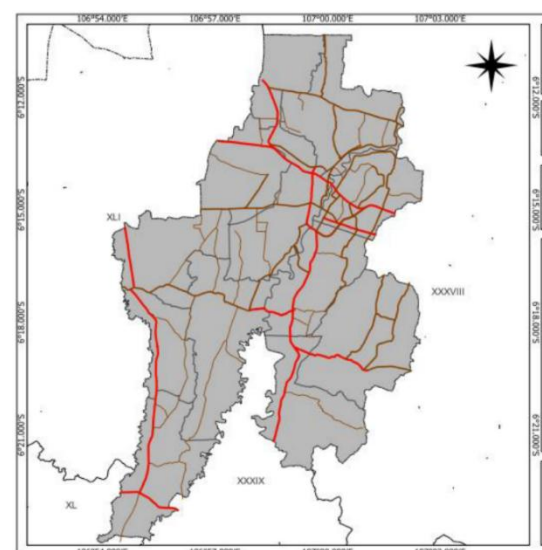
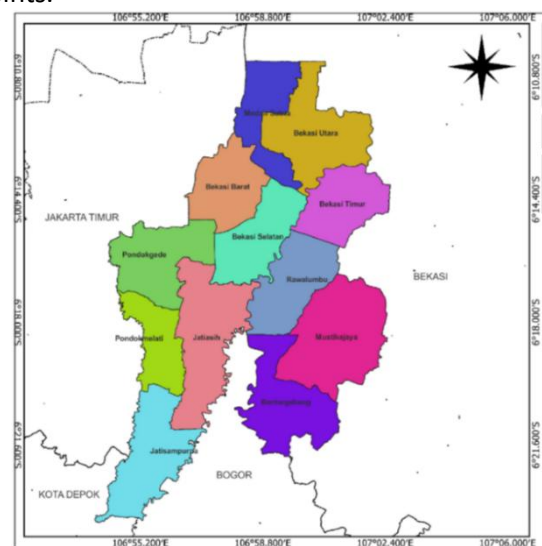
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Efforts to accelerate flood mitigation could potentially be suboptimal and difficult to meet increasingly complex cross-regional needs without strengthening supply chain resilience through supplier diversification, a risk-based logistics system, and optimal use of information technology. Logistics and supply chain management-based solutions have been implemented in various countries to strengthen and accelerate flood mitigation efforts, primarily through a pre-disaster logistics planning approach. The development of a risk-based supply chain utilizing flood hazard maps and hydrometeorological data is one of the main solutions prioritized in determining strategic locations for logistics warehouses, the placement of mitigation materials such as sandbags, water pumps, drainage equipment, and distribution priorities (Ascott et al., 2025; Borjigin et al., 2024). In addition, early warning systems (Luna et al., 2025), inventory management systems (He et al., 2026), and GIS-based monitoring (Nazir et al., 2025), as part of the implementation of integrated logistics information systems and digital technology, help ensure stock availability, accelerate decision-making, and minimize distribution delays when the threat of flooding increases (Lakhwani et al., 2025). Another solution implemented is strengthening collaboration in the flood mitigation supply chain, involving various parties such as the government, the private sector, humanitarian organizations, and local communities. Supplier diversification and the use of alternative distribution channels to increase supply chain resilience are part of partnerships with logistics and manufacturing companies. Efforts to improve response capacity and maintain sustainable mitigation facilities at the local level are executed through the establishment of community logistics centers and disaster logistics management training. Furthermore, to accelerate resource mobilization, procurement policy reforms are needed to be more flexible and contingency-based. Complete integration of resilient supply chain principles applied to flood mitigation efforts can increase the efficiency, effectiveness, and sustainability of disaster risk reduction.



Logistics and supply chain management readiness demonstrates a combination of rapid response and

The administrative map of Bekasi City, shown in Figure 1, and the road network map of Bekasi City, presented in Figure 2, serve as a fundamental basis for spatial analysis. They integrate information regarding administrative boundaries, flood vulnerability, transport connectivity, and the distribution of disaster-relief logistics. The administrative map defines the boundaries of Bekasi City, its districts, and sub-districts, allowing for a structured analysis of flood-prone locations, affected areas, populations in need of assistance, and response priorities based on administrative jurisdiction. The road network map facilitates the analysis of connectivity and accessibility; it identifies road segments potentially severed by flooding (Poudel & Gopinath, 2027), determines alternative routes for evacuation and aid distribution, and evaluates access to critical facilities such as hospitals, evacuation sites, logistics warehouses, and public service centers (Guo et al., 2026). The results of this analysis provide the foundation for prioritizing mitigation strategies, taking into account risk levels, the importance of accessibility, and the continuity of aid distribution.

In addition, the logistics response involves many stakeholders to provide aid distribution services and must coordinate in real time to avoid stockpiling or scarcity of goods in the field. Reliance on alternative routes and logistical improvisation shows the continued need to improve supply chain readiness in large-scale disaster mitigation as efforts to strengthen information systems and management of critical stocks continue to be carried out. The perception of slow and underprepared emergency response, due to a combination of complex structural, institutional, and disaster governance issues, is being faced in the flood mitigation process in these three provinces. Resource mobilization is often hampered by limited initial data, incomplete risk assessments, and suboptimal coordination between the central and regional governments, due to the central government's hierarchical mechanisms and the declared emergency status. Furthermore, pre-disaster logistical planning, supporting infrastructure readiness, and integration of mitigation with spatial planning and regional development policies have not been consistent,

indicating that flood mitigation remains a lower priority than emergency response (Bhatta et al., 2026; Rueda-Velasco et al., 2025). Mitigation efforts appear unprepared when flooding occurs, as difficult geographic access, uneven local government capacity, and inflexible bureaucratic and budgetary procedures contribute to slowing down the rapid and comprehensive mobilization of resources.

