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DAM CONSTRUCTION: ROLES AND CHALLENGES IN FLOOD CONTROL

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Abstract

The construction of four dams has been designated as a national strategic project in the 2025–2029 National Medium-Term Development Plan (RPJMN). Dams play a crucial role in flood mitigation by retaining and regulating water flow during heavy rainfall, while also serving as sources of raw water, agricultural irrigation, and supporting energy use. This article examines the role of dams in flood control and the various challenges encountered during their construction. Although dams provide significant benefits to communities, their effectiveness depends on integration with other mitigation programs and strategies to address social, ecological, and technical impacts. Commission V of the DPR RI needs to exercise its oversight function to ensure dam construction proceeds optimally, to minimize flood impacts, and to strengthen national water resilience.

Introduction

Four priority dams have been designated as part of the National Strategic Projects (PSN) listed in the 2025–2029 National Medium-Term Development Plan (RPJMN). These projects aim to strengthen water resilience and flood control in line with the government's commitment to construct multiple dams across the country. As vital infrastructure in water resource management, dams not only serve as sources of raw water and irrigation but also regulate river flow and control downstream water volumes (Boulange et al., 2021).

This policy is strategic, considering the high frequency of floods in Indonesia. From January to February 2025, a total of 393 flood events were recorded across various regions, particularly affecting Central Java, East Java, West Java, Riau, and Lampung (BNPB, 2025). These floods were triggered by high-intensity rainfall, damage in upstream river areas, and reduced water catchment areas (Rachman, 2025). Given the wide-ranging impacts—disruption to daily life, infrastructure damage, and increased health risks from contaminated water—a comprehensive mitigation strategy is needed. This article discusses the role of

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dams in flood control and the challenges they face to support mitigation efforts and reduce flood-related risks and impacts.

The Role of Dams in Flood Control

Dams mitigate flood risks by holding back water during periods of intense rainfall, helping to control water discharge into downstream areas. By slowing and reducing water flow, dams enable more regulated water distribution (Subianto et al., 2019). The four dams listed as part of the PSN are Way Apu, Jragung, Mbay, and Bulango Ulu. In addition, 12 more dams are listed in the indicative plan based on evaluation of the previous PSN. The total investment for these projects is IDR 36.237 trillion (Arini, 2025).

Between 2021 and 2023, the number of dams across Indonesia increased. In 2023, there were 229 dams, most of which were located in Java and Nusa Tenggara (Table 1).

Table 1. *Development of Dam Numbers in 2019, 2021–2023*

Region	2019	2021	2022	2023
Sumatra	9	10	10	11
Java	86	86	92	98
Kalimantan	7	8	8	9
Sulawesi	4	5	7	10
Nusa Tenggara	89	90	92	94
Bali	5	5	5	6
Maluku	1	1	1	1
Total	**201**	**205**	**215**	**229**

Source: Directorate General of Water Resources, 2023 (processed).

Several dams in Indonesia are designed to reduce flood discharge. The Ciawi and Sukamahi dams in Bogor, for example, can reduce flood intensity by 9 percent by lowering peak discharge, while promoting infiltration and evaporation, effectively decreasing runoff volume (Mardjono et al., 2018). Similar efforts have been made with the Ameroro Dam in Konawe, which has a capacity of 88 million cubic meters and can reduce flood impact across 6,640 hectares (Yunus, 2024).

The Riam Kanan Dam effectively controls river overflow by managing water flow and minimizing flooding in the Banjar region, while the Riam Kiwa Dam is projected to reduce flood risk by up to 70 percent (Yulianus, 2025). Although dams are effective at reducing upstream flood risks, their effectiveness downstream tends to diminish due to additional water from tributaries and local rainfall (Shrestha & Kawasaki, 2020). The planned construction of 16 dams across Indonesia is expected to increase water storage capacity and reduce flood risk by controlling water volume and flow velocity.

The effectiveness of dams in flood control also depends heavily on integration with other mitigation strategies, such as watershed management, river normalization, diversion canals, and improved drainage systems (Juwono & Subagiyo, 2017). Additionally, preserving upstream forest ecosystems is essential for maintaining soil water absorption. Beyond flood mitigation, dams also support raw water supply, agricultural irrigation, and energy production through hydropower (Khaddor et al., 2021). Thus, dams serve not only as infrastructure for hydrometeorological risk reduction, but also as long-term solutions for water and energy resilience.

Challenges in Dam Construction

Dam construction presents several challenges. First, land acquisition and population relocation are often required, which can trigger social conflicts. Community resistance is usually driven by dissatisfaction with land acquisition processes and compensation. A collaborative approach involving community dialogues and village forums is essential to address local concerns and prevent external interference. Public outreach on dam benefits can help the community understand the long-term advantages.

Second, from an ecological perspective, dams can alter natural river flow patterns and morphology, affecting aquatic species' habitats. Sediment movement can cause erosion and disrupt ecosystem balance. To address these challenges, river ecosystem restoration efforts are needed, such as improving water quality and quantity, replanting aquatic and riparian vegetation, and managing sediment (Rizki, 2023).

Third, technical risks such as dam failure may occur due to overtopping (water spilling over the dam crest) or piping (gradual seepage that undermines the structure) (Sriwibowowati, 2018). One notable case was the 2009 collapse of the Situ Gintung Dam, caused by heavy rainfall and weakened dam soil due to erosion and cracks that allowed water to seep through (Nabilah et al., 2020).

Overtopping prevention strategies include designing adequate spillways, monitoring dam stability under varying water levels and loads, while piping prevention involves routine inspections to detect early seepage and using filter layers to ensure safe water flow without transporting soil particles or causing crack propagation (Hapsari, 2023).

The challenges in dam development span social, environmental, and technical risk dimensions. With the right strategies, negative impacts can be mitigated effectively. Multi-stakeholder collaboration is essential to ensure dam development prioritizes not only short-term benefits but also long-term sustainability.

Conclusion

Dams serve to control flooding by holding back water during heavy rain, reducing flow volume and speed, and regulating distribution to downstream areas. In addition to being flood mitigation infrastructure, dams are part of long-term solutions for water resource management and disaster mitigation, providing raw water, irrigation, and energy through hydropower. Their effectiveness depends on integration with other mitigation strategies, such as watershed management, river normalization, optimizing catchment areas, and strengthening drainage systems.

Commission V of the DPR RI, through its oversight function, plays a vital role in ensuring that the construction of the four priority dams proceeds optimally as key infrastructure for water resilience and flood control. Oversight of dam continuity and complementary flood mitigation measures is necessary to ensure maximum effectiveness, as disjointed mitigation efforts may reduce the impact on flood risk reduction and national water resilience.

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