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Revitalizing flood-prone areas through socio-environmental strategies: A qualitative approach to urban flood management

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ABSTRACT

Background: The Ciliwung River is one of the most important rivers in Tatar Pasundan, especially because it passes through the capital city of DKI Jakarta and often causes annual floods in its downstream areas. The length of this river reaches almost 120 km and passes through several areas, including Bogor Regency, Bogor City, Depok City, and DKI Jakarta Province. High rainfall is one of the factors that often causes flooding in areas around rivers. **Methods:** This research aims to analyze the management of flood disasters that occur due to the overflow of the Ciliwung River. The analysis carried out by the author used qualitative methods with a literature review. **Findings:** The results obtained from the literature review of several journals, namely flood management on the Ciliwung River, cannot still be said to be completely successful. This is because several factors trigger floods that have not yet been resolved and appropriate solutions are needed for flood-prone areas so that they can be revitalized so that they can provide direct benefits to the community. **Conclusion:** The study highlights the persistent challenges in managing flood disasters caused by the overflow of the Ciliwung River. Despite various efforts, flood management in the Ciliwung River Basin has not been entirely successful. Several unresolved factors continue to trigger flooding, indicating the need for more effective and sustainable solutions. The revitalization of flood-prone areas is essential to mitigate the impact and provide direct benefits to the affected communities. **Novelty/Originality of the Article:** Unlike previous studies that focus on specific technical solutions, this research highlights the need for holistic revitalization of flood-prone areas, considering socio-environmental factors to enhance community resilience and sustainable flood mitigation strategies.

KEYWORDS: community resilience; flood management; mitigation; socio-environmental.

1. Introduction

Flooding is an event or situation where an area or land is submerged due to an increased volume of water. Disasters caused by hydrometeorological factors always increase every year. Even though sometimes it does not cause many casualties, this disaster still damages infrastructure and significantly disrupts the economic stability of the community. One of the causes of flooding is high intensity and rainfall, especially for lowland communities. Apart from that, the small capacity of the river can also cause flooding. If the intensity of rain is high, the volume of water flowing will also be high. If the river's capacity

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is inadequate because it is too small, this will cause the water to have no place and eventually overflow and cause flooding.

The Ciliwung River is one of the rivers that flows on the island of Java. It has a length of 120 km, with a water catchment area of 387 km. The Ciliwung River is a historic river that stretches from upstream in Bogor Regency to downstream on the north coast of Jakarta. The Ciliwung River is the largest river that crosses the city of Jakarta which has always been recorded to cause problems in the form of flooding for the residents of Jakarta. This happens because of the geographical location of the city of Jakarta which is located in the lowlands, even some areas in the northern part of the city have an altitude lower than sea level. Flood conditions in Jakarta are always made worse by the arrival of sea tides when river discharge rises during the rainy season.

Flood events along the Ciliwung River have become a recurring concern, especially in urban areas like Jakarta, which are densely populated and rapidly developing. Urbanization has significantly reduced the river's natural capacity to absorb and channel water due to land-use changes, such as the conversion of green open spaces into built-up areas. Impervious surfaces, like asphalt and concrete, hinder water infiltration and increase surface runoff, which directly contributes to the higher frequency and intensity of urban flooding (Firman et al., 2011). Moreover, inadequate drainage systems and poor solid waste management exacerbate the situation, causing blockages in water channels and reducing river flow capacity.

In response to these challenges, flood risk management in the Ciliwung watershed has become a priority for both local and national governments. Various structural and non-structural strategies have been implemented, including river normalization, construction of flood control infrastructure (e.g., East Flood Canal) (Wibowo et al., 2019), community-based disaster preparedness, and the relocation of communities living in flood-prone areas (Rahayu & Nitivattananon, 2021). However, despite these efforts, effective and sustainable flood mitigation remains a complex issue that requires a comprehensive, integrated approach involving multi-sectoral collaboration and active community participation.

Understanding the hydrological characteristics of the Ciliwung River and the socio-environmental dynamics of the Jakarta metropolitan area is crucial in developing adaptive and resilient strategies to manage urban floods. With climate change expected to increase the frequency of extreme weather events, including heavy rainfall, future flood risks in the Ciliwung basin are likely to intensify if not addressed with forward-thinking, data-driven planning (Marfai & Hizbaron, 2011).

