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Problems and Solutions of the Flood Control Program in Medan City and its Surroundings

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ABSTRACT Medan City is currently experiencing flooding and this indicates all existing flood control projects implemented over the years have been unsuccessful. Therefore, the main objective of this research is to determine the best solution to overcome floods in the city through a literature study supplemented by a perception survey. The steps implemented include discovering the causes of the flood, determining the failure of the past flood control projects, disclosing the perception of the people affected by floods toward the city government's commitment, and formulating the best solution to overcome the flood. It was discovered that there are two kinds of floods in Medan city which include the flash/river and the local/residence floods. The flash type was caused by the deforestation in the upstream area of the rivers flowing through the city while the local type is associated with high rainfall, lack of pervious area, and poor urban stormwater management. Moreover, the existing flood mitigation projects were observed to be unsuccessful because they applied the old paradigm with a normalization approach without compensating for the increase in the runoff discharge. This means there is a need to establish naturalization in the upper region of all rivers flowing through the city to reduce river flooding. The maintenance of the existing urban drainage system also needs to be combined with sustainable programs such as storing, absorbing, and reusing strategies to mitigate residence flooding. Furthermore, ten recommendations were proposed to stakeholders to overcome or significantly reduce flooding in Medan City and its surroundings. The first is the alignment of paradigms among stakeholders toward flood management while the last is completing related regulations and law enforcement.

KEYWORDS Flood control; Urban areas; Flood handling; Flood-free program; Medan city

1 INTRODUCTION

Several media very often broadcast the flooding events occurring in small and large cities during the rainy season. The situation is becoming worrisome with several environments observed to be getting flooded barely after only an hour of rain. This means the flooding problem has become a daily habit, both in large cities and small towns, especially in Indonesia. This is indicated by the frequent occurrence of large floods in Medan City as presented in Table 1 with different consequences experienced by the general public in the form of physical and psychological damages. The physical aspect includes the loss of property, health danger (hospital costs), and even human lives while the psychological ones are related to fear, loss of sense of security, and several others caused by the physical loss.

Several studies have been conducted on spatial modeling to determine the level of flood susceptibility in Medan City with the focus on some evaluation factors such as soil slope, soil type, land use, and rainfall as well as the application of four to five levels of vulnerability such as very low, low, medium, high, and very high. It was concluded that more than 50% of the areas in the city areas have high and very high flood vulnerability (Anggraini et al., 2021; Tampubolon, 2018). The field investigations conducted in 2019 showed that fourteen flood-prone points were recorded in Medan City as shown in Figure 1 and this exceeds 50% of the city area.

The findings of the online poll conducted by the Medan City government on the issues to be addressed are presented in Figure 2 and it was dis-

Table 1. River flood events that cross the area of Medan City (TKTPB, 2019)

No.	River name	Date of Occurrence	Notes
1	Belawan and Deli/Babura	14 January 2002	Some houses along the river were washed away and residents were evacuated, Polonia Airport did not operate for 12 hours
2	Belawan and Deli/Babura	6 January 2011	The roof of the house on the banks of the Babura River was submerged, and lectures at the USU campus were disrupted
3	Deli/Babura	28 October 3013	Thousands of homes were submerged, and lectures on the USU campus were disrupted
4	Deli/Babura	25 November 2015	Five sub-districts were flooded, hundreds of residents were displaced, and lectures on the USU campus were disrupted
5	Deli/Babura	16 September 2018 and 18-19 October 2018	River flooding accompanied by residential flooding, flooding everywhere, Medan Mayor apologizes, lectures at USU are disrupted.