This study develops the practical implementation of logistics and supply chain management in actively supporting the flood disaster mitigation process, which plays a role in filling the analytical gap between currently implemented disaster policies and operational practices in the field, particularly when linked to the context of humanitarian preparedness. This study further explores empirical understanding of logistics and supply chain systems functioning effectively in the pre-disaster phase, as well as structural barriers, inter agency coordination, and resource utilization that influence mitigation acceleration. This study contributes to strengthening the development of relevant strategic recommendation models for the government and stakeholders to improve the effectiveness of disaster risk reduction. The purpose of this study is to analyze the role and effectiveness of logistics and supply chain management in supporting humanitarian preparedness to accelerate flood disaster mitigation efforts in Bekasi City.

2. METHOD

The initial step implemented in this study used a qualitative approach through the development of a literature review. This study is perceived to have a strategic role in building a systematic conceptual basis in promoting the effectiveness of logistics and supply chain management in flood disaster mitigation (Pranita et al., 2023). Utilization of 960 previous publications sourced from Google Scholar that have been mapped and analyzed using VOSviewer to create a systematic knowledge structure, inter-topic relationships, and the evolution of key themes (Raharjo & Sarjana, 2022). The study identified key domains through topic clustering. This process ensures that the formulated

criteria and sub-criteria are not subjective, but are rooted in proven scientific values. The clustering results serve as an analytical basis for formulating alternative policies and operational strategies relevant to the context of Bekasi City, Indonesia. With this approach, researchers can adapt global findings to local characteristics. The obtained criteria and sub-criteria can then be used as input so that the decision-making process becomes more structured and evidence-based. This approach strengthens validity and contributes to the formulation of logistics and supply chain strategies to accelerate flood disaster mitigation (Jayanti et al., 2025).

The qualitative approach employed follows a sequence guided by the research questions, searching for literature, selecting studies based on the PRISMA method, preparing and cleaning metadata, mapping data using VOSviewer, interpreting the results qualitatively, and synthesizing findings, research gaps, and recommendations (Liu et al., 2023; Sarjana et al., 2024b). The PRISMA method ensures transparency in the literature selection process (Gong et al., 2021), while VOSviewer facilitates bibliometric mapping, the two methods complement each other without being interchangeable.

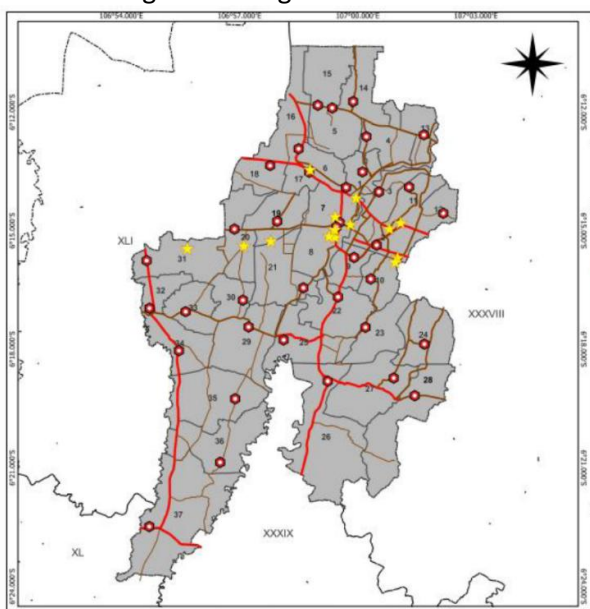


Figure 3. Map of centroids and special zones of Bekasi City

The map of centroids and special zones in Bekasi City, shown in Figure 3, plays a key role in accelerating flood disaster mitigation by helping to identify hubs of activity such as residential areas, commercial centers, industrial zones, and public service facilities, as well as specific zones, including flood-prone locations, logistics warehouses, hospitals, evacuation points, and aid distribution centers. This information is used to analyze the movement patterns of people and goods, estimate logistics requirements for each zone, and determine strategic locations for the storage and distribution of aid before a flood occurs. Integrating these centroids and special zones with administrative maps, road networks, and flood-vulnerability data, using a Geographic Information System allows for the identification of areas at risk of becoming isolated, the evaluation of accessibility to critical facilities, and the determination of priority alternative distribution routes for use when road networks are disrupted. This map serves as a spatial instrument for optimizing resource allocation, accelerating the movement of humanitarian logistics, and enhancing supply chain resilience, ensuring that flood mitigation and preparedness efforts in Bekasi City are carried out in a more targeted, efficient, and evidence-based manner. This map serves as a spatial instrument for optimizing resource allocation, expediting the movement of humanitarian logistics, and enhancing supply chain resilience, ensuring that flood mitigation and preparedness efforts in Bekasi City are carried out in a more targeted, efficient, and evidence-based manner.