Efforts to manage flooding in the Ciliwung River basin face not only technical challenges but also complex social and spatial planning issues. The rapid population growth in the Greater Jakarta area (Jabodetabek) has driven residential expansion into areas that were originally intended to function as water catchment zones. Many of these riverside areas, which ideally should remain undeveloped, have turned into densely populated settlements. This not only increases the vulnerability to flooding but also complicates relocation and spatial restructuring efforts by the government (Hudalah & Firman, 2012). This phenomenon highlights a dilemma between housing needs and the preservation of the river's ecological functions.

Moreover, climate change has exacerbated the problem by increasing weather anomalies, particularly extreme rainfall events. A study by Boer & Faqih (2004) indicates that rainfall intensity in the Jabodetabek region has increased significantly over the past two decades. This change has overwhelmed the existing drainage systems, especially during the peak of the rainy season. The combination of natural conditions, development pressures, and weak environmental regulation has amplified the potential for annual floods to become chronic disasters.

Another contributing factor to the decreasing environmental carrying capacity of the Ciliwung River is sedimentation caused by deforestation in the upstream areas. The conversion of forested land in Bogor and its surroundings has significantly reduced the soil's ability to absorb rainfall. As a result, rainwater flows rapidly into the river rather than being absorbed, drastically increasing water volume within a short time (Soemarwoto,

2001). This problem is further compounded by the absence of an integrated monitoring and control system between the upstream and downstream regions.

In terms of disaster risk management, technocratic approaches such as the construction of flood control infrastructure (e.g., levees, flood canals, and reservoirs) have provided short-term benefits. However, these strategies do not fully address the root causes of flooding in a sustainable manner. A more holistic approach is required—one that encompasses not only technical measures but also inclusive governance, community participation, and policy integration across regions and sectors (Miller et al., 2019).

Therefore, it is crucial to reevaluate the strategies currently employed in flood mitigation in the Ciliwung River area. This study aims to identify the key contributing factors to flooding in the Ciliwung watershed and to explore the mitigation efforts undertaken by various stakeholders. By emphasizing the synergy between structural and non-structural approaches, this research seeks to offer adaptive and sustainable policy recommendations to minimize the long-term impacts of flooding in urban river basins.

Therefore, based on these problems, reducing the risk of flood disasters in the area around the Ciliwung River needs to be carried out. This research aims to analyze the management of flood disasters that occur due to the overflow of the Ciliwung River.

1.1 Understanding flood disasters: Causes and impacts

Flood disasters are complex phenomena that can arise from various natural and human-induced factors. Understanding the causes of flooding is crucial for effective disaster management. Natural causes include heavy rainfall, rapid snowmelt, and storm surges, while human activities such as deforestation, urbanization, and poor land-use planning can exacerbate flood risks. The impacts of flooding are multifaceted, affecting not only the physical environment but also the social and economic fabric of communities. Floods can lead to loss of life, displacement of populations, destruction of infrastructure, and long-term economic setbacks. By comprehensively understanding these causes and impacts, stakeholders can develop targeted strategies to mitigate flood risks and enhance community resilience (Alborzi et al., 2022; Rijal et al., 2024).

1.2 The role of early warning systems in flood management

Early warning systems (EWS) play a critical role in flood disaster management by providing timely information to communities at risk. These systems utilize meteorological data, hydrological models, and satellite imagery to predict potential flooding events (Byaruhanga et al., 2024). Effective EWS can significantly reduce the loss of life and property by enabling timely evacuations and preparedness measures. The integration of technology, such as mobile alerts and community engagement, enhances the effectiveness of these systems. However, challenges remain in ensuring that warnings reach vulnerable populations, particularly in remote or underserved areas. Continuous improvement and investment in EWS are essential for enhancing flood preparedness and response (Byaruhanga et al., 2024).