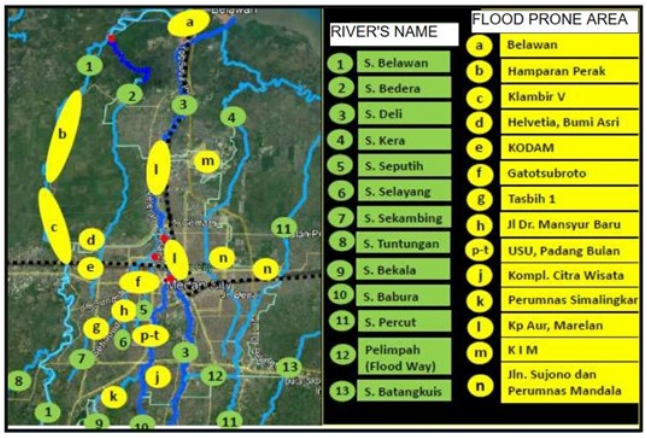

Figure 1. Flood-prone areas of Medan City (TKTPB, 2019)

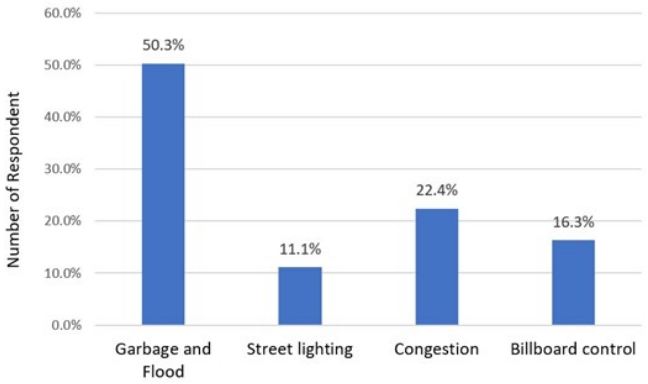

Figure 2. Polling results on four issues in Medan City (DKPM, 2000)

covered that the most important problems include garbage and flooding with 50.3% followed by traffic jams with 22.4%, control of billboards with 16.3%, and street lighting at 11.1%.

The government has implemented several flood-mitigation projects, especially in 1980, through the normalization of drainage systems, rivers, and creeks using the Medan Urban Development Project (MUDP) from 1980 to 2008. These were achieved through foreign loans such as Asian Development Bank (ADB), state budget (APBN), North Sumatra Province budget, and Medan municipal budget. It was, however, discovered that flooding persists and has become more frequent in recent times.

There are rare comprehensive studies on the cause, obstacle, and solution to floods in Medan City. Therefore, the objectives of this research are to answer the following questions based on limited literature studies: what is the cause of flooding in the city of Medan, why are the flood mitigation projects so far seem unsuccessful, and what actions should be taken to prevent flooding more effectively. The results are expected to be used as input especially for decision-makers to improve flood management performance.

2 METHOD

The methods generally used in achieving the objectives of this research are literature studies such as journals, dissertations, and consultant feasibility study reports. The main causes of flooding in Medan City were determined using several references such as the drainage master plan (PT MKJ, 2013), feasibility study reports on the retention pond construction plan compiled by four consultants (Konsultan Rekayasa Utama, 2017a,b; Nefta Consultan, 2017a,b; Pemeta International, 2017),

and the Medan flood-free blueprint book compiled by a task force appointed by the North Sumatra Provincial Government (TKTPB, 2019).

The question of "Why are flood mitigation projects considered unsuccessful so far" was answered through the review of flood prevention programs and their results (TKTPB, 2019; PT MKJ, 2013) using general indicators observed and experienced by flood-affected communities. Moreover, the flood mitigation activities were also compared using the sustainable urban drainage system developed and which is believed to be more effective for flood control in urban areas.

The public's perception of flood management in Medan was determined in an opinion survey conducted in 2019 using a total of 110 respondents spread across 10 *kelurahan* (part of sub-district) with frequent experience of flooding which include Kuala Bekala, Gedung Johor, Padang Bulan, Polonia, Beringin, Hamdan, Silalas, Tanjung Gusta, Amplas, and Sei Putih Barat. The respondents were allowed to select one of the 5 answers provided with 1 used to represent very unsure/believe/agree, 2 for not sure/believe/agree, 3 for quite sure/between trust and not/neutral, 4 for sure/believe/agree, and 5 for very sure/believe/agree. The survey was conducted as follows after which the results were later discussed in Section 3.3.2:

1. Preparation of a questionnaire with five main questions (Column 2 of Table 4) and five answer options according to the Likert scale.
2. Distribution of the questionnaire to approximately 15 residents selected randomly from each of the 10 parts of sub-districts.
3. Collection of 110 sets of completely answered questionnaires.
4. Processing of the questionnaire data and conduct of validity and reliability tests.
5. Analysis of the answers to the questionnaire.

