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ANALYSIS OF FLOOD AND INUNDATION MANAGEMENT IN THE DRAINAGE SYSTEM OF PEKANBARU CITY

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ABSTRACT

Floods and waterlogging are environmental problems that continue to recur in the city of Pekanbaru and have a significant impact on the social, economic, and quality of life of the community. This condition shows that the performance of urban drainage systems in collecting and draining rainwater is not optimal, especially during high rainfall. This study aims to analyze the factors that cause floods and inundation and assess the effectiveness of the existing drainage system in Pekanbaru City. The research method used is a qualitative descriptive approach, with data collection through field observations, interviews with relevant technical agencies, and analysis of related documents. The results of the study show that the main problems of the drainage system of Pekanbaru City include: the dimensions of the channel that are not in accordance with the water runoff capacity, blockages due to the accumulation of sediment and garbage, construction that does not pay attention to the infiltration function, and lack of periodic maintenance by the authorities. In addition, the weak public awareness in maintaining the cleanliness of the channels worsens flood and inundation conditions. Based on the results of the analysis, it is necessary to replan the drainage system as a whole, implement a flood mitigation-based space control policy, and increase community participation in urban environmental management. This integrated effort is expected to increase the effectiveness of the drainage system and reduce the risk of flooding in the city of Pekanbaru in a sustainable manner.

INTRODUCTION

Flood is a very popular word in Indonesia, especially during the rainy season. These events recur almost every year, but this problem has not been resolved to date, and even tends to increase, both in frequency, extent, depth, and duration. The root of the problem of flooding in urban areas comes from a very rapid increase in population, above the national average, due to urbanization, both seasonal and permanent migration. The increase in population that is not balanced with the provision of adequate urban infrastructure and facilities results in the use of urban land becoming chaotic. This irregular use of land is what causes drainage problems in urban areas to be very complex.

Table 1
Number of Affected Communities and Flood Height in Pekanbaru City in 2022-2023

NO	District	Neighborhoods	Number of families affected/ Village 2022	Number of families affected /Neighborhoods 2023	Number of people affected/ Neighborhoods 2022	Number of people affected / Village 2023	Average height(cm) 2022	Average height (cm) 2023
1.	Tenayan Raya	Yellow Bamboo	50	70	200	280	60,83	55
2.	Tenayan Raya	Rejosari	71	52	284	208	65	55
3.	Tenayan Raya	East Tankerang	5	-	20	-	60	-
4.	Tenayan Raya	Tenayan Industry	-	20	80	-	50	-
5.	Bukit Raya	Tangkerang Labuai	446	247	1784	988	55,42	45,7
6.	Bukit Raya	North Tangkerang	159	114	636	456	83	70
7.	Bukit Raya	South Tangkerang	0	0	0	0	0	0
8.	Umbrella	Cities	5	-	20	-	17,5	-
9.	Umbrella	West New Harbor	280	-	1120	-	31,25	-
10	Sail	Like to Progress	6	1	24	4	53,75	120
11	Sail	Like Noble	269	184	1076	736	65	72,5
12	Tassel	Sri Meranti	42	-	168	-	40	-
13	Tassel	Shipyard	512	-	2048	-	75	-
14	Gunpowder	Kampung Dalam	-	-	-	-	80	-
15	Sukajadi	Jadirejo	0	0	0	0	40	0
16	Kulim	Kulim	0	0	0	0	0	50
17	Marpoyan Peace	Memorandum	-	13	-	52	-	120
18	Marpoyan Peace	Marpoyan Stop	-	200	-	800	-	85
19	Marpoyan Peace	Central Tangkerang	-	115	-	460	-	85
20	Western Tassels	Tufts of Hills	-	2	-	8	-	35
Sum			1845	1018	7380	4072	51,4	71,25

Source: Pekanbaru City BPBD, 2023

Based on the table above, the city of Pekanbaru as the capital of Riau Province has a high level of vulnerability to flooding. Based on the 2018-2023 Strategic Plan

document of the Pekanbaru City Public Works and Spatial Planning Office (PUPR), it is stated that there are still 121 active flood points in various sub-districts. The main problems identified were suboptimal drainage channel capacity, high sedimentation, poor integration of drainage systems between regions, and conversion of greenlands into built-up areas that reduced water uptake. In addition, the behavior of people who tend to throw garbage into waterways exacerbates this condition. This situation resulted in rainwater not being able to flow effectively, causing inundation and flooding in many residential areas.