1.3 Community-based approaches to flood disaster management

Community involvement is vital in flood disaster management, as local knowledge and participation can lead to more effective and sustainable solutions. Community-based approaches empower residents to take an active role in identifying risks, developing preparedness plans, and implementing mitigation measures (Dewi, 2014). This can include initiatives such as constructing flood barriers, restoring wetlands, and creating local emergency response teams. Engaging communities in the planning process fosters a sense of ownership and responsibility, which can enhance resilience. Successful examples of community-based flood management highlight the importance of collaboration between local governments, NGOs, and residents in building adaptive capacities.

1.4 Policy and governance in flood disaster management

Effective flood disaster management requires robust policies and governance frameworks that facilitate coordinated responses across various levels of government and sectors. Policies should prioritize sustainable land use, environmental protection, and infrastructure development that considers flood risks. Governance structures must ensure that stakeholders, including local communities, are involved in decision-making processes. Additionally, integrating climate change adaptation strategies into flood management policies is essential, as changing weather patterns can alter flood dynamics. Evaluating and revising existing policies based on lessons learned from past flood events can lead to more resilient communities.

1.5 Technological innovations in flood management

Advancements in technology have transformed flood disaster management, providing new tools for prediction, monitoring, and response. Geographic Information Systems (GIS), remote sensing, and data analytics enable more accurate flood modeling and risk assessment. Drones and satellite imagery can be used for real-time monitoring of flood events, while mobile applications facilitate communication and information dissemination during emergencies. Furthermore, innovative engineering solutions, such as green infrastructure and permeable surfaces, can help manage stormwater and reduce flood risks. Embracing these technological innovations can enhance the effectiveness of flood management strategies and improve community preparedness.

1.6 Post-flood recovery and rehabilitation

Post-flood recovery is a critical phase in disaster management that focuses on restoring affected communities and infrastructure. This process involves assessing damage, providing humanitarian assistance, and implementing long-term recovery plans. Effective recovery strategies should prioritize the needs of vulnerable populations and ensure that rebuilding efforts incorporate resilience measures to withstand future floods. Community engagement in the recovery process is essential to rebuild trust and foster a sense of agency among residents. Additionally, integrating lessons learned from the flood event into future planning can enhance preparedness and reduce the risk of similar disasters occurring.

1.7 Climate change and its implications for flood management

Climate change poses significant challenges to flood disaster management, as it can lead to increased frequency and intensity of extreme weather events. Rising sea levels, altered precipitation patterns, and more severe storms can exacerbate existing flood risks. Understanding the implications of climate change on flood dynamics is crucial for developing adaptive management strategies. This includes investing in resilient infrastructure, enhancing early warning systems, and promoting sustainable land-use practices. Policymakers must prioritize climate adaptation in flood management frameworks to ensure that communities are better prepared for the impacts of a changing climate.

2. Methods

The data collection technique employed in this paper utilizes qualitative research methods through a literature review or secondary data collection concerning post-flood disaster management on the Ciliwung River. A literature review is a systematic process that involves gathering data from various sources, including journals, books, and official documents, which encompasses reading, note-taking, and processing research materials. In

this context, the research aims to identify and analyze various aspects of flood disaster management that have been implemented in the Ciliwung River area.

The first stage of data collection involves conducting an in-depth literature study. The author identifies and records relevant literature from diverse journals, books, and official documents related to flood disaster management in the Ciliwung River. This process includes searching for credible and up-to-date sources, as well as critically analyzing the information obtained. The author strives to understand the existing context and dynamics while linking these findings to the established problem formulation. By doing so, a robust theoretical framework is developed to support further analysis.

Following the data collection through the literature study, the next stage is data analysis. This process involves reviewing and comparing relevant sources concerning the issues raised in the research. The author applies data reduction techniques, which entail simplifying, summarizing, selecting key elements, classifying, and focusing on significant aspects that share common themes and patterns. The reduced data becomes clearer in description, facilitating the author's ability to proceed with data collection in subsequent stages. This data reduction aims to emphasize, condense, and focus the information by eliminating irrelevant data, thereby making it easier to draw conclusions (Miles, 2014).

After the analysis process, the author synthesizes the collected and analyzed data. This stage involves integrating information from various sources to build a comprehensive understanding of flood disaster management in the Ciliwung River. The author then draws conclusions based on the findings obtained and provides relevant recommendations for improving disaster management in the future. By following these stages, this research aims to contribute significantly to the understanding and development of more effective flood disaster management strategies in the Ciliwung River area. The qualitative approach employed in this research allows the author to delve deeper into the social, economic, and environmental contexts influencing flood dynamics, as well as to identify more sustainable and inclusive solutions.