Analytical Hierarchy Process (AHP) applied as a quantitative approach is crucial for developing and validating previous qualitative approaches. AHP is able to measure the complexity of identified criteria and sub-criteria into a systematic decision-making structure (Sarjana, 2024a). Input data using pairwise comparison allows for consistent comparisons between criteria and sub-criteria based on assessments, resulting in rational and evidence-based priority weights. Expert Choice serves as a process tool by providing various sensitivity analyses including performance, gradient, two-dimensional, and head-to-head to test the stability, consistency, and robustness of

decision results against weight changes (Sarjana, 2024b). AHP is able to improve the accuracy of recommendations in supporting the effectiveness

of logistics and supply chain management to accelerate flood disaster mitigation (Sarjana et al., 2024a).

Table 1. Role Allocation and Contributions of Respondents

No	Expert respondent	Area of expertise	Primary AHP criteria evaluated	Contribution to the research
1	Bekasi City Regional Disaster Management Agency (BPBD) Kota Bekasi	Flood mitigation and response	Disaster risk, preparedness, response time, emergency coordination	Determining priority needs for mitigation and management in affected areas
2	Bekasi City Transportation Agency	Transportation and traffic management	Road connectivity, accessibility, alternative routes, mobility flow	Identifying strategies to maintain transportation access during floods
3	Bekasi City Public Works and Water Resources Agency	Road infrastructure and water resources	Road vulnerability, drainage, inundation points, infrastructure recovery	Assessing requirements for the protection and restoration of critical infrastructure
4	Bekasi City Social Services Agency	Relief supplies and distribution	Stock availability, distribution reliability, warehouse capacity, supply flexibility	Evaluating strategies to ensure the availability and timeliness of aid
5	Academics	Analysis of transportation, logistics, GIS, or disaster management	System integration, indicator quality, strategy feasibility, model consistency	Validating the hierarchical structure and assisting in the interpretation of AHP results

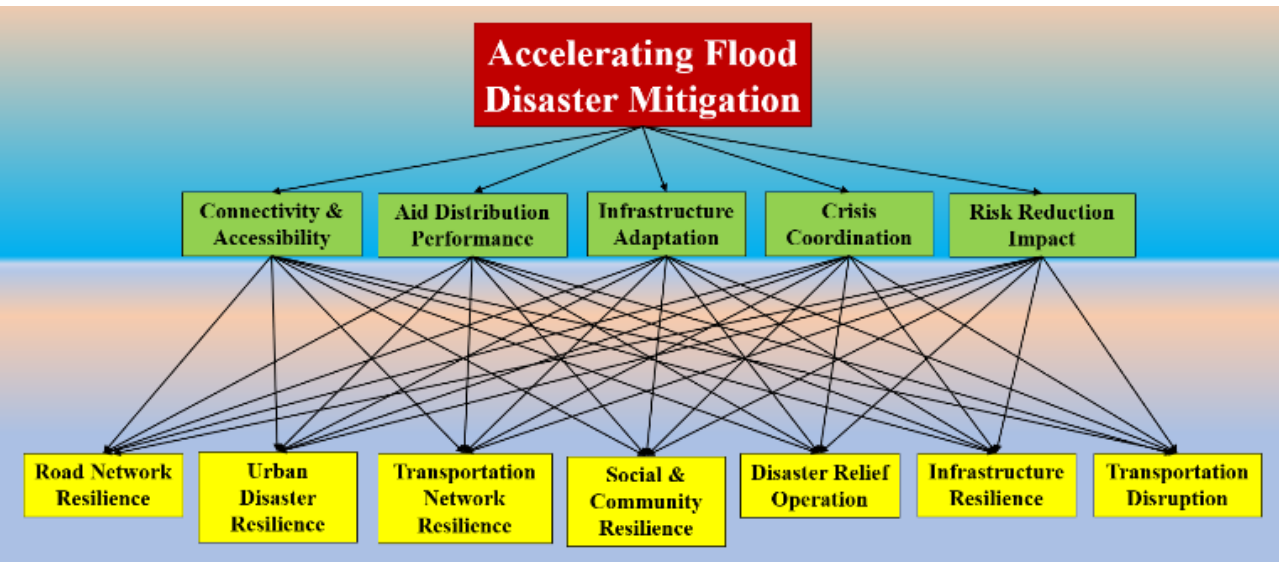


Figure 4. Hierarchy of Accelerating Flood Disaster Mitigation

This study utilizes five expert respondents, selected based on their competence, experience, and understanding of issues related to transportation and flood management, as detailed in Table 1. Each respondent provided pairwise comparison assessments of the established criteria and alternative strategies; these assessments were then integrated to derive

priority weights and a ranking of the strategies. The results highlight the aspects that should be prioritized among the available alternatives. The primary contribution of these respondents lies in the generation of AHP weights, which establish a foundation for cross-sectoral decision-making that is more focused, measurable, and relevant to accelerating flood mitigation efforts in Bekasi City.