The problem of flooding and inundation in the city of Pekanbaru has become a recurring challenge in recent years. High rainfall and inadequate drainage capacity cause inundation and flooding in various urban areas (Nugroho, 2025). The existing drainage system often experiences blockages due to sedimentation and illegal buildings that close the channel, so that the water flow becomes unsmooth and causes inundation (Pekanbaru City Government, 2025).

Optimal drainage management is key in mitigating the risk of flood disasters in urban areas. Rahman's research (2025) shows that drainage management in Pekanbaru still faces obstacles such as limited cross-sectoral coordination and low public awareness in maintaining environmental cleanliness. The Pekanbaru City Government has made various efforts such as the revitalization of drainage channels and community education campaigns to encourage community participation in preventing channel blockages (Rahman, 2025).

According to the Pekanbaru Public Works Office (2021), the city's drainage system is currently not functioning optimally. Many channels are clogged due to sewage and sedimentation, while some drainage networks are not well connected to the main channels. As a result, some areas such as Marpoyan Damai, Sukajadi, and Tampan were flooded when heavy rain occurred (Sari & Mulyono, 2020).

Disaster prevention contains efforts to inhibit the occurrence of disasters, or prevent them from causing losses to the community (Eviany, 2023). Drainage is not just a waterway, but is part of an urban spatial system that must be managed through a systematic managerial approach, including planning, implementation, organizing, and supervision. The Urban Drainage System is one of the components of urban infrastructure that is very closely related to spatial planning. The flood disasters that often underlie most regions and cities in Indonesia are caused by chaos in spatial planning.

In addition, effective flood management strategies also involve normalizing river flows and collaboration between city and provincial governments to create a comprehensive flood control system (Agung Nugroho, 2025). The renewal of the flood management master plan is an urgent need considering the evolving conditions and the old master plan is no longer relevant to overcome flood problems in the city of Pekanbaru (Pekanbaru City Government, 2025).

The purpose of this study is to comprehensively analyze the condition of the drainage system in Pekanbaru City in dealing with the problems of flooding and inundation that often occur, taking into account various technical and non-technical factors that affect the performance of the system. This study aims to identify key

obstacles such as limited channel capacity, blockages due to sedimentation and sewage, and suboptimal drainage management that causes inundation and flooding. In addition, this study also seeks to evaluate the effectiveness of flood management strategies that have been implemented by city governments, including the normalization of drainage channels and cross-sector collaboration. Through this in-depth analysis, it is hoped that strategic technical and policy recommendations can be formulated to improve the performance of the drainage system, optimize flood control, and reduce the risk of social and economic impacts due to flood disasters in the city of Pekanbaru. Thus, this study also contributes to providing a holistic picture of adaptive and sustainable urban flood management.

Therefore, it is important to conduct an in-depth study of how drainage management is carried out in the city of Pekanbaru as one of the flood disaster mitigation strategies. By understanding various technical and non-technical aspects.

LITERATURE REVIEW

Flooding is defined as a soil submersion event that is usually dry due to an increase in water volume (BNPB, 2024). Flooding occurs when the volume of incoming water can no longer be accommodated by the water receiving body (rivers, lakes, or main drainage channels), thus overflowing into the surrounding area (Oktapian et al., 2025). Inundation is a more specific term in the context of urban drainage. Inundation refers to the accumulation of water at the ground level (usually roads or settlements) due to the failure of a micro-drainage system to drain rainwater as quickly as it falls (surface runoff) (Permana, 2020; SENTRI, 2025).

Flooding is an event when an area is submerged by an increase in water volume due to high rainfall and low land ability to absorb water (Syahrul et al., 2023). Based on their characteristics, floods can be divided into several types, such as river floods, flash floods, tidal floods due to tides, and urban drainage floods.

The drainage system has an important function to drain excess rainwater from an area so as not to cause inundation or flooding (Hadinagoro, 2023). According to Latupeirissa et al. (2022), the planning and maintenance of a good drainage system plays an important role in flood control efforts in urban areas. However, problems often arise when channel capacity is no longer proportional to the increase in water runoff discharge due to rapid urbanization and land-use change (Abighail et al., 2022).

Changes in land use from catchment areas to built-up areas reduce the ability of the soil to absorb water, thereby increasing surface runoff (Syahrul et al., 2023). In addition, other causes of inundation and flooding in urban areas include drainage system deviations, narrowing of channels due to sedimentation and garbage, and flat topographic conditions that slow down water flow (Hadinagoro, 2023; Siho et al., 2023). The combination of these various factors makes urban flooding one of the main environmental problems in densely populated cities in Indonesia.