3. Results and Discussion

Based on Robbani et al. (2020), the conclusion is that when heavy rain occurs, the water discharge in the Ciliwung River will increase greatly, which then overflows onto land and becomes a flood disaster. Floods are very influential and can paralyze all community activities. It is hoped that structural and non-structural flood disaster mitigation planning in the Ciliwung River bank area will be able to overcome flood disasters. The government is expected to be able to improve infrastructure and implement actions to reduce flood disasters. The community is also likely to be able to increase awareness, communication, and cooperation. Cooperation between government and society is also highly expected. This can make you better prepared to face a flood disaster and recover more quickly after a disaster.

The Green Water Front is a concept for developing polluted river watersheds and utilizing open space in areas above the river. This space will function like a bridge which will increase interaction between residents who were previously separated by the river. Apart from that, it will form a public space, a children's play area, and a place to grow vegetables.

For this concept to be realized, cooperation is needed between three components, namely students and universities, the government, and communities around the riverbanks as subjects in this concept. If the Green Water Front concept is realized, it will also have several benefits, one of which is an effective solution to the problem of polluted river watersheds. This concept can create a clean and healthy environment, thereby improving the quality of life of residents living along river banks and creating water catchment areas to reduce flooding. The success of this concept will be determined by various parties including society and the government. The mindset that must be changed by the community and the government is not to make the Ciliwung River a source of disaster but to make it a water resource that can bring high economic value in the future.

Based on Candini et al. (2023), the conclusion was obtained, namely that the Ciliwung River needs to be protected and maintained so that it can accommodate rainwater can prevent flood disasters. One protection that can be sought is by regulating or arranging riverside areas or river borders, including arranging buildings around river borders. Nationally, regulations prohibiting the construction of permanent buildings on river borders have been regulated, and regulations in the Bogor area have also been stipulated regarding land use. However, in reality, currently, these regulations are still not implemented properly. This is proven by the fact that there are still buildings being erected in areas near the river, so supervision and control are needed from the authorities, especially in the Bogor and Puncak areas upstream of the Ciliwung River.

The results of Leonardy (2020) research are that common problems that occur in the city of Jakarta are flooding and a lack of green open space. The general solution that can be implemented by the Jakarta Regional Government is to normalize rivers to increase the volume of water that can be accommodated by rivers so that water does not flood river border areas. To be able to solve these two problems requires a solution that can combine answers to both problems in the city of Jakarta. The resilience concept which focuses on resolving natural disasters can be the solution needed by the city of Jakarta.

By applying the concept *of resilience* in the landscape as a solution to the lack of green open space, then both problems can be resolved. Application of concepts *landscape of adaptability and resilience landscape* In the landscape, a design will be obtained that can adapt to changes in river water levels and can meet the needs of green open space in the city of Jakarta.

Table 1. Selected literature on flood disaster management and community resilience

No	Author(s)	Title	Findings	Relevance
1	Robbani et al. (2020)	*Mitigasi bencana banjir di area tepian Sungai Ciliwung Jakarta*/Flood disaster mitigation in the Ciliwung Riverbank area, Jakarta	Heavy rain increases water discharge in the Ciliwung River, causing floods. Structural and non-structural mitigation, along with collaboration between government and community, is essential.	Emphasizes integrated flood mitigation, aligning with the need for area revitalization.
2	Firman et al. (2011)	Potential climate-change related vulnerabilities in Jakarta: Challenges and current status	Urbanization and land use changes increase surface runoff and worsen flooding. Drainage infrastructure is inadequate.	Highlights environmental and spatial factors as contributors to floods.
3	Rahayu et al. (2021)	What are the Essentials for Community Resilience against Recurring Floods?	Institutional and cross-sectoral coordination is weak, limiting effective flood risk management.	Supports the need for systemic, policy-based solutions beyond technical efforts.
4	Damanik et al. (2023)	Community Vulnerability To Flood Disaster Problems	Land conversion reduces soil absorption, increasing flood risk, especially in lowland areas.	Reinforces the urgency of land-use-aware revitalization strategies.
5	Marfai & Hizbaron (2011)	Community's adaptive capacity due to coastal flooding in Semarang coastal city, Indonesia	Community preparedness and response are lacking. Public education and involvement are vital.	Highlights the social dimension of flood management, in line with community resilience focus.