The measurement of criteria and sub-criteria is a crucial aspect in the study of accelerating flood disaster mitigation as an analytical framework in assessing the effectiveness of logistics and supply chain management comprehensively, as presented in Figure 4. Criteria such as connectivity and accessibility (Bakhtyari et al., 2025), aid distribution performance (Fanama & Bang, 2026), infrastructure adaptation (Kim & Kang, 2023), crisis coordination (Gaudette & Germain, 2026), and risk reduction impact were selected because they represent the determining factors for accelerating flood mitigation (Tiware et al., 2025). The decision-making process is directed at continuously improving the resilience of logistics and humanitarian systems. Meanwhile, sub-criteria obtained from the qualitative study clustering results include road network resilience, urban disaster resilience, transportation network resilience, social and community resilience, disaster relief operations, infrastructure resilience, and transportation disruption, which provide contextual and evidence-based analysis. The selected sub-criteria allow for detailed measurement in flood mitigation, especially in vulnerable areas in Bekasi city, Indonesia. Pairwise comparison is able to ensure the weighting between criteria and sub-criteria is carried out systematically so that the resulting priorities are consistent and transparent. Thus, determining the appropriate criteria and sub-criteria produces applicable strategic recommendations to accelerate flood disaster mitigation.

3. RESULT & DISCUSSION

The initial stage of this study involved defining the topic and research question, selecting databases, developing search keywords, and determining the year of publication. This aimed to ensure the collected publications were relevant to the topic, reduce inconsistencies, and make the search process more traceable. The next stage involved literature selection based on the PRISMA process, including identification, screening, eligibility checks, and determining publications to be included in the final analysis. Previous publications serve as a foundation for current scientific knowledge to improve the quality of logistics and

supply chain management to accelerate flood disaster mitigation, particularly in vulnerable areas in Bekasi City. This study analyzed 960 journals published in 2025 with a total of 2,382 citations, indicating that this topic has developed into a major and relevant field of study. The citation value per paper of 2.48, and the h-index and hA-index of 17 both indicate the existence of a number of core publications that are consistently referenced and utilized as a robust conceptual and methodological framework. The reviewed publications are able to create models, approaches, and best practices in humanitarian logistics, pre-disaster planning, and supply chain resilience that can be adopted for flood mitigation in Indonesia. Bibliometric characteristics such as high citations per author (710.80), papers per author (347.83), and average author rating per paper (3.59) demonstrate robust academic collaboration and the quality of cross-disciplinary expertise in publications in the past year. Flood mitigation requires the integration of knowledge from the fields of logistics, transportation, public policy, risk management, and disaster science. The findings and research gaps identified in previous publications are very useful in this study to avoid duplication, strengthen empirical relevance, and formulate contextual and applicable recommendations. Therefore, previous publications are encouraged as strategic references in scientific knowledge into effective logistics policies and practices in supporting flood disaster mitigation in the study area.

The creation of flood disaster mitigation clusters plays a crucial role in simplifying the multidimensional nature of flood mitigation issues, as shown in Table 2. The literature review, using previous publications and a clustering process, yielded nine clusters, mapping the patterns of relationships between topics and emerging scientific perspectives. This clustering serves as a scientific filtering mechanism to identify relevant, influential, and frequently discussed themes in accelerating flood disaster mitigation, with the aim of guiding the study toward a consensus of knowledge. The selection of seven sub-criteria, including road network resilience, urban disaster resilience,

transportation network resilience, social and community resilience, disaster relief operations, infrastructure resilience, and transportation disruption, represents a synthesis of nine clusters deemed appropriate for accelerating flood disaster mitigation. The selected sub-criteria represent structural, operational, and social

aspects that influence the effectiveness of logistics and supply chain management in a disaster context. This study bridges the practical needs of decision-making by reducing clusters to sub-criteria. This ensures that recommendations can be implemented to accelerate flood disaster mitigation in vulnerable areas.

Table 2. The Cluster of Flood Disaster Mitigation

1	2	3	4	5	6	7	8	9
Flood risk mitigation	Artificial intelligent	Disaster prevention	Disaster mitigation strategy	Flood resilience	Social & community resilience	Community participation	Disaster management	Climate resilience
Flood risk assessment	Disaster risk management	Flash flood disaster	Disaster resilience	Flood risk reduction	Disaster governance	Disaster preparedness	Flood vulnerability	Disaster mitigation planning
Flood risk management	Early warning	Flood prevention	Disaster relief operation	Remote sensing	Natural disaster	Flood control	Food security	Flood prone area
Spatial analysis	Flood forecasting	Public policy	Flood mapping	Urban flood risk mitigation	Disaster impact	Tidal flooding	Flood preparedness	Risk mitigation
Analytical Hierarchy Process	Social vulnerability	Transportation network resilience	Hazard mitigation	Urban flood resilience	Mitigation measure	Extreme weather	Sustainable development	Transportation disruption
Mitigation planning	Urban disaster resilience	Urban flood disaster	Machine learning	Infrastructure resilience	Severity	Infrastructure resilience	Flood disaster mitigation	Urban flood management
Road network resilience	Public awareness		Disaster response	Hydrodynamic modelling				Social media data