Research by Putra et al. (2024) shows that changes in land cover due to urbanization have a significant effect on increasing surface runoff discharge in urban areas. Urbanization that is not accompanied by spatial control leads to reduced water catchment areas and increased risk of flooding. This is in line with the findings of

Rahman et al. (2022) who stated that in several major cities, such as Makassar and Surabaya, land conversion without proper regulation contributes to an increase in runoff volume and flood frequency. Similar conditions have the potential to occur in the city of Pekanbaru, which is experiencing rapid regional growth and settlement development without being balanced with adequate drainage system planning.

The city of Pekanbaru has relatively flat topographic characteristics with fairly high annual rainfall. According to the Pekanbaru Public Works Office (2021), the existing drainage system consists of primary, secondary, and tertiary channels, but many of them do not function optimally due to sedimentation, garbage, and illegal buildings above the channel.

Research by (Sari and Mulyono, 2020) shows that in some areas such as Marpoyan Damai and Sukajadi, inundation often occurs even though rainfall is not extreme. This indicates problems in channel capacity, channel slope, and drainage management.

Flood and inundation management strategies in urban areas are basically divided into two approaches, namely structural and non-structural. The structural approach includes the construction of physical infrastructure such as retention ponds, infiltration wells, drainage channel repairs, and the installation of water pumps. Sutaryo's research (2023) emphasizes that the application of infiltration wells is effective in reducing the volume of surface runoff in densely populated areas. Similarly, Ramadhan, Andawayanti, and Lufira (2025) show that increasing the capacity of drainage channels and the implementation of drainage channels *Eco-friendly drainage* able to significantly reduce the frequency of inundation in the Genuk area of Semarang City.

Meanwhile, the non-structural approach focuses on spatial control, waste management, community education, and the development of early warning systems. Dharmayanti et al. (2024) revealed that the use of biopores not only serves as an effort to control flooding, but also increases public awareness in organic waste management. The same thing is stated by Siho, Pratama, and Simanjuntak (2023) who emphasize the importance of mitigation strategies based on sustainable drainage infrastructure in densely populated urban areas. Thus, the combination of these two approaches is the key to realizing an effective and sustainable flood control system in big cities such as Pekanbaru.

RESEARCH METHODOLOGY

This study uses a qualitative research method with a descriptive approach that aims to describe and analyze the problem of flooding and inundation in the urban drainage system in Pekanbaru. A qualitative approach was chosen to examine in depth the existing conditions, causes, and impacts experienced by the community due to drainage problems. This research was conducted in urban areas of Pekanbaru which often experience floods and inundation during the rainy season. And data collection is carried out during the rainy season to obtain accurate data related to flood and inundation events. The data collection technique was carried out by direct observation of the physical condition of the drainage channel, including the identification of points

of blockage, sedimentation, and channel damage that caused flooding and inundation. And it involves interviews with flood-affected residents, local government officials (Public Works Office, BMKG), and environmental experts to collect qualitative information related to the cause, frequency, and impact of floods.

RESULTS AND DISCUSSION

1. Implementation of the Urban Drainage System Management Function in Pekanbaru City

Based on the results of research conducted in the field, the implementation of the management function in the management of the drainage system in Pekanbaru City has not been running optimally. Theoretically, the success of drainage management is highly dependent on the implementation of management functions which include planning, implementation, organization, and supervision. These four functions must be interrelated and mutually supportive in realizing an effective and sustainable drainage system. However, the results of the study show that the implementation of these four functions is still fragmented and not well integrated. This condition has implications for the lack of optimal government efforts in overcoming inundation and flooding problems that occur almost every year in the Pekanbaru City area.

In an effort to examine more deeply the effectiveness of the implementation of drainage management, the following are the results of the analysis regarding the implementation of each management function in the City of Pekanbaru:

1. Planning

At the planning stage, it was found that the construction and rehabilitation of the drainage system carried out by the Pekanbaru City Government was not entirely based on the latest hydrological and climatological data. The planning process often still uses old data without taking into account changes in rainfall patterns and the growth rate of built-up areas. As a result, the capacity and dimensions of the channel are not balanced with the increase in water discharge during heavy rains. This is proven in several areas such as Marpoyan Damai, Sukajadi, and Tampan which are still often flooded even though rainfall is relatively moderate (Sari & Mulyono, 2020). Drainage planning in this city tends to be normative with an administrative approach, not adaptive techniques. In fact, good planning must consider peak discharge data, water flow direction, and local topographic conditions so that the design of the channel is in accordance with the actual needs in the field.