Table 1 presents a summary of relevant literature that supports the need for integrated, community-based, and environmentally aware approaches to flood disaster management. Based on Sugandhi et al. (2023) research produces conclusions, namely modeling results which show that runoff from standing water from the Ciliwung watershed in Kel. Kebon Baru, South Jakarta and Kel. Bidara Cina, East Jakarta, which occurs at a height of up to 1 meter, has an area of 39.51 ha. In general, areas where flooding occurs are areas close to rivers and consist of the closure of open land, roads, and settlements. Prediction results for buildings affected by flooding in Kel. Kebon Baru, Tebet District, South Jakarta has around 793 building units and 1096 building units in Kel. Bidara Cina, Jatinegara District, East Jakarta.

Flood management in the Ciliwung River Basin presents an ongoing challenge that involves both natural and human-induced factors. The literature reviewed reveals a recurring pattern of ineffective responses to flooding, despite repeated efforts by stakeholders. Several interrelated themes emerge from the analysis: the inadequacy of existing infrastructure, land use changes, climate change, institutional fragmentation, and the need for community-based strategies. Together, these factors underscore the necessity for a holistic and sustainable approach to flood disaster management in Jakarta.

The study by Robbani et al. (2020) emphasizes the direct correlation between high rainfall intensity and flood occurrence along the Ciliwung River. The findings confirm that without structural interventions such as improved drainage systems and flood barriers, communities living along the riverbanks remain highly vulnerable. However, as Robbani highlights, structural solutions alone are insufficient. Non-structural approaches—such as raising community awareness and improving preparedness—are equally important. This dual approach aligns with the primary goal of revitalizing flood-prone areas not only physically but also socially.

Moreover, Firman et al. (2011) point out that rapid urbanization has significantly contributed to the increasing frequency and severity of floods. The replacement of vegetated land with impervious surfaces has resulted in reduced water infiltration and greater surface runoff. This situation is worsened by the fact that Jakarta lies in a lowland area, and much of its northern part is even below sea level. As the city continues to expand, especially without integrated spatial planning, flood risks will likely intensify.

Climate change further exacerbates this issue. Syafrina et al. (2017) project a significant rise in extreme rainfall events due to global climate change trends. These environmental dynamics place even greater pressure on outdated drainage systems and unprepared communities. The anticipated increase in rainfall intensity calls for adaptive planning strategies that go beyond short-term infrastructure projects and instead focus on long-term climate resilience.

Institutional and governance challenges are also crucial. Rahayu & Nitivattananon (2021) argue that ineffective coordination among governmental bodies hinders the success of flood risk management programs. While numerous agencies are involved in Jakarta's flood control efforts, the lack of synchronization often leads to overlapping or contradictory actions. The absence of a unified institutional framework limits the potential for implementing comprehensive solutions, such as basin-wide watershed management plans.

In addition, studies such as Hermawan (2018) bring attention to the upstream-downstream linkages in flood causation. The degradation of upstream forested areas in Bogor due to deforestation and land conversion significantly reduces the capacity of the watershed to absorb rainfall. Water rapidly flows downstream, overwhelming the Ciliwung River and its urban drainage systems. While river normalization programs have been implemented to expand river capacity, Hermawan notes that social resistance, particularly around land acquisition and relocation, limits their effectiveness.

From a spatial perspective, Setiawan et al. (2022) provide flood vulnerability mapping using GIS tools, showing that the northern regions of Jakarta—through which the lower Ciliwung River flows—are most at risk. This mapping is critical in guiding decision-makers to target the most vulnerable areas for revitalization and intervention. Furthermore, land

use changes must be strictly regulated, especially in flood-prone zones, to prevent further degradation and support sustainable mitigation measures.