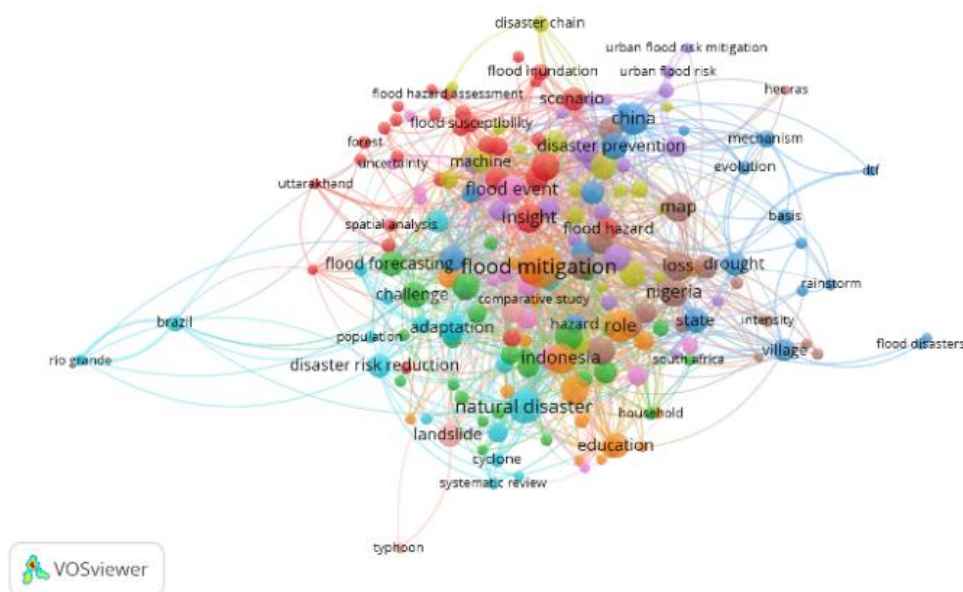


Figure 5. Network Visualization of Flood Disaster Mitigation

The network visualization of flood disaster mitigation, shown in Figure 5, serves as an analytical tool for comprehensively mapping the knowledge structure and interrelationships between topics in flood disaster mitigation studies. The network visualization results from VOSviewer, where each node represents a topic appearing in the analyzed journal publications, while the node size reflects the intensity of its occurrence and the level of relevance within the reviewed literature. This approach aims to identify key themes, conceptual relationships between topics, and interconnected research areas that can provide comprehensive insight into the evolving landscape of flood mitigation studies. Network visualization serves as an instrument for understanding the diverse complexities of the

issues. Furthermore, the selection of nodes as sub-criteria is adjusted to the research hierarchy to support efforts to accelerate flood disaster mitigation. Topics with large nodes and close connections are prioritized and selected because they have made significant contributions to the literature and are therefore aligned with the need to strengthen logistics and supply chain management. This process ensures that the selection of sub-criteria used for the next stage of analysis is conceptually grounded, empirically relevant, and consistent with efforts to accelerate mitigation. Thus, network visualization acts as a mapping tool and a methodological bridge that connects literature-based qualitative studies with quantitative studies applied to decision making.

Table 3. Eigenvector values and consistency ratio

Criteria	Eigenvector		Consistency vector
	Decimal	%	
Connectivity and accessibility	0.295	29.5	5.045
Aid distribution performance	0.125	12.5	5.045
Infrastructure adaptation	0.038	3.8	5.041
Crisis coordination	0.095	9.5	5.055
Risk reduction impact	0.447	44.7	5.043
λ Maks			5.046
n			5
Consistency Index			0.0092
Consistency Ratio			0.0083 (0.83%)

The test results presented in Table 3 indicate that the reduction of disaster impacts and risks is the most dominant consideration in determining the priority of flood mitigation strategies in Bekasi City. A weight of 29.5% for connectivity and accessibility, underscores the importance of an interconnected road network, access to affected areas, and the availability of alternative routes for evacuation and the delivery of logistics. Aid distribution performance, with a weight of 12.5%, highlights the necessity for timely and targeted aid distribution. Crisis coordination at 9.5%, emphasizes the need for effective coordination among the Regional Disaster Management Agency, the Transportation Agency, infrastructure managers, and logistics organizations. The 3.8% weight assigned to infrastructure adaptation indicates that this factor remains a prerequisite for the overall success of risk reduction strategies. The

Consistency Ratio (CR) of 0.83%, well below the 10% consistency threshold, demonstrates a high level of consistency in the respondents pairwise comparison assessments. These priority weights can be utilized to support strategy formulation, program focus determination, and resource allocation based on the relative importance of each criterion.

The performance sensitivity analysis, as a result of the AHP, presented in Figure 6, ensures that the resulting sub-criteria priorities are able to effectively support the acceleration of flood disaster mitigation. The sub-criteria measurements in this study used assessment criteria such as connectivity and accessibility, aid distribution performance, infrastructure adaptation, crisis coordination, and risk reduction impact. This analysis shows that changes in

criterion weights affect the performance of each assessed sub-criterion. Performance sensitivity allows for understanding the stability of AHP results and identifying the sub-criteria most responsive to mitigation directions. This ensures accurate and relevant decisions in a disaster context. The analysis results place social and community resilience in first place, confirming that social resilience and community capacity are key factors in accelerating flood mitigation, closely related to preparedness, local coordination, and risk reduction. The second-place ranking for transportation disruption indicates that disruption

to transportation networks is a critical variable that must be immediately minimized to maintain the smooth flow of logistics and humanitarian supply chains. Meanwhile, road network resilience is ranked third, emphasizing the resilience of road infrastructure as a prerequisite for sustainable access and distribution of aid. Performance sensitivity provides justification in prioritizing interventions so that logistics strategies and supply chain management can be focused on the most significant impacts to accelerate flood disaster mitigation.