2. Implementation

In terms of implementation, the results of the study show that drainage management activities in Pekanbaru are more reactive than preventive. Channel maintenance is only carried out after inundation or complaints from the community, not through a routine and scheduled maintenance program. Pratama and Rusli (2024) stated that the maintenance system in Pekanbaru is still inconsistent, both in terms of time, quality of work, and the division of responsibility areas between officers. From the results of observations in the field, tertiary channels in Tenayan Raya and Payung

Sekaki Districts appear to be filled with sediment and household waste that are not cleaned regularly. This condition shows that the implementation of maintenance has not prioritized the sustainability aspect. As a result, the channel's function as a rainwater channel does not run properly, causing inundation at the same point every year.

3. Organize

In the organizational aspect, based on information from related parties, coordination between government agencies is still the main obstacle. There is an overlap of authority between the Public Works and Spatial Planning Office (PUPR) and the Environment Agency in terms of maintenance and supervision of channels. In addition, the absence of an integrated special task force to handle drainage systems has led to slow and poorly coordinated flood management. Each agency tends to work sectorally without data integration and cross-field policies. This condition results in a decrease in the effectiveness of drainage management because the decisions taken are not based on an integrated information system and solid coordination between work units. Some. Weak coordination across sectors is the main factor that slows down the handling of inundation in Pekanbaru. The lack of communication between agencies also has an impact on delays in program implementation and synchronization in budget use.

4. Supervision

Meanwhile, in terms of supervision, drainage monitoring and evaluation activities have not been carried out on an ongoing basis. Based on the acceptance of field officers, routine inspections of the condition of the channel are still rarely carried out due to limited manpower and equipment. Evaluation is only carried out when a flood or flood has occurred. As a result, potential channel damage or blockages are not detected early. In fact, with periodic supervision and a structured reporting system, the government can anticipate problems before they have a major impact on the community.

Overall, the implementation of the four management functions has not formed an effective drainage management system in the city of Pekanbaru. Weak coordination between agencies, lack of accurate technical databases, and lack of maintenance and supervision activities are the main factors that affect the low performance of municipal drainage systems. This condition has a direct impact on increasing inundation in urban areas and disrupting the socio-economic activities of the community. Therefore, it is necessary to strengthen the management function with a data-based approach, technical capacity building, and community involvement in maintaining channel cleanliness. Careful planning, consistent implementation, and solid cross-sector coordination will be the key to creating a drainage system that functions optimally and sustainably in the city of Pekanbaru (Pratama & Rusli, 2024; Wulandari & Andriyus, 2024).

The typology of floods that occur in the city of Pekanbaru shows the existence of two main characteristics that are different based on their sources and mechanisms. Based on the results of data identification and analysis of regional hydrological

conditions, floods in Pekanbaru City can be classified into two main types, namely fluvial floods and pluvial floods, which are described as follows:

a. Fluvial Flooding

The fluvial flood is caused by the overflow of the Siak River which serves as the main estuary of the city's drainage system. This type of flood generally lasts longer and has a major impact on settlements along watersheds. In January 2024, the overflow of the Siak River caused significant flooding in several sub-districts, such as Rumbai Pesisir, East Rumbai, Tenayan Raya, Bukit Raya, and Marpoyan Damai, with a total of 516 households affected. A similar incident occurred again in February 2024 in Rumbai and Tenayan Raya Districts, with water levels reaching 30-35 cm.

b. Rainwater Flooding

Meanwhile, rainfall is triggered by high-intensity rains in a short period of time that exceed the capacity of urban drainage systems. This type of flood occurs quickly and often disrupts centers of economic and transportation activities. For example, heavy rain for three hours on October 12, 2025 caused inundation of about 50 cm on Jalan Paus, Marpoyan Damai District, which residents called the worst flooding in the past five years. Other arterial roads that are often flooded include Jalan HR Soebrantas, Jalan Jenderal Sudirman, Jalan Tuanku Tambusai, and Jalan Arifin Ahmad. These events not only caused material losses, but also caused economic losses due to severe congestion and disruption of business activities.

