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Towards a Resilient and Sustainable City: New Paradigm of Flood Disaster Governance Study Case Bekasi City

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ABSTRACT

Urban faces numerous challenges around the world due to its complexity, rapid urbanization, and diverse urban contexts. Bekasi City facing flood many years as an impact this problem. In early 2020, flooding points in Bekasi City reached 58 points with an area of around 15.37 ha or 73% of the city area with a depth of 1-4 meters. Looking at its history, the longer the flooding, the wider and depth. In 2005 the inundation area ranged from 164 ha, then in 2018, the inundation area increased to 12353 ha. The funds spent on flood management almost one-third of regional budget. The question that should be asked is why flooding still occurs, even though the efforts that have been made are not small. The social, economic and environmental impacts of flooding are significant. If it continues uncontrol, it is feared that the sustainability of Bekasi City is threatened. Therefore, a big picture of the current flood control system in Bekasi City is needed. This study identified that the critical gap in urban environmental risk management strategies in Bekasi City, Indonesia, is the necessity of incorporating community participation and non-structural measures to establish flood-resilient communities and mitigate risk. Addressing this management deficiency will contribute to the realization of a resilient and sustainable Bekasi City.

1. INTRODUCTION

The studied problem was a flood disaster. Floods are of concern because of their extraordinary impact on ecosystems and socioeconomics [1-3]. Losses are not only materials but also cause many casualties [4]. Damage to ecosystems and disruption of socioeconomic activities lead to high rehabilitation costs. This situation feared the unsustainability of the city.

This study focuses on the escalating flooding problem in Bekasi City. The inundation area significantly expanded from 164 ha in 2005 [5] to 12353 ha in 2018 [6], and the situation has further deteriorated by 2021. This phenomenon is attributed to the city's geographic location and increasing frequency of extreme weather events.

Bekasi City has experienced rapid population growth, reaching 2.59 million in 2022 [7], and is expected to continue to grow at a rate of 1.7% per year. Bekasi City is categorized as a metropolitan city (Government Regulation No. 26/2008 of the National Spatial Plan) because it has a population of more than one million people. Owing to its strategic location and proximity to Jakarta, Bekasi City has become a major metropolitan area that attracts significant investment and development. Therefore, the economic growth of Bekasi City has continued to increase. The demography and economic profiles of Bekasi City are shown in Table 1.

Table 1. Demography and economic profile

Description	Unit	2020	2021	2022
Social				
Population	million	2543	2564	2590
Population growth	%	2.39	1.92	0.91
Economic				
GDP at current price	Trillion rupiahs	96.49	101.38	109.88
Economic growth	%	-2.58	3.22	4.96

Source: Central Bureau of Statistics of Bekasi City (Jumlah Hujan - Tabel Statistik - Badan Pusat Statistik Kota Bekasi (bps.go.id)

Bekasi City is situated in a low-lying area prone to flooding because of its proximity to several watersheds and its sloping topography. Rapid urbanization and population growth have exacerbated flooding, leading to significant economic and social impacts.

Flooding has severe consequences on ecosystems, resulting in habitat destruction, pollution, and biodiversity loss. Floods cause substantial property damage, disruption of daily life, and loss of livelihoods. The high rehabilitation costs associated with these impacts can strain the resources of a city and hinder its sustainability.

Bekasi City has implemented various technical measures, including the construction of flood control infrastructure and normalizing drainage systems. Despite these efforts, flooding persisted, indicating the need for more comprehensive and effective strategies. Inadequate preparedness plans have resulted in significant material losses and increased emergency response costs, thereby highlighting a city's vulnerability to flooding. Given the ongoing challenges posed by flooding in Bekasi City, the research objectives were to analyze the existing flood control system and identify its strengths, weaknesses, and areas for improvement. This study provides valuable insights for urban planners and policymakers to develop more effective flood management strategies, and offers a model that can be applied to other cities facing similar challenges.

2. LITERATURE REVIEW

2.1 The prevalence and impact of urban flood

Flooding occurs when the amount of water on the land surface surpasses the capacity of drainage channels or rivers, resulting in overflow and inundation or the flow of water in quantities exceeding normal limits [8-10]. Urban flooding arises from a confluence of natural and human-induced elements [11]. Unfortunately, flooding often results in human casualties [12-15]. Floods pose the most significant climate risk in many countries, impacting households, communities, businesses, and governments [16-18].

Rapid urbanization in low-lying areas, such as Bekasi City, increases the exposure to various types of floods, including changes in rainfall patterns. The transformation of land into residential and industrial zones exacerbates vulnerability to flooding, especially in urban and potentially urban regions [11, 19]. Furthermore, inadequate drainage systems, when coupled with land change, worsen urban flooding [19]. This underscores the necessity for resilient and flexible drainage systems.

Natural disaster data reveal that floods are the most prevalent and highest-ranking disasters globally [19-21] owing to their frequent and extensive influence on populations, buildings, civil engineering structures, economic activities, public services, and infrastructure [22]. Areas with high levels of urbanization and settlement density carry the greatest risk of flooding [23-25]. However, simply because an area is at high risk of flooding does not necessarily mean that it is the most vulnerable, as adaptive factors within the population or ecosystem can reduce vulnerability [23, 26].

2.2 Resilient cities and adaptive governance

A resilient city can handle different types of stresses without causing chaos or permanent damage [27-29]. Resilient cities are designed to anticipate, survive, and recover from disasters [30]. The city must be flexible to various disturbances such as disasters [31-33]. The concept of resilient cities is intertwined with sustainable development, which rests on the triad of mitigation, adaptation, and innovation [34, 35].

