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The Importance of Standard Operating Procedures (SOPs) in Flood Control in Sidoarjo Regency

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A B S T R A C T

Due in significant part to drainage degradation, sediment accumulation, tidal backflow, and disjointed institutional coordination, flood disasters continue to occur in Sidoarjo Regency every rainy season. In order to improve preparedness, expedite emergency responses, and facilitate methodical post-disaster rehabilitation, this project creates an organized Standard Operating Procedure (SOP) for flood control in the Afvoer Pucang region. Using interviews, field observations, and data from important organizations such PUBMSDA Sidoarjo, BPBD East Java, BPBD Sidoarjo, and the Brantas River Basin Center (BBWS), a qualitative case study design was used. The Miles and Huberman paradigm, which prioritizes reduction, organization, and iterative verification, was used to examine the data. The results demonstrate that a successful SOP needs to function throughout three interrelated stages. In order to improve community preparedness, the pre-flood phase concentrates on regular channel maintenance, hydrometeorological monitoring, public outreach, and disaster simulation exercises. Quick decision-making, command post activation, technical coordination for pump and gate operations, evacuation of susceptible individuals, and prompt logistics distribution are crucial during the emergency response phase. Structured damage assessments, expedited cleanup, and regular process reviews to improve institutional coordination are the main focuses of the post-flood phase.

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INTRODUCTION

The Indonesian province of East Java is renowned for its beautiful and diverse natural landscape. East Java's two major rivers, the Brantas and Bengawan Solo, are captivating for their natural beauty and potential for flooding. At approximately 320 kilometers long, the Brantas River is one of the longest rivers in East Java. Originating from Mount Arjuno and Mount Welirang in the Tengger Mountains, it flows eastward through cities such as Malang, Batu, and Blitar before finally emptying into the Madura Strait.

The Brantas River serves three purposes: 1) Clean Water Source: Many people rely on it for their daily water needs; 2) Agriculture: The land surrounding the river is suitable for farming; and 3) Electrical Energy: Numerous dams and reservoirs on these rivers were constructed to produce electricity.

Bengawan Solo River: One of the longest rivers in Indonesia, the Solo River, or Bengawan Solo, is approximately 600 kilometers long. It flows from the Kendeng Mountains eastward through the Surakarta (Solo) region before finally reaching the Java Sea.

Every year from October to April, the Sidoarjo region of Eastern Indonesia experiences the rainy season. During this time, a number of areas suffer from flooding disasters, which can be brought on by human activity or natural causes (Idham & Mukhtar, 2024). Flooding can be considered a natural catastrophe since it is a natural occurrence that significantly interferes with human daily activities. Natural disasters are a collection of natural occurrences that endanger and interfere with human activity or have detrimental effects on people. Additionally, ordered areas of community life can become irregular due to flooding. Flooding is still an issue in Indonesia's major cities. Rapid population expansion and advancements in development are to blame for this.

Sidoarjo Regency's drainage system is complex, consisting of drainage and irrigation channels, as well as drainage channels equipped with dams to regulate water levels. Flooding occurs due to high water levels in the channels. During high tide, backwater flows in rivers and canals near the coast prevent flooding from immediately receding, exacerbating the situation, according to the Sidoarjo Regency Regional Development Planning Agency (Bappeda) (Bapeda Kabupaten Sidoarjo, 2015) (Sidoarjo Regency Development Planning Agency, 2015).

Significant flooding occurred in the Sidokare area of Sidoarjo, East Java, inundating multiple residential zones including Sidokare, the Sidokare Indah Housing Complex, Sidokare Asri, and Kapasan Sidokare. Several key access routes—such as village roads, Yos Sudarso Street, and the Pucang area—were likewise affected. The impact extended further to Bluru Kidul, Pondok Jati, Gajahmagersari, Mayjend Sungkono, Pucang Anom, Gading Fajar, Lemah Putro, West Kutuk, and surrounding neighborhoods (M Taufik, 2021). Flooding events of this scale highlight the critical importance of comprehensive Standard Operating Procedures (SOPs) for flood prevention, emergency response, and post-disaster recovery. Persistent issues within the drainage system—ranging from sedimentation and narrowed culverts to uncontrolled land-use changes and insufficient inter-agency coordination—continue to hinder effective flood

management. A well-designed and consistently implemented SOP can significantly enhance the speed, accuracy, and coordination of flood mitigation efforts. In Sidoarjo, the technical measures undertaken by the Public Works and Water Resources Highways Agency (PU BMSDA) may be further strengthened through structured management strategies, including improved preparedness planning, streamlined reporting mechanisms, clear division of responsibilities among agencies, and effective public communication. Together, these elements form an integrated approach capable of reducing flood risks and improving community resilience.

