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Flood Disaster Risk Analysis on November 27, 2025 Regarding Damage to Road and Bridge Infrastructure in Kuranji District

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ABSTRACT

Floods are one of the most frequent hydrometeorological disasters in urban areas in Indonesia and have a significant impact on transportation infrastructure. The flooding event on November 27, 2025, in Kuranji District caused damage to several roads and bridges, disrupting community mobility and socio-economic activities. This article aims to analyze the risk of flooding on road and bridge infrastructure damage in Kuranji District through a hazard, vulnerability, and capacity analysis approach. This study uses a descriptive qualitative research method with data sources in the form of disaster incident reports, post-disaster field observations, and regional infrastructure and disaster planning documents. The analysis results indicate that high rainfall intensity, limited drainage capacity, the proximity of infrastructure to river channels, and the relatively old physical condition of infrastructure are the dominant factors increasing the risk of damage. Road infrastructure experienced pavement damage, roadway erosion, and decreased soil bearing capacity, while bridge infrastructure experienced foundation erosion, abutment damage, and decreased structural stability. This study concludes that the risk of flood disasters to road and bridge infrastructure in Kuranji District is in the high category and requires integrated mitigation efforts through risk-based planning, strengthening infrastructure structures, and increasing institutional capacity.

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1. INTRODUCTION

Floods are one of the most frequent hydrometeorological disasters in Indonesia and have a wide-ranging impact on people's lives and regional development. Nationally, the increase in flood frequency and intensity over the past decade is inextricably linked to global climate change, which has triggered extreme rainfall, shifting seasonal patterns, and increased extreme weather events (IPCC, 2021). These conditions place significant pressure on urban areas, which generally have high population densities and limited environmental carrying capacity.

In addition to climate factors, flooding in urban areas is also influenced by uncontrolled land-use changes. The conversion of green open spaces to residential and commercial areas has reduced the soil's ability to absorb rainwater. At the same time, urban drainage systems in many areas have not been designed to cope with increased surface runoff. As a result, flooding and overflows frequently occur when rainfall intensity exceeds the capacity of the available drainage system.

Kuranji District is one of the urban areas with a high level of vulnerability to flooding. Geographically, Kuranji District is traversed by several rivers and waterways that function as catchment areas and drainage channels for rainwater. The relatively flat to low-lying topography in some areas makes water easily pooled during heavy, prolonged rainfall. The flooding of November 27, 2025, is clear evidence that this region still faces serious challenges in flood risk management.

The main problems arising from the flooding in Kuranji District were not limited to the impact on residential areas but also significantly impacted public infrastructure, particularly roads and bridges. Roads and bridges are vital infrastructure that serve as the backbone of public mobility, the distribution of goods and services, and access to education, health, and economic services. Damage to this infrastructure will have a domino effect, disrupting socio-economic activities, increasing transportation costs, and hampering emergency response when disasters occur.

Based on initial observations and post-disaster reports, road infrastructure damage in Kuranji District includes peeling and damage to the asphalt pavement, the formation of potholes, erosion of the shoulders and roadbed, and a decrease in the bearing capacity of the subgrade due to prolonged waterlogging. This damage not only reduces the comfort and safety of road users but also increases the risk of traffic accidents and accelerates road degradation.

In bridge infrastructure, the problems identified tend to be structural in nature and pose a greater risk. Several bridges experienced scouring of their foundations due to heavy floodwater flow, damage to bridge abutments, and decreased structural stability. These conditions are extremely dangerous if not addressed promptly, as they can lead to bridge structural failure, directly impacting user safety and regional connectivity.

Other issues exacerbating the risk of infrastructure damage are vulnerability and management capacity. Some road and bridge infrastructure in Kuranji District is older and designed to technical standards that do not fully consider the increased risk of flooding due to climate change. Furthermore, limited maintenance budgets, inadequate regular monitoring of infrastructure conditions, and the lack of integration of disaster risk analysis into infrastructure development planning contribute to increased vulnerability.

Based on these issues, a comprehensive study is needed to analyze the risk of flooding on road and bridge infrastructure damage in Kuranji District. Risk analysis that includes aspects of hazard, vulnerability, and capacity is expected to provide a complete picture of the level of risk faced and become the basis for formulating mitigation strategies and developing more adaptive and sustainable infrastructure.

Article Type

This article is classified as an original research article. The study presents the results of a disaster risk analysis focusing on flood impacts on road and bridge infrastructure in Kuranji District. The research employs a descriptive qualitative approach supported by hazard, vulnerability, and capacity analysis to assess infrastructure damage resulting from the flood event on November 27, 2025. The findings contribute empirical evidence to support disaster risk reduction–based infrastructure planning and the development of adaptive and sustainable urban infrastructure systems.

2. METHOD, DATA, ANALYSIS

This research is original research using a literature review approach. The literature review was conducted by reviewing various written sources, such as scientific journals, reference books, and official reports. This approach was chosen to gain a comprehensive understanding of the risk of flooding on road and bridge infrastructure damage based on actual conditions in the field.