The focal point of resilience lies in the ability of communities to effectively react to disasters and attain adaptive governance [33-37]. This condition is attained through collaboration and dissemination of knowledge, engagement of many stakeholders, adjustment to particular socio-ecological systems and local socio-economic conditions, and modification of governance frameworks in response to changing circumstances and challenges [38]. Hence, it is imperative to implement transparency, inclusiveness, connectedness, accountability, and government efficiency [39].

Mitigation encompasses hazard identification, risk analysis, and management, constituting a series of measures that assess societal risk levels and diminish them to an acceptable threshold, aiming to avert disasters or mitigate their detrimental effects if they occur [36]. Adaptation refers to self-adjustment to risk, and is adapted to the existing hazards and vulnerabilities of an object [37-39]. Innovation is a period for examining the introduction of novel strategies to manage existing risks that surpass the current capabilities of an entity, such as developing innovative technologies to mitigate disaster risks [40].

2.3 Challenges in flood risk management

Environmental management literature suggests that resilience is key to managing complex systems and reducing vulnerability owing to uncertainty and unexpected changes [41]. However, evolving flood risk management is largely a culture of defence or resistance rather than resilience [42, 43].

The resilience paradigm is very important given the position of most cities in Indonesia, which are inseparable from various types of threats from natural disasters and disasters caused by human behavior. Similarly, Bekasi City is a flood hazard area. Its location downstream of the Cikeas, Cileungsi, and Sunter watersheds, which are densely populated, renders Bekasi City vulnerable to disaster. Therefore, flooding in Bekasi City cannot be avoided but must be faced with the adaptive capabilities of the community and its environment [18].

To manage water-related risks effectively, it is essential not only to improve physical science tools for flood forecasting and modeling but also to advance social science tools for disaster management policy development [44-46]. This is best achieved through the development of collaborative frameworks [42]. Effective hazard mitigation planning requires a comprehensive approach that includes government support, community engagement, and the strategic use of technology and social media. The literature underscores the need for decentralized, community-empowered systems [47], the integration of disaster risk reduction into sustainable development [48]. To enhance community resilience and preparedness, a shift towards innovative strategies and improved coordination among stakeholders is essential [49].

Currently, studies on adaptation strategies and social resilience in Indonesia are rare, highlighting the importance of this research in filling this gap. Considering a systems perspective, strategies can be implemented to reduce vulnerability and enhance resilience [50, 51].

3. METHODOLOGY

This paper presents an analytical description of the current flood control system in Bekasi City. A research flowchart is shown in Figure 1.

To obtain an overview of Bekasi City's existing flood control system, problems were identified using a causal loop diagram. A descriptive analysis of Bekasi City's flood control system is needed to determine what inputs can and cannot be controlled and to know what outputs are desired and what outputs are not.

Data sources came from preliminary discussions or brainstorming with the Regional Development Planning Agency, Department of Highways and Water Resources, and Bekasi City Regional Disaster Management Agency (BPBD), coupled with supporting data such as 2005-2020 flood data (tabular and spatial) and regional agency strategic plans. The matrix in Table 2 summarizes the types and techniques of data collection required for the existing conditional analysis.

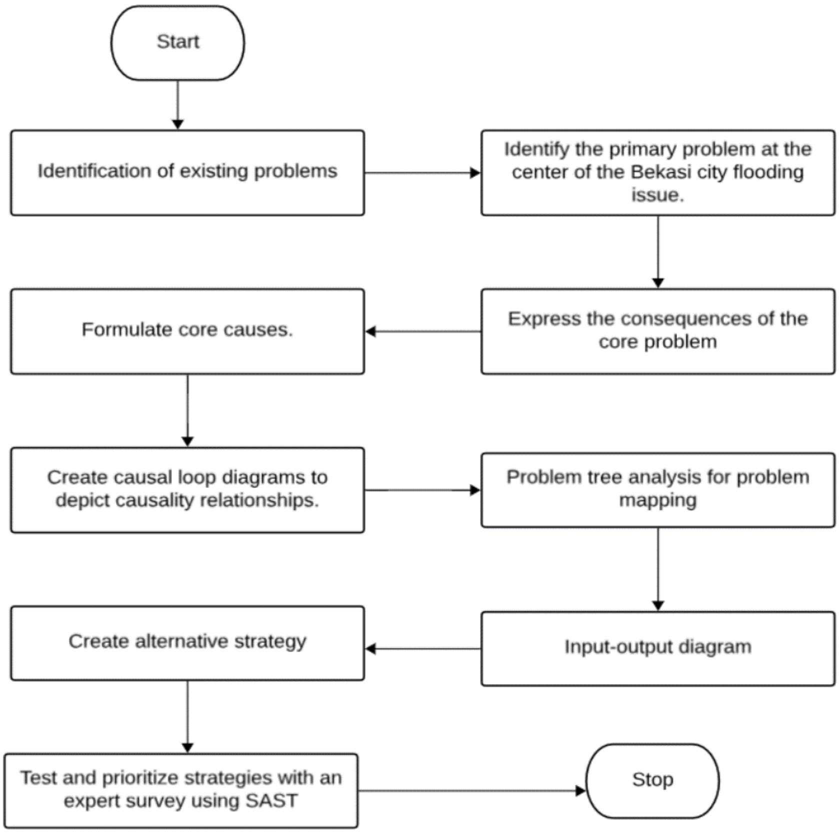

Figure 1. Research flow chart

Table 2. Data types and sources

Objective	Data	Data Source	Method	Output
Analyzing Bekasi City's current flood control system	Administrative map Flood control structure data Strategic Plan related to flood/disaster control in each Regional Office	Regional development planning agency National Disaster Management Agency (BNPB) Regional Disaster Management Agency Department of Highways and Water Resources City Planning Agency	Descriptive analysis	Description of the Bekasi City flood problem situation and governance of the flood control system in the form of a "business process map

4. RESULT AND DISCUSSION

4.1 General overview

Located adjacent to DKI Jakarta Province, West Java Province encompasses Bekasi City. Situated adjacent to Indonesia's capital, Bekasi City offers numerous transit and communication benefits. The geographical coordinates of Bekasi City are 106º48'28"-107º27'29″ East Longitude and 6º10'6"-6º30'6" South Latitude. Twelve (12) sub-districts comprising 56 urban villages, were established under Bekasi City Regional Regulation Number 04 of 2004. Bekasi comprises an area of 210.49 square kilometers. Location map of Bekasi City (Figure 2).