Arini T. Soemohadiwidjojo, (2014) asserts that Standard Operating Procedures (SOP), sometimes referred to as "procedures," are more comprehensive and lucid papers that describe how policies and production activities outlined in the guidelines are carried out. Procedures are basically written instructions on how to carry out routine or customary tasks. This is done to prevent mistakes or modifications that can have an impact on the overall functioning of the business.

LITERATURE REVIEW

General Concept and Role of SOP

Standard Operating Procedures (SOPs) are an essential framework for preserving an orderly and efficient workflow in a variety of businesses, according to research. SOPs are thought to provide consistency, efficiency, and adherence to rules and quality standards. According to a study done in the manufacturing industry by (Fadila Rahmawati & Naura Nazhifah Suryana, 2024), SOPs help businesses operate more efficiently and steadily. SOPs assist micro, small, and medium-sized enterprises in maintaining product quality and business continuity, according to research by (Amanda Citra Ramada, 2022). SOPs are therefore more than just administrative; they are a tool for keeping an eye on the sustainability and quality of an organisation.

The Relationship Between SOPs and Employee Performance

Various studies have validated that the implementation of Standard Operating Procedures (SOPs) positively contributes to staff performance evaluation and operational efficiency. A study by Noni Netralis Gulo and colleagues (2024) indicated that SOPs have the potential to increase the effectiveness of government officials' capabilities, despite challenges in their implementation. This study's findings align with those of Dwi Agustina (2021), who stated that SOPs can improve the efficiency and accuracy of employee tasks, although there are some areas where improvements are needed, such as schedule accuracy and execution precision. Quantitatively, research by (Hablil Rahman, 2021), (Helda Fitriani, 2021), and (Gilang Maulana, 2019) also confirmed that SOPs significantly impact staff performance, particularly in terms of output, accuracy, and work quality. However, (Wiryanto Santoso, 2021) observed that work environment factors have a greater influence than implementers.

Effectiveness of SOPs in Public Services

Studies in the government sector show that Standard Operating Procedures (SOPs) significantly improve the quality of public services. According to Dira Yefri Amalia, (2022) and Ryutaro Siburian et al., (2020), implementing SOPs facilitates the clarification of service standards. However, because employees and the public do not yet understand the importance of adherence to procedures, performance remains low. According to research conducted by Novi Rismayanti, (2018) and Sulfayanti, (2021), although SOPs in government institutions comply with regulations, they have not reached their full potential. There are technical limitations and information is not widely disseminated. Alfiano Patrik Kilis, (2012) contradicts these findings and shows that consistent SOP implementation in government governance can increase effectiveness and efficiency and prevent errors in the bureaucratic system.

METHODOLOGY

Due of the inability to compare this research with other research objects, a qualitative case study approach is used. (Sudaryono, 2018) states that a case study is a kind of qualitative research in which researchers thoroughly examine the behaviours, events, and processes of one or more individuals. Researchers use a variety of data collection approaches over an extended period of time to gather thorough data for case studies, which need time and effort. There is no way to compare this research with research done elsewhere.

As the name suggests, the case study research method examines a specific case or phenomenon occurring in society and is conducted comprehensively to understand the background, circumstances, and interactions that occur. Case studies are conducted on a single entity, event, or group of people under specific circumstances or conditions; they do not draw conclusions about the phenomenon within the population or group of people. This research used a qualitative case study methodology in Sidoarjo Regency.

Data Collection Techniques

Data collection carried out in this research was carried out using the following methods:

1. Interview

Sources of information were obtained from informants in the field, including Junior Expert Irrigation Engineering (Functional Position) of Public Works, Highways, Water Resources (PUBMSDA) Sidoarjo, Regional Disaster Management Agency (BPBD) East Java, Regional Disaster Management Agency (BPBD) Sidoarjo Regency, Brantas Wiyung River Basin Center (BBWS) Surabaya in the Water Resources Network Maintenance section, Brantas Wiyung River Basin Center (BBWS) Surabaya in the Operations and Maintenance section.