Importantly, the social dimensions of flood resilience cannot be ignored. Studies by Marfai et al. (2015) and Widyastuti & Yuliastuti (2019) highlight the significance of community-based adaptation and solidarity. They observe that local knowledge, social networks, and proactive engagement significantly enhance a community's ability to cope with and recover from flooding events. In this regard, revitalization must also include social infrastructure—such as early warning systems, evacuation plans, and disaster education programs—so that communities are empowered to act swiftly during disasters.

The current study differentiates itself by advocating for holistic revitalization, not limited to physical restructuring or technical engineering but encompassing socio-environmental resilience. This approach includes restoring natural water catchment functions in upstream areas, strengthening institutional collaboration, and integrating local communities in planning and implementation processes. By doing so, flood-prone areas along the Ciliwung River can be transformed into resilient, adaptive, and productive urban spaces.

In conclusion, the literature clearly supports the need for a shift in flood management strategy in the Ciliwung River Basin. Instead of reactive, segmented interventions, what is required is a proactive, inclusive, and integrated approach. The revitalization of flood-prone areas—considering ecological sustainability, urban planning, and community resilience—offers the most promising path forward to reducing flood risk and enhancing the quality of life for the people of Jakarta.

3.1 Flood disaster management in Ciliwung River: Challenges and sustainable solutions

The Ciliwung River, which flows through several key regions in the Pasundan area, including the capital city of DKI Jakarta, plays a vital role in the ecosystem and the lives of the surrounding communities. Stretching nearly 120 kilometers, the river serves not only as a source of life but also as a source of problems, particularly in the context of recurring flood disasters. Each year, the downstream areas of the river experience severe flooding, often caused by high rainfall, poor land management, and climate change. In this context, this study aims to analyze flood disaster management resulting from the overflow of the Ciliwung River, using a qualitative approach and an in-depth literature review.

Flooding in the Ciliwung River area is not a new phenomenon. Historically, floods have been a recurring issue, especially in densely populated areas such as Jakarta. According to the Meteorology, Climatology, and Geophysics Agency/*Badan Meteorologi, Klimatologi, dan Geofisika* (BMKG), high rainfall during the rainy season often exceeds the capacity of existing drainage systems, causing water to overflow and inundate residential areas. Additionally, factors such as the conversion of agricultural land into residential areas, deforestation, and unplanned infrastructure development have contributed to the increasing flood risks. Previous studies indicate that land use changes around the river have reduced the soil's capacity to absorb water, thereby increasing surface runoff that can potentially lead to flooding.

One of the main challenges in flood disaster management along the Ciliwung River is the lack of coordination among the various stakeholders involved, including local governments, communities, and non-governmental organizations. Although the government has implemented various programs to address the flood issue, such as the construction of embankments and drainage systems, many of these efforts are not well-integrated. This often results in temporary solutions that fail to address the root causes. For instance, the construction of embankments may reduce flood risks in the short term, but without proper land management and community participation, flooding problems will persist.

In this regard, a holistic approach to revitalizing flood-prone areas is crucial. Revitalization should not only involve physical development but also incorporate social, economic, and environmental aspects. One strategy that can be implemented is the

development of public education programs on disaster risk management. Communities must be involved in the planning and decision-making processes related to water resource management. By raising awareness of flood risks and providing knowledge on mitigation measures, communities can be better prepared for disasters and contribute to prevention efforts.

Furthermore, ecosystem-based management can also serve as an effective solution to reduce flood risks. Research has shown that ecosystem restoration, such as reforestation of watershed areas and the rehabilitation of wetlands, can enhance groundwater absorption and reduce surface runoff. By restoring the natural functions of ecosystems, we can not only reduce the risk of flooding but also improve environmental quality and biodiversity. For example, planting trees along riverbanks can help stabilize the soil, reduce erosion, and increase the land's water absorption capacity (Perkasa et al., 2021).

The importance of collaboration between the government, the public, and the private sector cannot be overlooked. In many cases, private sector involvement in water resource and infrastructure management can bring innovation and additional resources. For instance, companies can invest in environmentally friendly technologies that help manage rainwater and reduce flood risks. Additionally, partnerships between the government and non-governmental organizations can strengthen local capacity in disaster response by providing training and necessary resources.