Based on the BNPB's study, Bekasi City has a moderate to high level of danger. Through the INARisk application, BNPB identifies areas that are frequently flooded (Figure 3). In Bekasi City, these areas are located in the North Bekasi, South Bekasi, and Medan Satria subdistricts. Areas in the South Bekasi Sub-district, which are prone to flooding, are areas passed by the Bekasi River. However, flooded areas in the North Bekasi and Medan Satria Sub-districts were not passed by the Bekasi, Cakung, or Cibitung Rivers. This indicates that other factors can cause flooding in these areas [52].

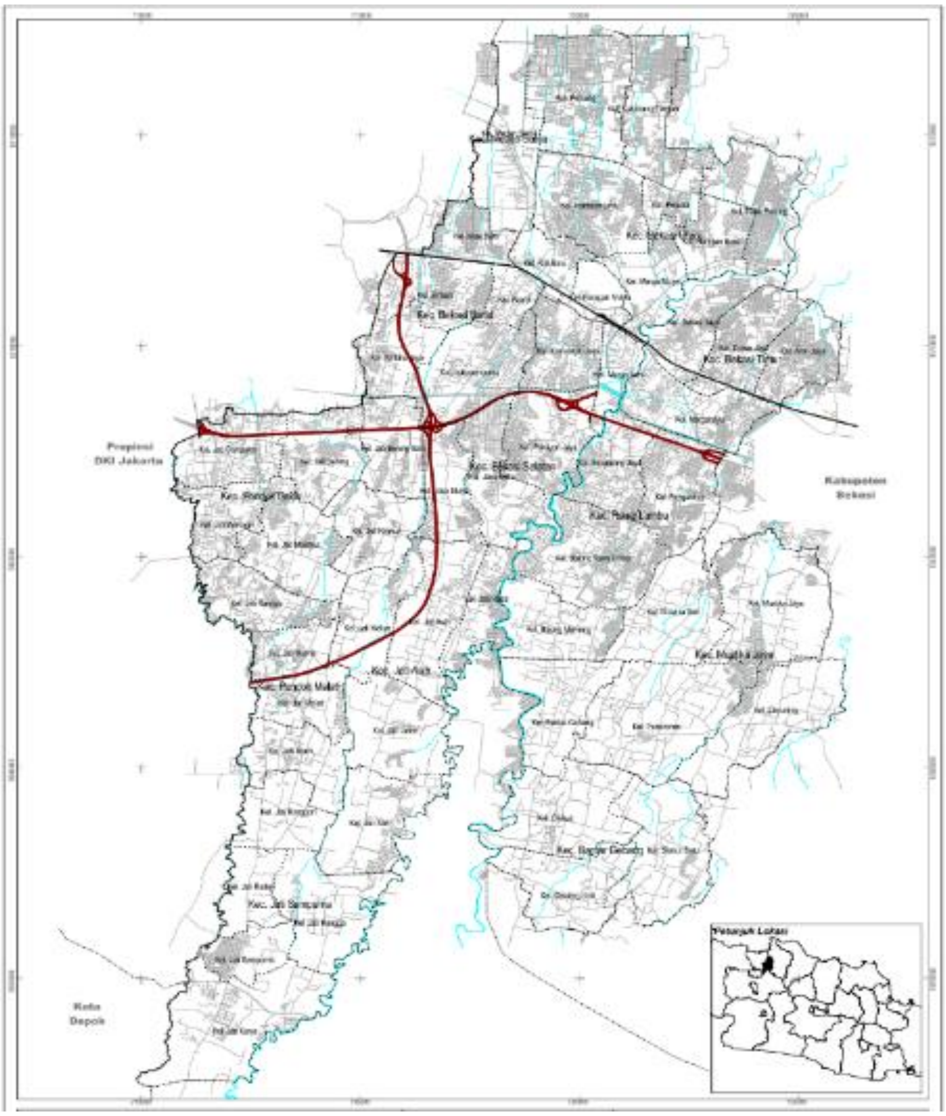

Figure 2. Bekasi City map

Figure 3. Flood disaster map of Bekasi City
Source: inaRISK (bnpb.go.id)

A study conducted by the Bekasi City Government in 2021, combined with field observations, revealed that rapid population growth and subsequent demand for residential land are the primary factors contributing to flooding in the city. The increasing population has fueled a surge in urban development, including the construction of residential areas, transportation infrastructure, commercial centers, and service facilities.

To accommodate this growth, Bekasi City has been actively developing new malls, residential complexes, office buildings, roads, and transportation infrastructure, such as the Jakarta-Cikampek II toll road, Becakayu, and the Indonesia-China Fast Train (KCIC) line. However, rapid urbanization has led to the proliferation of canals and their intersection with rivers. As a result, the increased number of crossings has heightened the risk of canal blockages, which can cause drainage overflow and ultimately contribute to flooding.

Canal obstructions are not only caused by the number of crossings but also by the decline in the quality of canal functions due to the lack of canal maintenance by the central government or local government. Less intensive maintenance reduces the capacity of the primary, secondary, and tertiary canals. This is exacerbated by the fact that canal and polder constructions are not in accordance with construction specifications and standards.