2. Observation

In addition to conducting interviews, the researchers also conducted observations at several locations: Public Works, Highways, Water Resources (PUBMSDA) Sidoarjo, Regional Disaster Management Agency (BPBD) East Java, Regional Disaster Management Agency (BPBD) Sidoarjo Regency, Brantas Wiyung River Basin Center (BBWS) Surabaya in the Water Resources Network

Maintenance section, Brantas Wiyung River Basin Center (BBWS) Surabaya in the Operations section, and Soetomo in Surabaya and Sumput in Sidoarjo as heads of UPTD.

Observation is essentially an activity using the five senses to obtain the information needed to answer research questions. Observation results can include activities, events, occurrences, objects, specific conditions or situations, and a person's emotional feelings (Bungin, 2007).

3. Documentation

Apart from conducting interviews and making observations, information can also be gathered from facts preserved in correspondence, diaries, picture archives, meeting minutes, mementos, activity journals, and so forth. The Head of the Centre for Disaster and Environmental Studies (PSBL) Dr. Soetomo University Surabaya, the Head of UPTD Sumput Sidoarjo, the Junior Expert Water Engineering (Functional Position) of Public Works, Highways, Water Resources (PUBMSDA) Sidoarjo, the Regional Disaster Management Agency (BPBD) East Java, the Regional Disaster Management Agency (BPBD) Sidoarjo Regency, the Brantas Wiyung River Basin Centre (BBWS) Surabaya in the Water Resources Network Maintenance section. Secondary data, including medical records, monthly reports, annual reports, patient records, certifications, activity journals, photo recordings of meeting outcomes, and more, were used to gather the data. This kind of secondary data can be used to uncover information about historical occurrences. Researchers must be theoretically sensitive when using the document to prevent it from becoming a useless tool.

According to (Sugiyono, 2018:240), a document is a record of events that have occurred, either in written or oral form. Examples of documents can include photographs of activities, policy documents, and any regulations.

Data Collection

In the first model analysis, data is gathered from observational results, wawancara results, and various documents related to the research problem. Next, data is analysed by tambahan data pencarian.

1. Data Reduction

Analysis known as data reduction sharpens, classifies, directs, discards, and organizes data so that final conclusions can be drawn and verified. Miles and Huberman (Miles B. Mathew & Huberman A. Michael, 2009). According to Mantja in (Harsono, 2008), data reduction continues throughout the research. The product of data reduction is a summary of field notes, whether from initial notes, expansions, or additions.

2. Data Presentation

The goal of data presentation is to identify significant patterns, provide possible conclusions, and suggest action. Data presentation also serves as a series of information organizations that enable research to be conducted (Miles B. Mathew & Huberman A. Michael, 2009).

3. Conclusion

Conclusions are part of a complete configuration activity according to Miles and Huberman (Miles B. Mathew & Huberman A. Michael, 2009). Conclusions

are also verified during the research. Conclusions are drawn when researchers compile records, patterns, statements, configurations, causal directions, and various propositions.

RESEARCH RESULT

This study looks at the implementation of Sidoarjo Regency's Standard Operating Procedures (SOPs) for Flood Management, which are essential for organised and methodical disaster management. Pre-flood, emergency response, and post-disaster are the three primary phases of flood management that are covered. The SOPs concentrate on mitigation and enhanced preparedness during the pre-flood phase, including mapping susceptible areas, normalising streams, and educating populations on how to lower possible hazards. In the emergency response stage, the SOPs emphasize infrastructure recovery and rehabilitation, assessing losses, and evaluating the effectiveness of disaster management procedures. In the post-disaster stage, the SOPs also emphasize rapid and measured action during flooding, including inter-agency coordination, victim evacuation, logistics distribution, and real-time monitoring of field conditions. These three stages demonstrate that the Standard Operating Procedures (SOPs) can serve as administrative guidelines and practical mechanisms for building a more efficient, flexible, and sustainable flood management response in Sidoarjo Regency.

Pre-Flood Stage (Mitigation and Preparedness)

Table 1 Pre-Flood Stage (Mitigation and Preparedness)

No	Activity	PIC	Note
1	Inspection and normalization of the Afvoer Pucang channel	Dinas PUBMSDA	At least 2 times per year
2	Monitoring of water discharge and rainfall	PUBMSDA, BPBD Sidoarjo & BBWS Brantas	Through CCTV and BMKG
3	Socialization to the community regarding disasters and flood mitigation.	BPBD Sidoarjo & Head of Village	Through RT meetings and leaflet education
4	Flood emergency response simulation	East Java BPBD	Involving all elements and communities
5	Disaster Resilient Village	East Java BPBD	Involving all elements and communities