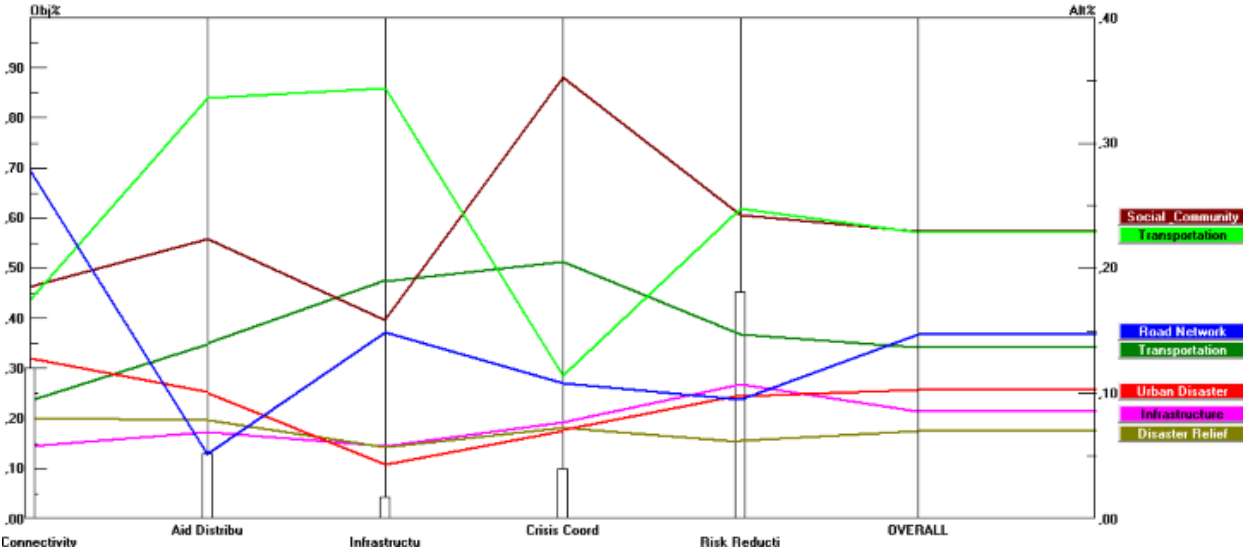


Figure 6. Performance Sensitivity Accelerates Flood Disaster Mitigation

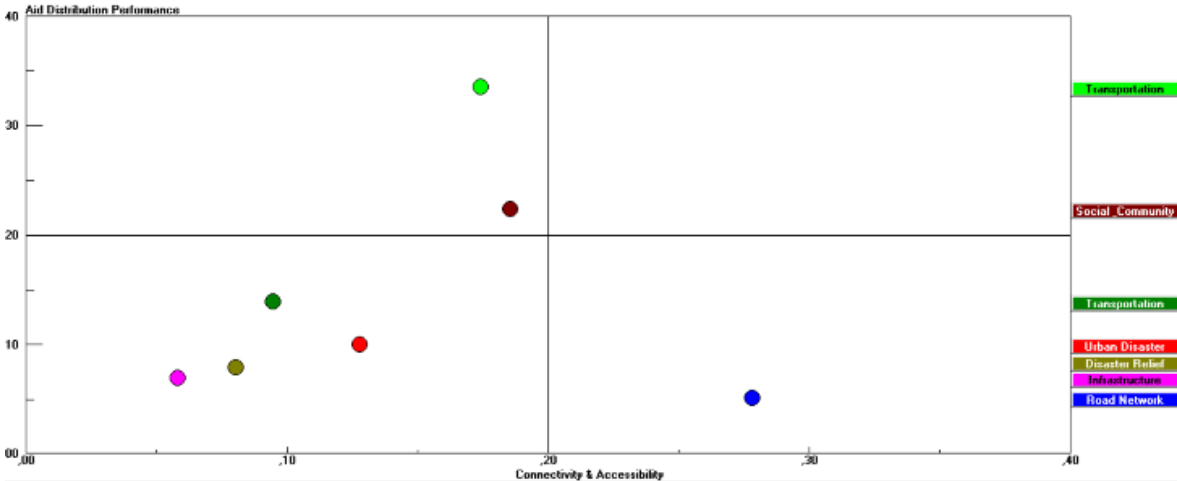


Figure 7. Two-Dimensional Sensitivity Accelerates Flood Disaster Mitigation

The two-dimensional sensitivity analysis of the AHP results presented in Figure 7 plays a role in improving understanding of the position and contribution of each sub-criterion in efforts to

accelerate flood disaster mitigation. The two-dimensional approach allows for the simultaneous evaluation of two assessment criteria against the priority sub-criteria to provide a comprehensive

picture of decision stability. This analysis helps identify superior factors despite variations in criterion weighting through sub-criterion mapping and indicates the most adaptive intervention areas to disaster dynamics and logistical needs. The analysis results place transportation network resilience in first place, confirming that transportation network resilience plays a central role in ensuring connectivity, accessibility, and smooth supply chains in flood situations. Social and community resilience is ranked second, indicating that strong social capacity and

community involvement complement the technical aspects of infrastructure. Meanwhile, transportation disruption is ranked third, emphasizing the management and mitigation of transportation disruptions, which are expected not to be a major obstacle in aid distribution and resource mobilization. Two-dimensional sensitivity provides visual justification that the positioning of sub-criteria contributes to supporting the acceleration of flood disaster mitigation and determining operational policy priorities.