Population growth has led to increased waste generation in rivers and canals. A lack of public awareness and inadequate waste transport capacity adds to the burden on rivers and canals. If waste removal is not continuous, the river body will narrow, posing the risk of river water overflow during high rainfall. This is compounded by the malfunctioning of the sluice gates and polders. Canals and rivers filled with garbage can be seen in several places, such as the Sunter River and the Fajar Indah Canal (Figure 4).

However, the high demand for residential land has encouraged the occupation of floodplains, and land cover has become the dominant built space. If deforestation occurs upstream, the quantity of green space decreases and the infiltration capacity decreases. Floodplains that change their functions also cause sedimentation, leading to a reduction in the capacity of the catchment area. The decreasing quantity of blue open space owing to increasing land cover changes also reduces the capacity of the catchment area. If not properly anticipated, this phenomenon poses a risk of overflow in the downstream watershed, particularly when rainfall is at its highest.

Figure 4. Garbage fills rivers and canals
(object coordinate)

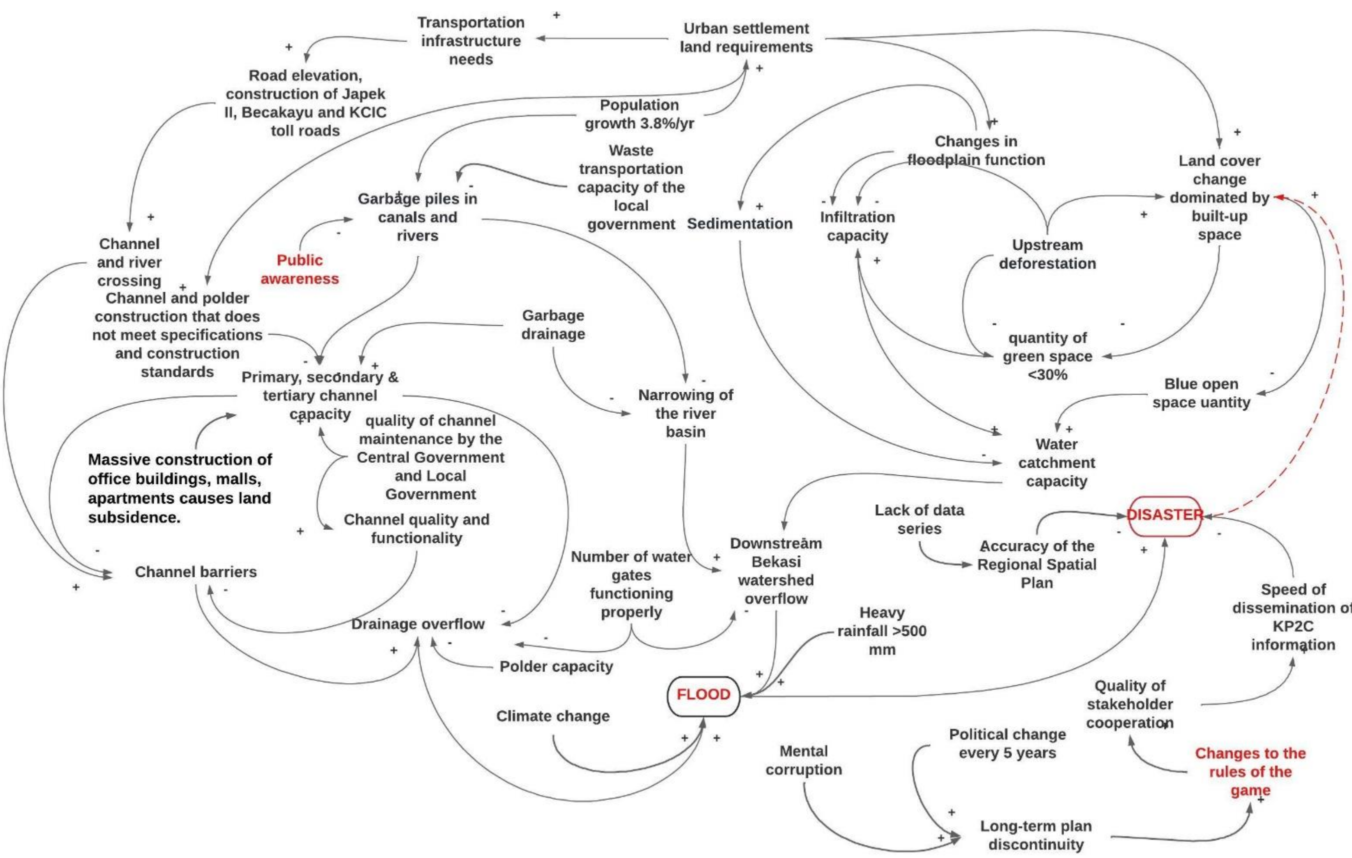

Figure 5. Causal loop diagram of flooding in Bekasi City

The flood hazard was realized early because of the relatively flat topography of Bekasi City, sloping 0-2% to the north with an elevation of 4-81 m above sea level. Bekasi City is dominated by swamps and situ, which have changed their function into settlements and service centers. This was anticipated by issuing regional spatial plans that considered the disaster risk. However, owing to limited information and data that are difficult to confirm and often discontinuous, the plans made are inaccurate. This was the source of disaster.

Government politics also influences the implementation of regional development plans. The change in regional heads and legislative members every 5 (five) years creates a discontinuity in long-term plans. In addition, the persistence of corrupt mentality among technocratic circles causes the existing order to change. This leads to poor stakeholder cooperation. Although it is indirect, this weakness is a potential disaster. One of the challenges for the Bekasi City Government in flood control is the lack of integrated handling of flood control with the Central Government, the West Java Provincial Government, the Provincial Government of the Special Capital Region of Jakarta, border areas, and other related stakeholders. A flood diagram of Bekasi City is shown in Figure 5 above.