Emergency Response Stage (When Flooding Occurs)

Table 2. Emergency Response Stages (When a Flood Occurs)

No	Activity	PIC	Note
1	Alert/emergency status announcement	Sidoarjo BPBD	Based on a rapid assessment
2	Activation of field posts and evacuation	BPBD Sidoarjo Dinkes, Kominfo, Dinsos	Establishment of joint posts at BPBD, sub-districts and villages
3	Pump operation & opening and closing of water gates	PUBMSDA & BBWS Service	Technical coordination to reduce discharge
4	Evacuation and rescue of residents	BPBD & Basarnas	Focus on vulnerable groups
5	Delivery of logistics and clean water	BPBD, Dinsos	Delivery of logistics and clean water

Post-disaster stage

Table 3. Post-disaster Stage

No	Activity	PIC	Note
1	Damage Survey and Preparation of Jitupasna	PUBMSDA) & BPBD	Data for official reports
2	Cleaning of drains and settlements	PUBMSDA, BPBD, DLHK, Volunteers	Maximum 7 days after the flood recedes
3	Evaluation and revision of SOP	All agencies	Every rainy season ends

Coordination Mechanism

a. The Sidoarjo Regency Regional Disaster Management Agency (BPBD) Office's Command Centre shall act as the focal point for all operational tasks, including resource management, information processing, and decision-making. Digital maps of the impacted area, monitoring systems like CCTV and AWLR, and emergency communication equipment are examples of facilities. During the alert or emergency state, pertinent entities, including the Public Works and Water Resources Agency (PUBMsDA), the Disaster Management Agency (BBWS), the Indonesian National Armed Forces (TNI/Polri), and community organisations, can coordinate directly from this location.
b. To facilitate quick and efficient communication, digital tools like emergency reporting applications and cross-agency WhatsApp groups are being used. The Sidoarjo Regency Regional Disaster Management Agency

(BPBD), the East Java Provincial BPBD, the Public Works and Water Resources Agency (PUBMSDA), the Brantas River Basin Management Agency (BBWS), the Water Resources Management Unit (UPTD DAM), and village officials are among the agencies represented in this work.

c. Coordination meetings at least once a week during the emergency response period
d. Coordination meetings are held at least twice a year and every time alert status I is determined.

From the three main stages of flood disaster management in tables 1, 2, and 3, it can be described in the SOP diagram for implementing flood disaster management in Sidoarjo Regency as presented in Figure 1.