A study was conducted to determine the most effective effort or program for flood control, especially using the Medan flood-free blueprint book (TKTPB, 2019) which is considered comprehensive and good due to its adherence to a new paradigm known as the sustainable urban drainage system, as well as additional references from within and outside the country.

3 RESULTS AND DISCUSSION

3.1 Causes of Flood in Medan City and Surrounding Areas

The Medan municipal government appointed a consultant in 2013 to create a Drainage Master Plan (DMP) for Medan City with the main objective of designing a city drainage system capable of overcoming both local and flash floods. The consultant assessed the existing condition of the drainage system to fulfill the contract and the results are presented in Table 2. It was discovered

Table 2. The problems of the urban drainage system of Medan City (PT MKJ, 2013)

No	Issues	Descriptions
1	Channel dimensions	Narrowing, caused by the sediment of mud and garbage
2	Borderlines	Many buildings violate the channel and river border lines
3	Greenery open space	Only about 5%, much smaller than the requirement of 30%.
4	Community perception	Considering the river and channel as the "back area" or disposal place for litter.
5	Municipal wastes	Domestic and industrial wastes have not been well managed
6	Building permit (BP)	Violation of BP is common
7	Urban drainage system	Occurring disintegration between the primary and the secondary drainage systems
8	Type of drainage channels	Opened, many incoming wastes
9	Land use change	Numerous watershed development and land use changes in the upper watershed
10	Community habitual	Lack of awareness to maintain the city infrastructure that has been built