4.2 Flood disaster governance

Floods are troubling because of their significant impact on ecosystems and socioeconomic aspects. The losses incurred are not exclusively financial, but also result in many casualties (BNPB 2021). Funding dedicated to flood management in 2020 totalled 74 million dollars from the State Budget (APBN) and 6.7 million dollars from the Regional Budget (APBD). According to literature analysis, the primary cause of flooding in Bekasi can be identified through problem tree analysis. Figure 6 shows that flood control governance has not yet been established, which is the main issue.

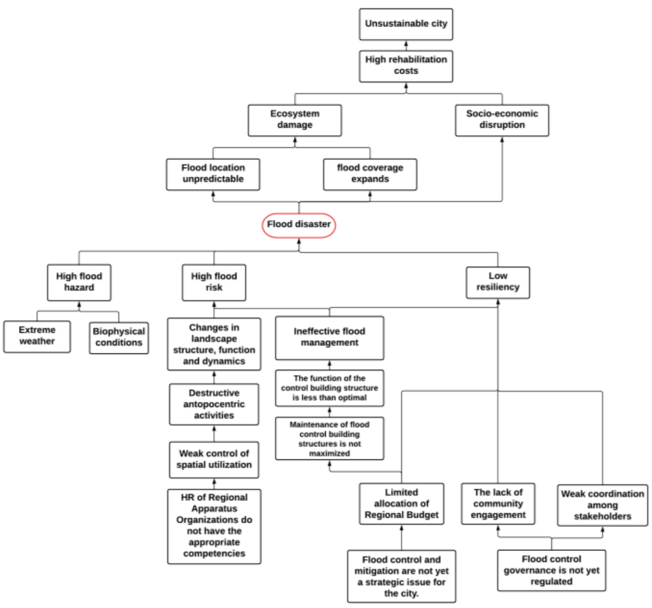

Figure 6. Flood main problem mapping

The Bekasi City Government issued Bekasi City Regional Regulation Number 11 of 2014 concerning the establishment of a regional disaster management agency. Regulations were made to strive for the organization and service of the community in the field of regional disaster management. The Bekasi City Regional Disaster Management Agency (BPBD) was established on January 19, 2015. Next, to guarantee a decent life and protect the community from the threat of disasters that will, are, and have occurred, as well as security disturbances or other social problems, the Bekasi City Government issued Bekasi City Regional Regulation Number 06 of 2019 concerning the Implementation of Disaster Management. With this regional regulation, it is expected that disaster management can be carried out systematically, integrated, planned, structured, and coordinated by optimizing Bekasi City's capabilities.

According to Act No. 24 of 2007, concerning disaster management, pre-disaster is divided into disaster risk management, mitigation, and preparedness. The implementation of disaster management at the pre-disaster stage, as referred to in Article 33 letter, includes: a) a situation where no disaster occurs, and b) a situation where there is a potential for disaster. In the pre-disaster stage, an early warning becomes an important component before a disaster occurs. In this case, the BPBD Bekasi City conducts flood detection by conducting flood disaster preparedness pickets 24 hours a day, when the rainy season starts from October to March. All information obtained from the Cikeas and Cileungsi River monitoring stations was collected into a data and report center using short message service (SMS)-gateway software. The information is then distributed to the public through the website and to communities such as the Cileungsi Cikeas Care Community (KP2C) [53]. In addition to websites and communities, early warning dissemination is conducted through WhatsApp groups, sounding warning sirens, and direct announcements by local officials.

Structural mitigation of flood management carried out by BPBD Bekasi City by installing early warning system tools in five locations of the Cikeas-Cileungsi River flow, namely downstream of Pondok Gede Permai river, Ciangsana Cikeas Bridge, Pondok Pesantren Darussalam Cileungsi Tengah, Wika Cileungsi Bridge, and Cibongas Sentul. The early warning system in Bekasi City is in the form of a Peilschall, which is a ruler used to measure river water levels, as well as automatic sensors. Using these tools, monitoring officers can provide information 5-6 h before the water reaches the Bekasi area [53].

Table 3. Flood control system stakeholders

Flood Control Management	Stakeholders
Structure	
Dams	Department of Highways and Water Resources Bekasi City
Improvement of river network system	Department of Highways and Water Resources Bekasi City
Construction of flood embankments	Department of Highways and Water Resources Bekasi City
Non-structure	
Watershed management	Ciliwung Cisadane River Basin Center
Land use regulation	Spatial Planning Agency and Regional Development Planning Agency
Handling emergency conditions	Bekasi City Regional Disaster Management Agency, Armed Forces-Police, Red Cross
Flood disaster risk assessment	National Disaster Management Agency, Bekasi City Regional Disaster Management Agency

Stakeholders that play a role in non-structural flood control are the Ciliwung Cisadane River Basin Center (BBWS), Bekasi City Spatial Planning Agency, Bekasi City Regional Development Planning Agency, Bekasi City Regional Disaster Management Agency (BPBD), Armed Forces-Police (TNI-POLRI), Indonesian Red Cross, and the National Disaster Management Agency (BNPB) [52]. Table 3 shows the stakeholders who played a role in flood control in Bekasi City.

Based on the data and facts of the aforementioned flood incidents, it is evident that BPBD Bekasi City requires proficient disaster management to address multifaceted issues in flood disaster management. Similar to the city of Kuching-Sarawak, the vital challenges that must be confronted by Bekasi City encompass the need for comprehensive and continuous data, disaster risk education, provision of infrastructure, financial resources, and planning processes [54]. Disaster management involves planning, organizing, and mobilizing resources to handle all the stages of a natural disaster. When combined with a public administration perspective, disaster management includes institutionalized measures based on a policy framework aimed at preventing and minimizing losses and enhancing citizens' capacity to cope with disaster events. Furthermore, it is imperative for BPBD Bekasi City to ensure that the management of flood victims aligns with the principles of disaster management while being fair and unbiased without causing harm to any involved parties.