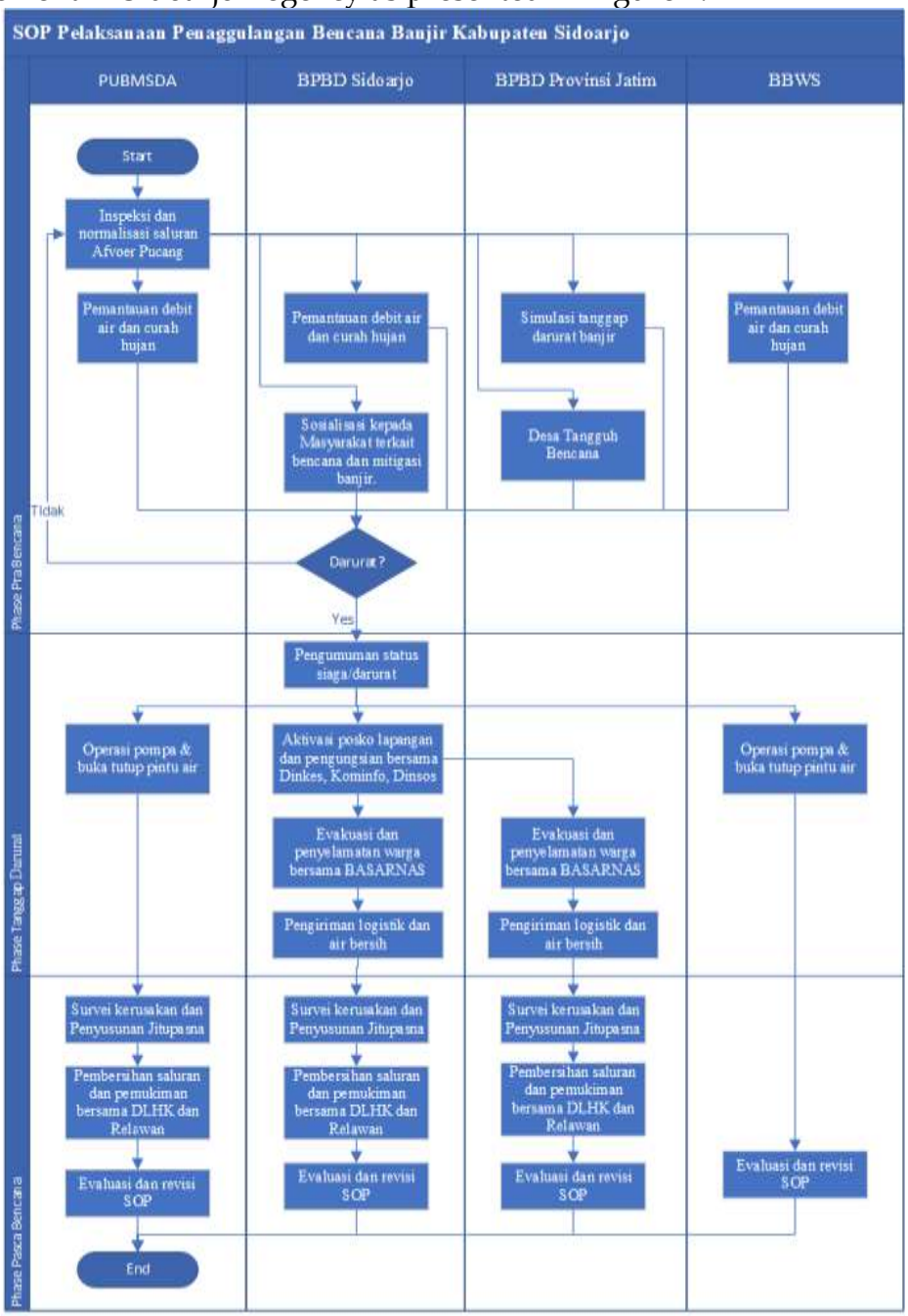

Figure 1. Diagram of SOP for Implementing Flood Disaster Management in Sidoarjo Regency

DISCUSSION

The findings of this study confirm that flood control effectiveness within the Afvoer Pucang system is determined not solely by physical drainage infrastructure, but by the quality of institutional coordination, operational governance, and procedural clarity. Evidence from field observations and stakeholder engagement demonstrates that the absence of an integrated Standard Operating Procedure (SOP) has resulted in fragmented responses, overlapping institutional roles, and delayed operational decisions during flood events. These conditions illustrate that technical capacity alone is insufficient when not supported by a coherent governance framework capable of guiding collective action under dynamic hydrological conditions.

A central issue identified in the analysis is the fragmentation of authority among water resource agencies, disaster management institutions, and local operational units. Although each entity possesses formal mandates, the lack of a unified operational reference weakens inter-agency coordination, particularly during emergency situations. This fragmentation reflects broader governance challenges commonly observed in urban flood management, where sectoral separation and regulatory ambiguity hinder adaptive capacity. The Afvoer Pucang case reinforces the argument that flood risk is exacerbated not merely by environmental factors, but by institutional disconnection that limits synchronized response and accountability.

Operational deficiencies further contribute to flood vulnerability, particularly in relation to maintenance practices. The study reveals recurring problems such as sediment accumulation, waste blockage, and mechanical deterioration of sluice gates, which collectively reduce the hydraulic efficiency of the Afvoer system. These findings support existing literature suggesting that flood impacts are often intensified by inadequate maintenance regimes rather than by structural design limitations. Institutionalizing routine inspections, preventive maintenance schedules, and technical performance standards within a formal SOP would therefore play a critical role in sustaining long-term system functionality.

Another important finding relates to the predominantly reactive nature of flood management practices. Decision-making processes remain largely dependent on experiential judgment and manual observation, with limited integration of real-time monitoring or predefined operational thresholds. As a result, responses to rising water levels tend to be delayed and inconsistent. From a disaster risk management perspective, this condition highlights a gap between conventional operational approaches and contemporary anticipatory governance models that emphasize early warning systems and data-driven decision-making. Incorporating hydrological indicators, rainfall forecasts, and trigger-based response mechanisms into the SOP framework would significantly enhance preparedness and reduce response time.