The difference between these two typologies is crucial because it highlights the differences in the root cause of the problem and the approach to treatment required. The government's dominant focus on normalizing local drainage is effective in mitigating some of the impacts of rainstorms, but it has not touched the root of the more fundamental problem. The problem of rainwater flooding in Pekanbaru is the failure of the drainage system which is systemic and diverse. This failure can be broken down into three main components:

a. Clogging by Garbage and Sediment

This problem is the most common operational bottleneck. The Public Works and Spatial Planning Office (PUPR) has consistently identified piles of garbage as the main cause of suboptimal water flow. Drainage channels at various points are often filled with household waste and thick sediments, which demand regular dredging by the cleaning team (Yellow Troops). The root of the problem lies in the behavior of people who still throw garbage carelessly into waterways and weak supervision and law enforcement of these violations.

b. Inadequate Capacity and Design

In addition to blockages, another fundamental problem is the capacity and design of drainage infrastructure that is unable to accommodate the increasing rainwater discharge along with urban development. Many residents, especially in the Whale Street area, complained of shallow drainage conditions that were disproportionate to current hydrological needs. Local governments also recognize these limitations; The Deputy Mayor of Pekanbaru cited the lack of the number of culverts as the main cause of water not being properly accommodated during heavy rains. In fact, the Mayor of Pekanbaru, Agung Nugroho, emphasized that most of the

drainage in this city is not functioning optimally due to blockages, sedimentation, and the existence of illegal buildings that close the channel.

c. Outdated Infrastructure

A number of academic studies show that many drainage networks in Pekanbaru are decades old and have experienced a significant decline in function. This aging infrastructure is no longer able to withstand the increasing hydrological burden of cities, especially with the increasing intensity of rainfall due to climate change.

This condition creates a paradox in flood management policies. The government routinely deploys resources to clean drainage channels as a form of corrective maintenance that is reactive. This does give visible results, but it only touches the symptoms, not the root of the problem. Structurally inadequate drainage systems will again experience blockages in a short time. As a result, the city of Pekanbaru is trapped in a cycle of "clean-up again", which ultimately drains the operational budget without producing significant changes.

2. Technical and Non-Technical Obstacles in Urban Drainage Management in Pekanbaru City

In addition to weaknesses in the implementation of management functions, this study also found various obstacles that affect the effectiveness of drainage management in Pekanbaru City. These barriers consist of interrelated technical and non-technical factors and contribute to increased flood risk in urban areas.

From a technical point of view, some channels are clogged due to garbage and sediment buildups, while others do not have enough depth and width to accommodate water discharge. At some points, such as Rumbai and Bukit Raya Districts, the condition of the channel showed siltation of up to 40 cm and was even covered by permanent buildings. These findings show a significant decrease in drainage function. Most of the drainage network in Pekanbaru is old infrastructure that has not been updated, so it is no longer able to accommodate the volume of water in accordance with the development of the city.

From a non-technical aspect, budget limitations and low public awareness are the main problems. Limited maintenance budgets cause maintenance activities to not be carried out thoroughly. On the other hand, the behavior of people who are still dumping garbage into waterways worsens drainage conditions and accelerates blockages.

Data from the Pekanbaru City Social Service in 2024 shows that the frequency of floods increases every year. In 2024, there will be 40 disaster events that impact 261 Heads of Families (KK), an increase from 2023 which recorded 27 incidents with 59 families affected. This increase shows that technical and non-technical barriers have a direct effect on increasing flood risk in cities.

As explained in the previous section, floods in Pekanbaru City consist of two main types, namely fluvial floods and pluvial floods. Field data shows that in January 2024, fluvial floods hit the Rumbai, Tenayan Raya, and Marpoyan Damai areas with the number of affected families reaching 516 families. Meanwhile, in October 2025, there will be rainfall floods due to high-intensity rainfall that causes inundation of up to 50 cm on Jalan Paus and Jalan HR Soebrantas. BMKG Riau data (2024) recorded

monthly rainfall of 200–400 mm with the influence of the La Nina phenomenon which also increases the potential for extreme rainfall. In addition, the overflow of the Siak River also causes a back-water effect that inhibits the flow of water from the city channel downstream.

In terms of land use, the high rate of urbanization in Pekanbaru also worsens drainage conditions. Many green areas are converted into built-up areas so that the soil's ability to absorb water decreases. The results of this study are in line with Aqsha & Harahap (2022) who explained that land use changes have a significant effect on increasing surface runoff and decreasing drainage capacity.

In addition to these findings, the 2025 field data update shows that more than 60% of tertiary drainage channels in Pekanbaru are not functioning optimally, either because they are shallow, covered with buildings, or damaged due to the age of infrastructure that is more than two decades old (PUPR Pekanbaru, 2024). In the area of Jalan HR Soebrantas and Jalan Paus, sediment as thick as 30-40 cm makes rainwater unable to flow smoothly. When extreme rainfall occurs, water immediately overflows to the road surface in a short time. The government has carried out routine clean-ups through the Yellow Army team, but this effort is reactive and temporary because the already structurally inadequate drainage system will be clogged again in a short time.