Flood disasters in Bekasi City persist annually during the rainy season, and various subdistricts are prone to flooding. Previous mayoral administrations have been unable to resolve this issue, which now requires prompt policy solutions from the Bekasi City Government as well as other pertinent agencies, including the Bekasi City BPBD. The leadership factor in public administration is vulnerability not only in Bekasi City, but also in most of Indonesia. Changes in regional heads can lead to adjustments in vision, mission, and city management strategies, which must be considered for Bekasi City's flood control policy.

Causal loop diagram analysis revealed the factors responsible for flooding and flood disasters. The identification of flood events demonstrates that the flood control system comprises both controllable and uncontrollable inputs. Additionally, employing the input-output diagram technique (see Figure 7) reveals that processing uncontrollable outputs generates desired outputs by means of flood mitigation. This system employs unwanted outputs and Flood Risk Management (FRM) endeavors in producing controlled inputs.

Uncontrollable factors in the flood control system include rainfall and stakeholder cooperation levels. The system's desired outcomes are to prevent flood exposure from expanding, minimize material and immaterial losses, and most importantly, prevent floods from becoming a disaster. Achieving these outcomes requires mitigation efforts aligned with the directives of Act Number 24 of 2007, Act Number 26 of 2007, Act Number 32 of 2009, and Act Number 17 of 2019. Effective flood mitigation requires implementation of an early warning system, public awareness campaigns, and improved flood forecasting.

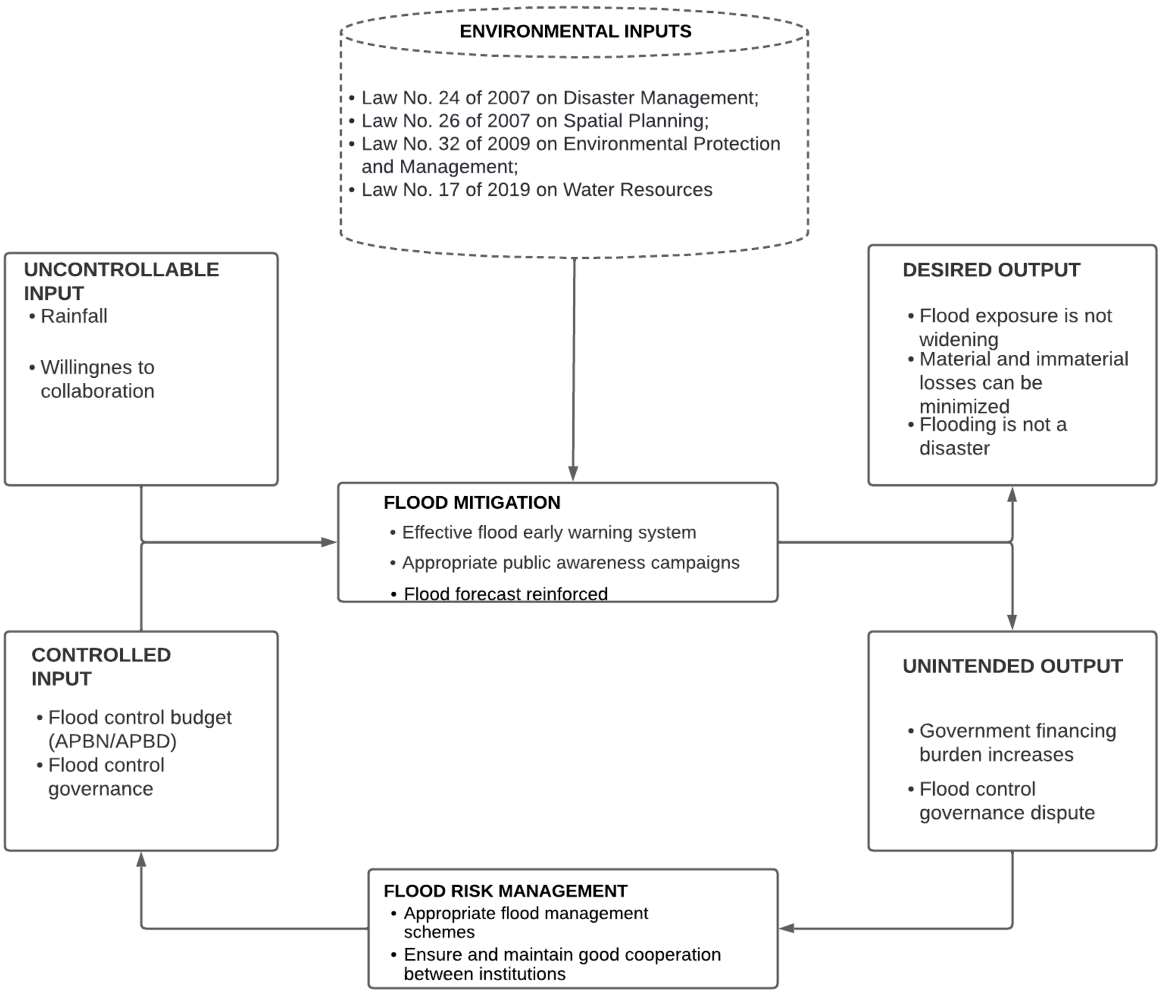

Figure 7. Output input diagram

However, this approach could lead to an increased government financing burden and dispute over flood control governance. Thus, it is essential to develop an appropriate flood management scheme and maintain cooperation between institutions to overcome these challenges. The anticipated outcomes of this cycle are the provision of inputs in the form of a flood control budget (APBN/APBD) and implementation of regulated flood control governance.