The risk analysis was conducted based on the concept of disaster risk, which is a function of hazard, vulnerability, and capacity. The hazard analysis included rainfall intensity, inundation height, flood duration, and water flow velocity. The vulnerability analysis focused on the physical condition of road and bridge infrastructure, the age of the buildings, the type of material, drainage conditions, and the proximity of the infrastructure to rivers. The capacity analysis included the local government's capacity for infrastructure maintenance, disaster preparedness, and post-disaster management.

The research data was obtained through a search and review of various literature sources, such as flood incident reports, previous research results, scientific journals, and regional infrastructure and disaster planning documents. The data analysis used a descriptive-analytical technique, reviewing and comparing findings in the literature using relevant theoretical frameworks and disaster management policies.

3. RESULT AND DISCUSSION

The results and discussion in this study provide an in-depth description of the impact of flooding on road and bridge infrastructure in Kuranji District, linking it to the concept of disaster risk, which encompasses hazard, vulnerability, and capacity. The discussion is structured narratively to provide a comprehensive overview of the level of risk and its implications for regional infrastructure development.

Result

The research results show that the flood on November 27, 2025, caused extensive damage to road infrastructure in Kuranji District. Several main roads and neighborhood roads experienced inundation of varying depths and duration. The prolonged inundation resulted in peeling of the asphalt pavement, the appearance of potholes, and damage to the shoulders and roadbed due to erosion.

Road damage was most common on roads located in low-lying areas and adjacent to drainage channels and river channels. Poor drainage conditions prevented rainwater from draining quickly, prolonging the inundation period. Furthermore, water saturation in the roadbed reduced its bearing capacity, resulting in subsidence and cracks in the pavement structure.

Regarding bridge infrastructure, the research results indicated both structural and non-structural damage. The most prevalent structural damage was scouring of bridge foundations due to the heavy floodwater flow. This scouring has the potential to reduce the stability of bridge structures and increase the risk of failure if not promptly addressed. Non-structural damage included damage to bridge abutments, cracks in bridge decks, and damage to supporting elements such as guardrails and structural connections.

The extent of bridge damage varied, influenced by site characteristics and bridge design. Bridges with short spans and those over small rivers were more vulnerable, especially if they lacked protective structures or foundation reinforcements. These findings suggest that design factors and environmental conditions significantly influence the extent of infrastructure damage caused by flooding.

Discussion

This discussion focuses on interpreting research results by linking empirical findings to a disaster risk analysis framework. The risk of flooding to road and bridge infrastructure in Kuranji District is the result of the interaction between high flood hazard levels, physical vulnerability of the infrastructure, and limited management and maintenance capacity.

From a hazard perspective, high rainfall intensity and relatively long flood duration increase hydraulic pressure on road and bridge structures. This condition accelerates the degradation of road pavement materials and increases the potential for erosion of bridge foundations. These findings indicate that increasingly frequent extreme rainfall patterns have exceeded conventional infrastructure planning assumptions.

Infrastructure vulnerability is a significant factor in increasing the risk of damage. Most roads and bridges in Kuranji District were built to technical standards that do not fully consider the risk of high-intensity flooding. Limited supporting drainage systems, less adaptive construction materials, and the proximity of infrastructure to river channels increase the potential for damage during flooding.

Cumulative road damage indicates that flooding not only causes temporary damage but also accelerates the reduction in infrastructure's service life. Repeated water saturation of the subgrade weakens, increasing the frequency of damage to the road surface. Meanwhile, in bridge infrastructure, foundation erosion is a crucial issue that can threaten structural stability and user safety.

In terms of capacity, limited maintenance budgets, a lack of regular inspections, and a reactive approach to management mean that potential damage cannot be optimally anticipated. Disaster risk analysis has also not been fully integrated into regional infrastructure development planning, so mitigation efforts are often not a top priority.

The results of this study emphasize the importance of a disaster risk reduction approach in infrastructure development and management. Strengthening road and bridge designs to adapt to flooding, increasing drainage system capacity, and protecting bridge structures from erosion are strategic steps to reduce risk levels. Furthermore, strengthening institutional capacity and integrating disaster risk analysis into regional development planning are key to achieving resilient and sustainable infrastructure.

4. CONCLUSION

Based on the research results, it can be concluded that the flood disaster on November 27, 2025, carries a high risk of damage to road and bridge infrastructure in Kuranji District. The main factors causing this high risk include high rainfall intensity, limited drainage capacity, physical vulnerability of the infrastructure, and suboptimal maintenance capacity. Therefore, integrated mitigation efforts are needed through disaster risk reduction-based infrastructure development, improving the quality of drainage systems, and strengthening institutional capacity and regional policies.

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Hopefully, the results of this research will benefit the community and serve as a reference for efforts to improve the quality of infrastructure development and reduce disaster risk sustainably.

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