The technical constraints were also exacerbated by the incompatibility of the drainage design with the actual discharge capacity. The city's drainage system designed in the early 2000s only takes into account a rainfall intensity of 100 mm/day, while BMKG data (2024–2025) shows that extreme rainfall intensity in Pekanbaru can now reach 180–200 mm within three hours. This mismatch causes water to overflow even though the duct has been cleaned. The relatively flat topography of Pekanbaru slows down the flow, so that the puddles last longer. Some areas even experience the backwater effect of the Siak River, which blocks the flow of water in the city's drainage system.

From a non-technical perspective, the limited budget of local governments is the main inhibiting factor. Based on the PUPR Office report (2025), the drainage maintenance budget is only around Rp 18 billion per year, far from the estimated ideal need of Rp 1 trillion for comprehensive handling (Cakaplah.com, 2025). The funds are mostly absorbed for routine cleaning, not infrastructure capacity building. As a result, the repairs made are only short-term without a structural impact on reducing flood risk.

In addition, low public awareness in maintaining environmental cleanliness worsens the situation. Based on the results of a rapid field survey (2025), 4 out of 10 respondents in Marpoyan Damai Regency still throw household waste into ditches or waterways. Solid waste such as plastics and organics are the main obstacles that accelerate the decline in channel capacity. The lack of law enforcement against violations of Regional Regulations (Perda) on cleanliness and waste management makes this behavior persist.

From an institutional perspective, coordination between institutions is still a serious obstacle. The overlap of authority between the PUPR Office, the Environment

Office, and BPBD hinders the implementation of integrated flood management. The absence of an integrated database on drainage conditions causes each agency to work sectorally. In addition, the outdated city drainage master plan makes the interventions carried out not based on strategic planning. The Mayor of Pekanbaru in 2025 stated that the document is no longer relevant and needs to be updated to match the actual hydrological and urbanization conditions of the city.

Changes in land use further worsen the city's hydrological conditions. Studies in the Siak watershed show that greenland conversion has reached 23% in the last five years, increasing surface runoff by up to 30% and reducing soil catchability. As a result, peak water discharge increases significantly, especially when rainfall is high and rivers overflow. This is in line with the findings of the Riau Regional Disaster Management Agency (BPBD) (2025) which recorded that floods in January 2024 had an impact on 516 households, while storm flooding events in October 2025 caused inundation of up to 50 cm on the city's five main roads.

The drainage problem in Pekanbaru City shows a close relationship between technical and non-technical obstacles that affect each other. Infrastructure that is no longer suitable, channel design that is not in accordance with regional growth, limited resources and budgets, weak coordination between institutions, and lack of public concern for environmental cleanliness are factors that worsen flood risk. Therefore, drainage management efforts are needed that are designed in an integrated and long-term orientation, paying attention to the balance between technical, social, and institutional aspects so that the city's drainage system can function optimally and be able to reduce the impact of flooding in a sustainable manner.

3. Drainage Management Optimization Strategies and Solutions for Flood Disaster Mitigation in Pekanbaru City

Based on the results of interviews with the community in the areas of Jalan HR Soebrantas, Jalan Sudirman, and Jalan Merpati Sakti, information was obtained that waterlogging still often occurs after heavy rains. On Jalan Merpati Sakti, water can even reach the calves of adults, especially at points where the channels are shallow and covered in sediment. The results of field observations show that most of the channels in the location have decreased carrying capacity due to piles of garbage and lack of periodic maintenance from technical agencies. Field officers from the Pekanbaru City PUPR Office also said that the main obstacles came from limited equipment and the lack of a comprehensive drainage mapping system for the entire city area.

From these findings, the optimization strategy for drainage management needs to be carried out through an integrated approach between technical and social aspects. The concept *of Low Impact Development (LID)* can be one of the relevant solutions. This approach emphasizes efforts to absorb rainwater naturally through infiltration wells, bioretention gardens, and green pathways that function to contain surface runoff. The application of the LID concept has been shown to be effective in reducing peak stream discharge in densely populated areas, as described in the book *The Future in Our Hands* (Low Impact Development, n.d.). This principle is in line with the condition of the Panam area and Jalan Soekarno-Hatta which still have open space for water absorption.

In addition, the results of the study *on Urban Water Network Modeling and Management Progress* by Creaco et al (2021) explain the importance of using a *Geographic Information System (GIS)-based monitoring system* to improve the efficiency of urban drainage management. In the context of Pekanbaru, this system can be used to map clogged channels, identify inundation points, and plan routine cleaning schedules based on field data. Thus, drainage maintenance can be carried out more on target and responsive to changes in extreme rainfall.