According to Table 3, flood disaster control in Bekasi City is the sole responsibility of the government. The default method for the government is still a structural or physical approach, with the social approach only apparent during pre-disaster processes, when the community is involved in public consultations for drafting regulations. While there have been efforts to socialize disaster response, these efforts have not been comprehensive. During disasters, the BPBD was unable to successfully evacuate flood victims in Bekasi City. In the aftermath, the BPBD collaborated with the BMSDA Office to clean up garbage and mud and provided trauma healing for flood victims in conjunction with the Social and Health Services. Community members used personal funds to rebuild damaged homes during reconstruction. Based on this explanation, the Bekasi City Government has not implemented optimal flood management.

To achieve the desired outcome (refer to Figure 7), it is necessary to optimize and manage the controllable inputs. Legitimate business processes should be utilized to express flood control budgets and governance. Here, is the recommended business process map (see Figure 8).

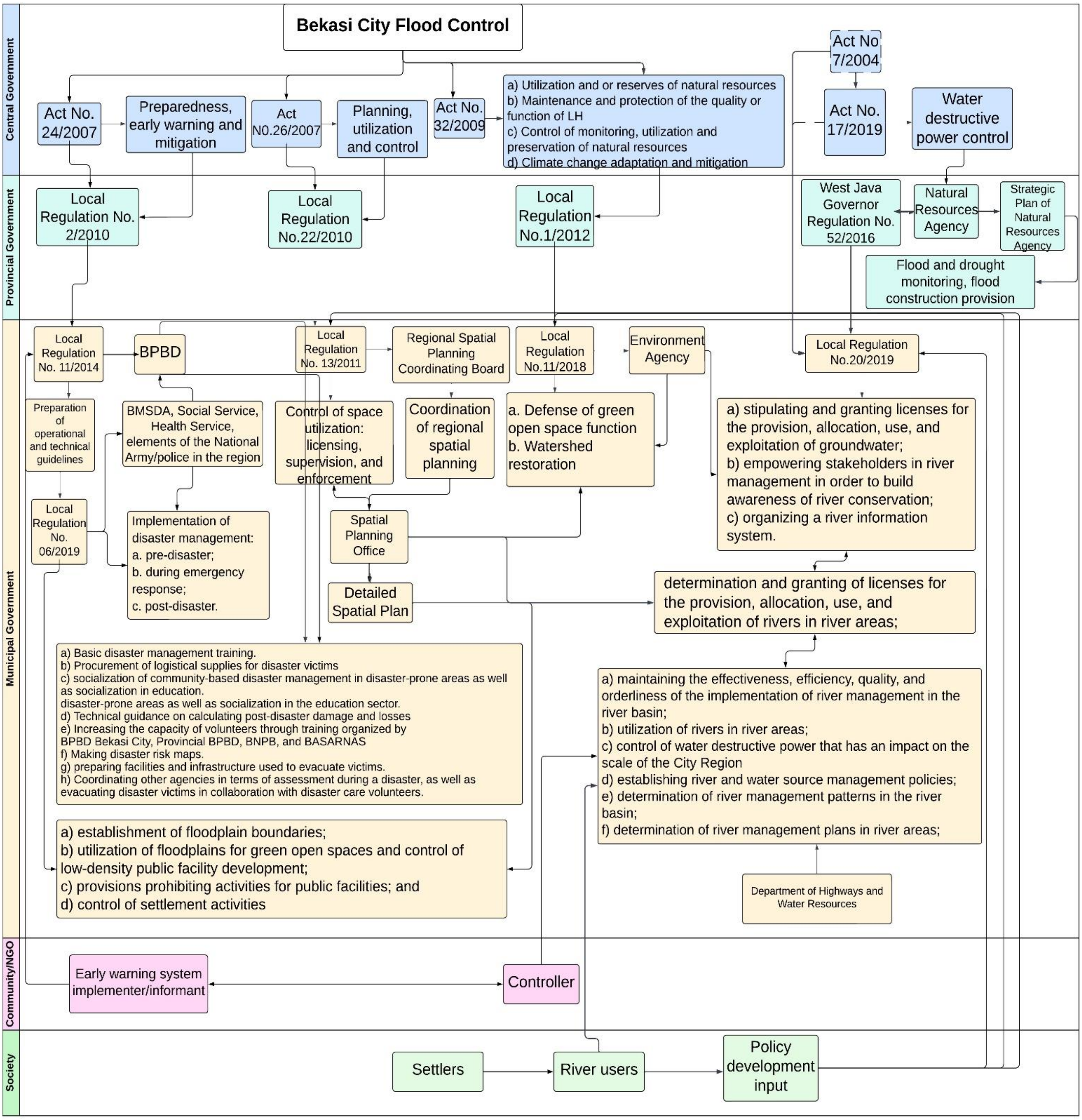

Figure 8. Flood control business process map

Table 4. Recommended strategy details

Strategy	Specific & Innovative Measures
Normalizing Rivers	Employing natural flood control methods including reforestation, wetland restoration, and vegetated buffer zones to mitigate water flow and sediment buildup in the Bekasi watershed, namely in the vicinity of Village: Jatirasa, Bojong Rawa Lumbu, Bojong Menteng, and Bantar Gebang.
	Riverbed sensor system: Install smart sensors to monitor sediment build-up and flow rates, providing real-time data to prevent flooding.
Forming Disaster-Resilient Urban Villages	In flood-prone regions, future residential development is focused on the design of modular housing modules that are either floating or easily elevated.
	Integrate rain gardens and bio-swales into the community infrastructure to effectively catch stormwater runoff and mitigate the occurrence of flooding.
	Interactive Risk Maps and Virtual Reality Simulations: Utilise Geographic Information System (GIS)-based risk mapping and virtual reality (VR) simulations to educate and equip communities for catastrophic events.
	Establish resilient food systems by advocating for vertical farming and rooftop gardening that utilise flood-resistant crops to ensure food security in times of calamities.
Optimizing Infrastructure	Install smart drainage systems with sensors and automated gates to regulate water flow based on real-time data.
	Utilise permeable pavement designed to facilitate the infiltration of rainfall into the earth, therefore minimising surface runoff.
	Construct subterranean reservoirs beneath urban areas to store surplus precipitation during floods and supply drinkable water during periods of drought.
	Flood-proofing public infrastructure involves the retrofitting of public facilities such as hospitals and schools with measures such as waterproof barriers, raised utilities, and emergency water storage.
Enhanced Flood Management & Forecasting	Integrate artificial intelligence (AI) and machine learning models that use weather data, satellite imagery, and historical flood patterns to predict floods with greater accuracy.
	Optimize the efficacy of community-sourced flood monitoring liked KP2C by leveraging community-driven data gathering (such as photographs and videos) to continuously monitor flood occurrences in real-time and offer incentives to encourage active involvement.
Strengthening Public Awareness & Collaboration	Develop *mobile games* or *interactive learning platforms* that teach local communities about flood risks, disaster response protocols, and climate resilience in an engaging way.
	Build digital platforms for government, NGOs, and private sectors to collaborate and share resources during flood events.
	Public-Private Partnerships: Encourage private investment in flood-resilient infrastructure through public-private partnerships, incentivized by tax breaks or shared profit models.