The social dimension of flood control also emerges as a critical factor influencing system resilience. Communities residing along the Afvoer Pucang corridor experience recurrent flood exposure, yet their involvement in mitigation efforts remains informal and marginal. The absence of structured community participation limits opportunities for early detection of operational issues, local

monitoring, and shared responsibility in flood risk reduction. These findings align with participatory governance theories, which emphasize that community engagement strengthens adaptive capacity and enhances the legitimacy of risk management strategies. Integrating community-based roles into the SOP could therefore improve both operational effectiveness and social resilience.

From a policy and regulatory standpoint, the analysis demonstrates that existing legal frameworks governing water resources and disaster management provide normative guidance but lack operational specificity at the local system level. This disconnects between regulation and implementation constrains effective flood control, as institutional actors operate without clear procedural direction tailored to site-specific conditions. The proposed SOP framework functions as an intermediary instrument that translates abstract regulatory mandates into actionable operational guidelines. This supports a socio-legal perspective in which governance effectiveness is contingent not only on legal substance but also on procedural clarity and institutional practice.

While the study focuses on a single urban drainage system, the Afvoer Pucang context reflects characteristics common to many flood-prone urban areas in Indonesia, including high population density, complex institutional arrangements, and recurring hydrological stress. Although broad generalization is limited, the findings offer analytical insights that are transferable to similar settings. Overall, the discussion underscores that the formulation of an integrated SOP is not an administrative formality, but a strategic necessity for improving coordination, strengthening operational capacity, and enhancing the resilience of urban flood control systems.

CONCLUSIONSAND RECOMMENDATIONS

This study concludes that flood management in the Afvoer Pucang system requires a structured, collaborative, and adaptive operational framework capable of responding to extreme hydrological conditions. The findings demonstrate that reliance on physical infrastructure alone is insufficient; effective flood control must be supported by integrated procedures and coordinated institutional action. To address this gap, the study developed a comprehensive Standard Operating Procedure (SOP) that operates across pre-disaster, emergency response, and post-disaster phases, and was formulated through the involvement of technical agencies, disaster management institutions, local government, and community stakeholders. The results also show that flooding is intensified not only by rainfall and tidal influence but by inadequate drainage performance and solid waste accumulation, highlighting the importance of preventive measures such as routine channel maintenance and sustained community awareness as core components of flood risk management.

Under extreme conditions, particularly when heavy rainfall coincides with tidal flooding, the proposed SOP provides differentiated operational responses through hierarchical flow regulation from upstream to downstream structures, coordinated gate operations based on alert levels, and the activation of early warning systems. During emergency situations, the SOP establishes clear mechanisms for rapid response, evacuation, and the delivery of essential services,

supported by monitoring technologies that enable timely and evidence-based decision-making. Based on these findings, it is recommended that the SOP be formally institutionalized and supported by continuous technological enhancement, regular training, and periodic evaluation to ensure long-term effectiveness. Given its integrated and adaptive design, the SOP offers strong potential for replication in other urban and peri-urban areas with similar hydrological characteristics, contributing to more resilient and risk-based flood governance practices.

ADVANCED RESEARCH

Future studies are encouraged to broaden the analytical focus beyond major flood control structures by incorporating secondary drainage systems, tributary channels, and areas that experience recurrent inundation. Such an expanded scope would allow for a more holistic understanding of urban flood dynamics and system interdependencies. Particular attention should be given to strengthening the quantitative foundation of hydrological and climatic data through more consistent measurements of peak discharge, rainfall intensity, and channel capacity. The use of hydrological modeling tools would further enable the simulation of diverse flood scenarios and provide a more robust evaluation of the operational reliability and effectiveness of the proposed Standard Operating Procedures (SOPs). Moreover, involving local communities through participatory research approaches remains essential for capturing lived experiences, local adaptation practices, and the actual performance of early warning systems, ensuring that future policy recommendations are grounded in social realities rather than solely technical assumptions.

In addition, subsequent research should prioritize empirical testing of the SOP framework under multi-hazard conditions, particularly situations where river flooding coincides with tidal inundation, in order to assess institutional coordination and operational resilience during extreme events. The integration of geospatial technologies, such as Geographic Information Systems (GIS) and remote sensing, is highly recommended to support dynamic and spatially explicit flood risk assessments. Beyond engineering and operational perspectives, future investigations would benefit from interdisciplinary approaches that incorporate socio-economic dimensions, allowing for a more comprehensive evaluation of policy impacts on livelihoods, vulnerability, and equity. Comparative analyses across different regions or national contexts, along with longitudinal studies supported by continuous monitoring, are also important to ensure that flood control SOPs remain adaptive and relevant amid accelerating climate change and urbanization processes.

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