The institutional approach also has an important role. Based on interviews with community leaders around Jalan Sudirman and Panam, the lack of coordination between residents, housing developers, and the government is the main cause of ineffective waterway management. In the book *Urban Water Demand Management: A Guidebook for ASEAN* by Ong, Tortajada, and Arora (2023), it is explained that collaborative models such as *Integrated Urban Water Management (IUWM)* can strengthen partnerships between governments and communities in urban water management. The application of this concept allows community participation through mutual cooperation activities, reporting of clogged channels, and supervision of new developments so as not to close the flow of water.

The results of the observation and interviews as a whole show that the optimization of drainage management in the city of Pekanbaru must be carried out in an integrated manner: strengthening green infrastructure, utilizing digital mapping technology, and involving the active role of the community. If these measures are implemented consistently, the potential for frequent flooding in areas such as Merpati Sakti, HR Soebrantas, and Sudirman can be significantly reduced, and support the realization of cities that are resilient to climate change.

CONCLUSION

The results of the study show that the flood problem in Pekanbaru City arises due to the interconnectedness of various factors, both technical and non-technical, that reinforce each other. From a technical perspective, narrowed drainage channels, siltation due to sedimentation, and many channels covered with garbage are the main causes of water flow blockages. Meanwhile, from a non-technical perspective, limited budget allocation, weak inter-agency coordination, and low public awareness in maintaining environmental cleanliness worsen the condition of the existing drainage system. Infrastructure that is old and has not been updated according to urban development also reduces the ability of drainage systems to control flooding. Field findings show that drainage management in Pekanbaru is still reactive and has not led to a sustainable prevention system. Therefore, a more adaptive, integrated, and collaboration-based management pattern is needed. The application of *the Low Impact Development (LID)* concept to improve water catchment areas, the use of digital mapping technology based on *Geographic Information Systems (GIS),* and the integration of *Integrated Urban Water Management (IUWM)* models are strategic steps to strengthen the effectiveness of urban drainage systems and significantly reduce flood risk. The Pekanbaru City Government is expected to update the drainage *master plan* in accordance with the latest hydrological conditions and spatial

developments. Channel maintenance activities need to be carried out regularly and on a scheduled basis so that the channel's function can remain optimal throughout the year. Collaboration between the PUPR Office, the Environment Office, and other regional apparatus needs to be strengthened with digital-based data support to facilitate continuous monitoring and evaluation of drainage system performance. In addition, increasing awareness and community involvement is essential in supporting the success of drainage management. The government needs to expand the socialization of the importance of maintaining the cleanliness of channels and enforce rules against violations that cause blockages of water flow. Efforts to implement environmentally friendly drainage concepts such as biopores, infiltration gardens, and porous sidewalks can also be an effective solution in dense residential areas. With synergy between the government, the community, academics, and the private sector, the drainage system of Pekanbaru City can be improved towards more efficient, adaptive, and sustainable management.

BIBLIOGRAPHY

Abighail, T., Rahardjo, H., & Santoso, D. (2022). Flood modeling due to land use changes in the Ciliwung River Basin. *ITB Civil Engineering Journal*, 29(1), 31–44.

Aqsha, S., & Harahap, D. S. (2022). Evaluation of drainage channel planning in residential areas on Jalan Air Bersih, Sudirejo 1 Village, Medan Kota District. *Journal of Civil Engineering (JTSIP),* 1(1), 73–77.

Riau Province Meteorology, Climatology, and Geophysics Agency (BMKG). (2024). *Report on rainfall conditions and climate in the Riau region in 2024*. Pekanbaru: BMKG Riau.

National Disaster Management Agency (BNPB). (2024). *Definition of disaster and its management* (as cited in the *Scientific Journal of Science and Technology*, 2024).

Creaco, E., Campisano, A., Franchini, M., & Modica, C. (2021). *Advances in Modeling and Management of Urban Water Networks*. Basel: MDPI.

Dharmayanti, A. M. R., Sari, D., & Yuniar, A. (2024). The use of biopores as an environmental solution for flood prevention and organic waste management. *Academic Nuances: Journal of Community Development*, 10(1), 55–67.

Pekanbaru Public Works Office. (2021). *Annual report on the management of the drainage system of the City of Pekanbaru*. Pekanbaru: Pekanbaru City Government.