Future steps include normalizing rivers, forming disaster-resilient urban villages, optimizing infrastructure, and increasing recovery efforts. It is recommended that the drainage system in the case study area should be improved. Appropriate flood management schemes should be planned and flood forecasting should be strengthened. An effective early warning system for floods should activate plans and promote public awareness campaigns to educate and train local communities to handle such disasters. It is also recommended that strong collaboration be maintained between different agencies during these events (see Table 4 for details).

The results of a survey of disaster, environmental, and social experts showed that five strategies are feasible to implement (Figure 9). The most definite and important is strategy D2 (optimize the efficacy of community-sourced flood monitoring liked KP2C by leveraging community driven data gathering (such as photographs and videos) to continuously monitor flood occurrences in real-time and offer incentives to encourage active involvement). Next is the B3 strategy (interactive risk maps and virtual reality simulations: Utilize geographic information system (GIS)-based risk mapping and virtual reality (VR) simulations to educate and equip communities for catastrophic events). Strategies A1 and C2 are equally certain and important but less important than D1 and B3. A1 strategy, employing natural flood control methods including reforestation, wetland restoration, and vegetated buffer zones to mitigate water flow and sediment buildup in the Bekasi watershed, namely in the vicinity of Village: Jatirasa, Bojong Rawa Lumbu, Bojong Menteng, and Bantar Gebang important and must be done but the impact is not in the short term. Similarly, C2 efforts (utilize permeable pavement designed to facilitate the infiltration of rainfall into the earth, thereby minimizing the surface runoff). The fifth strategy was D1, integrating artificial intelligence (AI) and machine learning models that use weather data, satellite imagery, and historical flood patterns to predict floods with greater accuracy.

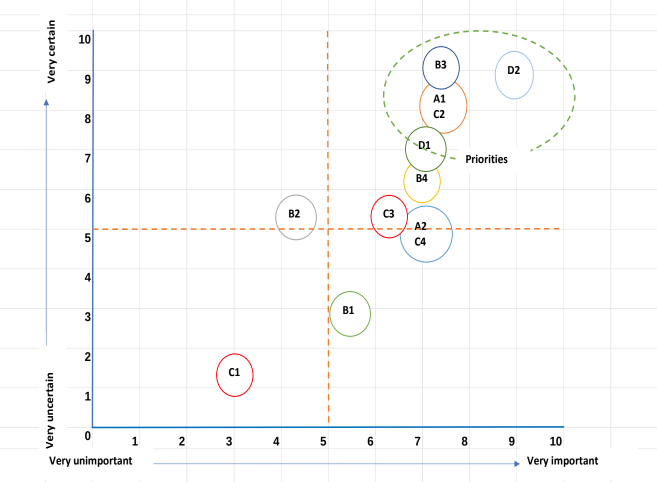

Figure 9. SAST result

5. CONCLUSIONS

Bekasi City has experienced floods for many years. From a geographical perspective, the city lies downstream of the Cikeas, Cakung, Sunter, and Bekasi watersheds, with elevations ranging from 11 to 81 m above sea level and a sloping topography. Bekasi City is prone to flood hazards, particularly during severe weather events. The aforementioned description demonstrates that a city is vulnerable and could become unsustainable if not properly managed. Hence, an extensive evaluation of the current flood control system in Bekasi City is imperative. This study aims to address the worsening phenomenon of flooding in Bekasi City. This research is useful for policymakers in other cities with characteristics similar to those of Bekasi.

To achieve the desired outcome in a resilient and sustainable city, it is crucial to optimize and manage controllable inputs. Legitimate business processes must be utilized to articulate flood control budgets and governance. Recommendations for the future will involve enhancing flood management and forecasting by optimizing the efficacy of community-sourced flood monitoring by leveraging community-driven data gathering to continuously monitor flood occurrences in real time and offering incentives to encourage active involvement. In addition, disaster-resilient urban village troughs utilize Geographic Information System (GIS)-based risk mapping and virtual reality (VR) simulations to educate and equip communities regarding catastrophic events.

For the long-term agenda, rivers need to be normalized by employing natural flood control methods. In addition, infrastructure measures such as permeable pavements are utilized to minimize surface runoff. Finally, artificial intelligence (AI) and machine learning models use weather data, satellite imagery, and historical flood patterns to predict floods with greater accuracy.

This approach is more characteristic of pre-disaster risk mitigation. The objective is that with this model, the city will demonstrate increased resilience to flood disasters compared to the existing governance structure.

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