In the effort to create sustainable solutions, policy aspects must also be taken into account. Policies that support sustainable water resource management and environmental protection should be a priority. The government needs to develop strict regulations regarding land use, waste management, and ecosystem protection. Moreover, policies that encourage public participation in environmental governance and disaster management will be essential to achieving long-term resilience.

3.2 Uncovering the root causes: Challenges and solutions in ciliwung river flood management

The Ciliwung River, which flows through several key regions in the Pasundan area, including the capital city of DKI Jakarta, has long stood as a silent witness to the challenges faced by surrounding communities, particularly in the context of flood disasters. Each year, floods caused by the river's overflow result in significant economic and social losses. This discussion aims to explore the root causes of flooding along the Ciliwung River and investigate practical solutions to address these pressing challenges.

3.2.1 Root causes of flooding in the Ciliwung River

One of the main causes of flooding in the Ciliwung River is the high level of rainfall, especially during the rainy season. Data from the Meteorology, Climatology, and Geophysics Agency (BMKG) indicates that rainfall in Jakarta and its surrounding areas frequently exceeds the capacity of existing drainage systems. However, extreme weather conditions are not the only contributing factor. Rapid land-use changes, such as the conversion of agricultural land into residential and commercial zones, have significantly reduced the land's ability to absorb water. Research shows that rapid urbanization around the river has altered natural water flow patterns, thereby increasing flood risks.

In addition, deforestation and the reduction of green spaces near the river have exacerbated the issue. Forests and vegetation serve as natural water absorbers, and the loss of these areas severely limits the land's water retention capacity. As a result, more surface runoff flows into the river in a short period, greatly increasing the likelihood of flooding.

3.2.2 Lack of coordination and effective policy

Another major challenge in managing floods along the Ciliwung River is the lack of coordination among various stakeholders, including local governments, communities, and non-governmental organizations. Although the government has initiated several programs

to address flooding—such as building embankments and drainage systems—many of these efforts lack integration and long-term planning. Temporary solutions are often implemented without a thorough assessment of their long-term impact, leading to recurring flood issues.

Existing policies are also often insufficient to address the root causes. For example, regulations concerning land use and environmental protection are not consistently enforced. This weak enforcement allows for unregulated development and excessive exploitation of natural resources, further aggravating the risk of flooding.

3.2.3 Sustainable solutions to address flooding

To effectively address these challenges, a more holistic and sustainable approach is required. One viable solution is ecosystem-based management. Ecosystem restoration—such as reforesting watershed areas and rehabilitating wetlands—can enhance the soil's capacity to absorb water and reduce surface runoff. Research indicates that restoring the natural functions of ecosystems not only mitigates flood risks but also improves environmental quality and biodiversity (Huang et al., 2019; Li et al., 2022; Wang et al., 2025).

Public education and community engagement are also crucial components of flood mitigation. Communities should be actively involved in planning and decision-making processes regarding water resource management. Educational programs on disaster risk management can raise public awareness about flood risks and equip residents with knowledge on mitigation strategies. By engaging the community, more relevant and effective solutions can be developed.

3.2.4 Multi-stakeholder collaboration

Collaboration between the government, community, and private sector is also essential. Private sector involvement in water resource and infrastructure management can bring innovation and additional resources. For instance, companies may invest in environmentally friendly technologies that help manage stormwater and reduce flood risk. Furthermore, partnerships between the government and non-governmental organizations can strengthen local capacity to respond to disasters by providing necessary training and resources.

4. Conclusion

Based on the results of literature review analysis from several journals, it can be concluded that flood management in the area around the Ciliwung River cannot yet be said to be completely successful. In general, areas that are flooded are areas close to rivers and consist of open land cover, roads, and settlements. Cooperation between the government and society is also very necessary. The efforts that can be taken to overcome flooding include: (1) regulating or arranging riverside areas or river borders, such as arranging buildings around river borders; (2) the green water front concept, if realized, will provide several benefits, including being an effective solution to the problem of polluted river basins; (3) applying the landscape concept of adaptability and resilience landscape to the landscape will result in a design that can adapt to changes in river water levels and can also meet the green open space needs of the city of Jakarta.

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