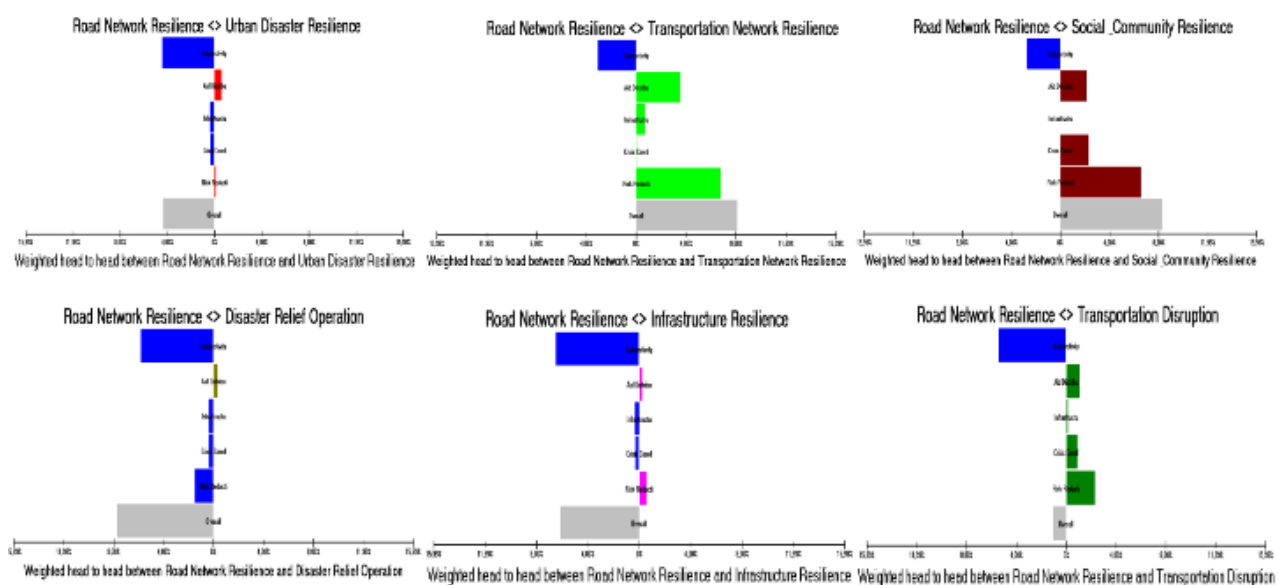


Figure 8. Head-to-Head Sensitivity Accelerates Flood Disaster Mitigation

The head-to-head sensitivity analysis in Figure 8 plays a role in strengthening accurate decision-making based on AHP by comparing sub-criteria in specific research such as accelerating flood disaster mitigation. Comparisons of sub-criteria such as road network resilience, urban disaster resilience, transportation network resilience, social & community resilience, disaster relief operations, infrastructure resilience, and transportation disruption are conducted based on criteria applied as an assessor, including connectivity and accessibility, aid distribution performance, infrastructure adaptation, crisis coordination, and risk reduction impact. The analysis shows that the strength of the sub-criteria changes depending on the assessment dimension used. This approach is able to reveal that no single sub-criterion is absolutely superior in all aspects

and that the superiority of the sub-criterion depends on the focus of the policy or specific operational needs. Furthermore, the results of the head-to-head sensitivity confirm that goal setting in AHP greatly determines the direction and weight of decisions, because the results of comparing two identical sub-criteria will produce priority values that may differ when assessed on different criteria. In the context of Bekasi City, which have diverse characteristics, infrastructure, and social capacities, this allows for more adaptive mitigation priorities. Head-to-head analysis ensures that the chosen logistics and supply chain management strategies support critical needs on the ground and are transparent for effective policy formulation focused on disaster risk reduction through targeted analysis aimed at accelerating flood mitigation.

Transportation Network Resilience
 Social & Community Resilience
 Transportation Disruption
 Infrastructure Resilience
 Urban Disaster Resilience
 Road Network Resilience
 Disaster Relief Operation



Figure 9. Priority Accelerates Flood Disaster Mitigation to Optimize Logistics and Supply Chain Management

The final results and recapitulation of the AHP sensitivity analysis presented in Figure 9 play a role in setting priorities for accelerating flood disaster mitigation through optimizing logistics and supply chain management in Bekasi City. This analysis synthesizes all sensitivity results, including performance, gradient, dynamic, two-dimensional, and head-to-head, into one integrated decision that directs priorities toward accelerating mitigation. Transportation network resilience is designated as the top priority, indicating that the resilience of the transportation network as a whole is seen as the most crucial factor in ensuring connectivity, accessibility, and smooth logistics distribution during flood conditions. Mitigation efforts and humanitarian preparedness risk being hampered from the outset without transportation network resilience. Social and community resilience is the second recommendation, emphasizing the importance of social capacity, community participation, and local networks in supporting the effectiveness of logistics and supply chain systems, especially in the pre-disaster phase and during a disaster. Meanwhile, transportation disruption, as the third priority, indicates that managing transportation disruptions is a significant supporting factor in accelerating flood mitigation. Other sub-criteria, such as road network resilience, urban disaster resilience, disaster relief operations, and infrastructure resilience, have not been prioritized due to their perceived lower contribution to accelerating mitigation. These findings provide a more focused policy direction, allowing limited resources to be allocated to accelerating flood mitigation in the three affected provinces.