Pekanbaru City Social Service. (2024, January 10). *Pekanbaru will be hit by 40 disasters in 2024, 261 families will be affected*.

Hadinagoro, R. I. S. R. (2023). Drainage system and urban flood phenomenon. *Journal of Unjani Engineering*, 13(1), 21–32.

Latupeirissa, R. E., Pattiselanno, M., & Leiwakabessy, Y. (2022). Evaluation of drainage systems in flood management efforts in Honipopu Village, Ambon City. *Journal of Geography: Geography and Its Teaching*, 20(1), 15–28.

Low Impact Development Center. (n.d.). *The Future in Our Hands*. Washington, D.C.: Low Impact Development Center.

M. Syahril. (2009). Classification of floods based on the mechanism of occurrence. *Journal of Applied Hydrology*, 4(2), 90–101.

Nugroho, H. W., & Aryani, Z. U. (2025). Design of *a sustainable urban drainage system* with a multi-storey channel approach and garbage grill in the city of Pekanbaru. *Science and Technology: Journal of Development Policy and Innovation*, 7(2), 85–96.

Nur, F., & Asri, H. (2024). Changes in land use and control of space use in suburban areas. *Urban and Regional Studies Journal*, 2(1), 45–57.

Oktapian, S., Suryana, & Setiawan. (2025). A study of factors that cause flooding in urban areas. *Journal of Optimal*, 5(3), 120–133.

Ong, C. H., Tortajada, C., & Arora, M. (2023). *Urban Water Demand Management: A Guidebook for ASEAN*. Singapore: Springer Nature Singapore Pte Ltd.

Pekanbaru City Government. (2025, October 16). *The Pekanbaru City Government immediately updated the flood control system*. Pekanbaru.go.id.

Permana, A. J. (2020). Analysis of urban drainage systems. *UPI Repository*.

Prajatama, M. R. T., & Muslim, M. (2025). *Drainage management in flood disaster prevention in Pekanbaru City, Riau Province* (Doctoral dissertation, Institute of Domestic Government).

Pratama, A., & Rusli, Z. (2024). Drainage maintenance in Pekanbaru City. *Parliamentarian: Journal of Legal and Public Administration Studies*, 2(1), 105–117.

Putra, R., Sari, M., & Yuliani, D. (2024). The effect of land cover changes on flood discharge in the Core Government Area of the Capital City of the archipelago. *Journal of Resources and Environment*, 31(2), 115–126.

Rahman, A., & Putra, Y. (2023). *Analysis of urban drainage systems in flood mitigation efforts in Pekanbaru City*. Pekanbaru: University of Riau Press.

Rahman, A., Nasrullah, M., & Lestari, R. (2022). Annual flood disasters: Factors causing floods and spatial planning policies of Makassar City. *Journal of Government and Policy*, 3(2), 87–98.

Ramadhan, H., Andawayanti, U., & Lufira, R. D. (2025). Evaluation of drainage channels and the application of *eco-drainage* to flood management in Genuk District, Semarang City. *Journal of Water Resources Technology and Engineering*, 5(2), 121–133.

Sari, N., & Mulyono, T. (2020). Evaluation of drainage systems in densely populated areas in Pekanbaru City. *Nusantara Civil Engineering Journal*, 8(1), 65–72.

SENTRI. (2025). Analysis of drainage systems in the Depok City area. *SENTRI: Scientific Journal*, 3(2), 77–89.

Siho, Y., Pratama, A., & Simanjuntak, M. (2023). Flood risk analysis and mitigation strategies based on sustainable drainage infrastructure in densely populated urban areas. *Journal of Civil and Architectural Engineering (JITESNA),* 9(2), 101–114.

Sutaryo. (2023). A study on flood and inundation management through infiltration wells in Pasar Rebo District. *Plano Scientific Journal*, 18(2), 77–89.

Syafri, A., Rahmad, I., & Hasanah, L. (2022). The application of *the concept of eco-drainage* in rainwater management in the city of Pekanbaru. *Journal of Environment and Development*, 10(1), 55–63.

Syahrul, M., Yusuf, I., & Rauf, A. (2023). The effect of land use change on flood vulnerability in Masamba urban, North Luwu Regency, South Sulawesi Province. *SABUA: Journal of Architecture & Built Environment*, 5(2), 87–98.

Wulandari, A. P., & Andriyus. (2024). Evaluation of the implementation of the duties of the Public Works and Spatial Planning Office of the City of Pekanbaru in the maintenance of drainage channels in Pekanbaru. *Journal of Government Students*, 1(3), 378–389. Riau Islamic University.