Key findings indicate that the effectiveness of logistics and supply chain management in supporting humanitarian preparedness to accelerate flood disaster mitigation is largely determined by the resilience of the transportation system and the social capacity surrounding it (Junlin

et al., 2026). The AHP priority results identify transportation network resilience as the primary reference, thus emphasizing that a resilient, adaptive, and integrated transportation network is the foundation of humanitarian preparedness. Network resilience enables logistics distribution (Pang et al., 2024), resource mobilization (Yuliana et al., 2026), and access to affected areas to be maintained during flood conditions. These findings reveal the crucial role of logistics and supply chains as strategic instruments for accelerating mitigation (Zhou et al., 2026). Furthermore, social and community resilience as the second priority and transportation disruption as the third priority indicate that accelerating flood mitigation is highly dependent on physical, technical, social strength, and the system's ability to manage disruptions. Community resilience strengthens local preparedness, accelerates coordination, and improves the effectiveness of logistics network utilization, while transportation disruption management plays a role in maintaining supply chain continuity during disasters. These findings emphasize that optimizing logistics and supply chain management for flood mitigation must be oriented towards strengthening transportation networks, empowering communities, and controlling disruptions to significantly and sustainably improve humanitarian preparedness in Bekasi City.

Referring to Figure 10, the contribution to accelerating flood disaster mitigation in Bekasi City is through the affirmation of resilience as a mitigation strategy in logistics systems and supply chain management. This contribution demonstrates the critical role of transportation network resilience in maintaining connectivity and accessibility during floods (Di et al., 2026; Erdem et al., 2026). This contribution justifies the fact that without a resilient transportation network in the form of roads, bridges, and alternative routes, mitigation

efforts will be hampered, resulting in suboptimal aid distribution, resource mobilization, and humanitarian coordination (Qu et al., 2026). Social and community resilience is a supporting pillar of the logistics system's effectiveness and therefore recommendations are made to strengthen the role of local communities through capacity building, community involvement in mitigation planning, and strengthening social networks as nodes for information and logistics distribution. Community resilience can support humanitarian preparedness, accelerate local responses, and maintain supply chain continuity when formal systems experience limitations (Seif et al., 2026). In the context of Bekasi City, with their diverse social and geographical characteristics, a community based approach is key to bridging infrastructure limitations and accelerating adaptive flood mitigation.

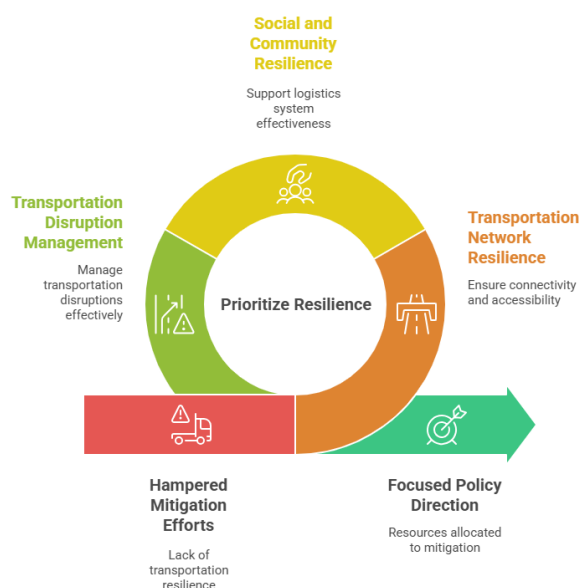


Figure 10. Accelerating Flood Disaster Mitigation Model

Another recommendation is the implementation of transportation disruption as a preventive measure to avoid hampered mitigation through the consequences of hampered mitigation efforts when transportation resilience is not a priority. Transportation disruption needs to be managed and integrated into disaster logistics policies through alternative route planning, diversification of transportation modes, and risk-based contingency scenarios (Ozmemis et al., 2025). Transportation network resilience, social and community resilience, and transportation disruption

management prepared by the central and regional governments will accelerate flood mitigation more effectively, targeted, and sustainably, especially in the three affected provinces. This can be done through focused policy direction and selective resource allocation, especially to the three main priorities.

4. CONCLUSION

This study confirms that logistics and supply chain management play a strategic role in supporting humanitarian preparedness to accelerate flood disaster mitigation in Bekasi City. The analysis shows that mitigation effectiveness depends on emergency response capacity and the readiness of a resilient, coordinated, and adaptive pre-disaster logistics system to flood risks. Based on the two approaches developed, this study successfully identified key factors influencing the acceleration of flood mitigation to provide a basis for more targeted decision-making. The priority findings, which prioritize transportation network resilience, social and community resilience, and transportation disruption, suggest that accelerated flood mitigation must focus on strengthening transportation networks, empowering communities, and systematically managing distribution disruptions. These three recommended factors complement each other in maintaining the sustainability of logistics and humanitarian supply chains in flood-prone areas. This study provides practical recommendations for the government and stakeholders to design more effective, contextual, and sustainable flood mitigation policies and strategies.

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