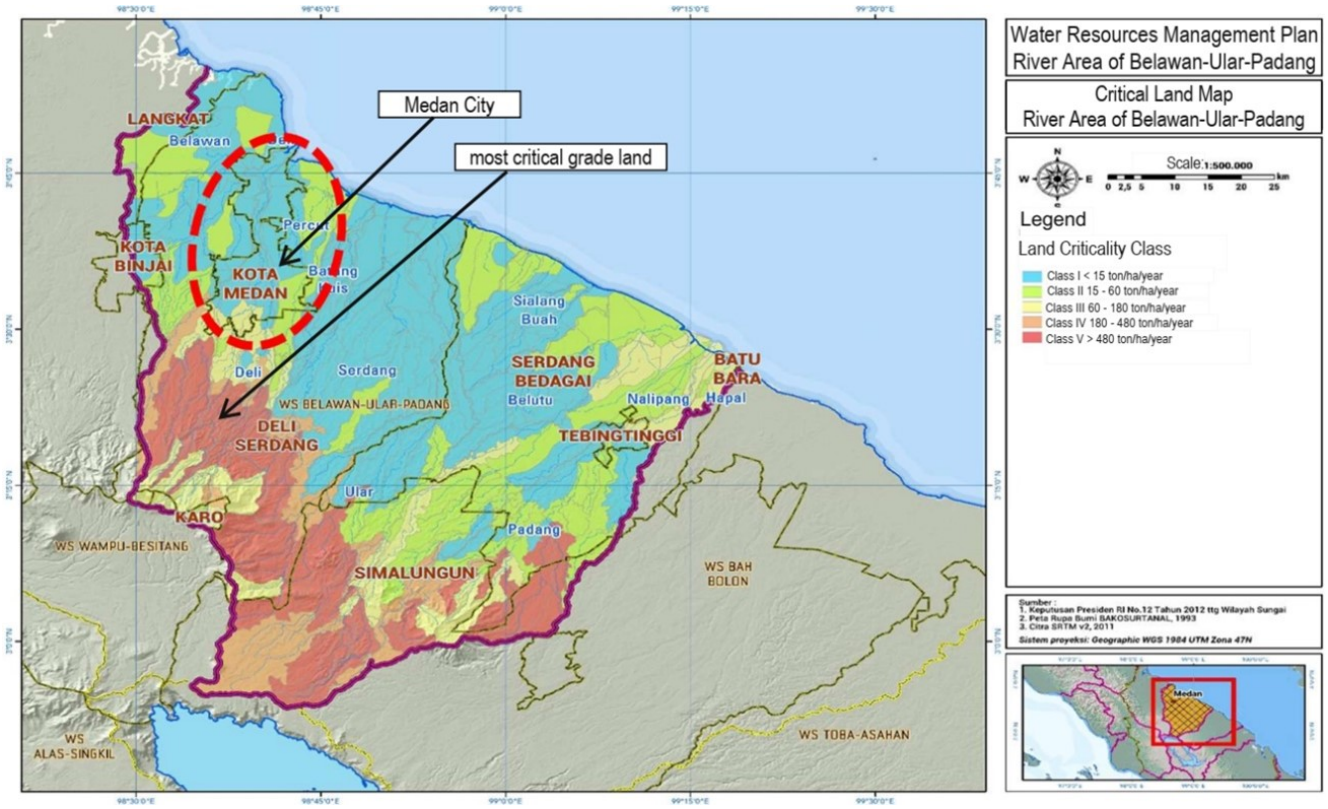

Figure 3. Map of critical land at the Belawan-Ular-Padang River Region (TKTPB, 2019)

that Issues numbers 1, 2, 4, 6, and 10 are due to the community attitudes, while the remaining 3, 5, 7, 8, and 9 are associated with the policies implemented by the city stakeholders.

Several studies (PT MKJ, 2013; Konsultan Rekayasa Utama, 2017a,b; Nefta Consultan, 2017a,b; Pemeta International, 2017; TKTPB, 2019) have reported that there are two kinds of floods in Medan City which are the flash/river and local/residence flood. The first is caused by the deforestation in the upstream area of the rivers flowing through the city of Medan as indicated in Figure 3 while the second is associated with the high rainfall, lack of pervious area, and poor stormwater management or traditional rainwater management.

The annual rainfall in the city and its surrounding areas ranges from 2000 to 3000 mm while the daily maximum is between 77.5 and 160.1 mm (BMKG-WIL I, 2019). The lack of pervious area is evidenced by points 2 and 3 in Table 2 while the poor stormwater management is indicated by points 1, 2, 6, 7, and 8.

Medan Flood-Free Blueprint Book (TKTPB, 2019) shows that the flood is caused by several factors which include river sedimentation, low capacity of secondary and tertiary channel systems, lack of culverts, misdirected drainage, garbage in the drainage channel, river overflow, reverse flow of the river, settlement on the river border, settlements on flood exposure, a weak collaboration between related agencies, and absence of integrated comprehensive planning document. These are observed to be similar to those previously identified and are further categorized into two types which include overflow of rivers and the lack of urban drainage. The river sedimentation, overflowing rivers, backflow of rivers, and settlements on river banks are classified as the first category while the others belong to the second category.

3.2 Why the Existing Flood Control Projects Failed?

3.2.1 Conventional Urban Drainage System (CUDS)

The Traditional Rainwater Management (TRM) is focused on draining only the peak discharge and is designed based on rapid disposal which involves moving to another place. The reactive efforts implemented by the municipalities during the time

Table 3. History of Medan Urban drainage Projects (TKTPB, 2019)

No	Project Name	Period	Project Description
1	MUDP-I	1980 - 1990	Normalization of drainage system: Channel lining, box drain, open channels, culverts, pipe Normalization of tributaries: Sei Kera, Sei Badera, Sei putih, Sei Sikambing
2	MUDP-II	1991 - 1996	
3	MMUDP	1997 - 2002	
4	MFCP	2003(?) – 2008	Normalization of rivers: Belawan, Deli, Percut. Floodway Deli-Percut
5	APBD	2009 - 2018	Drainage canal repair by Medan City Public Work Agency
6	APBD/ APBN	2019 - 2022	Flood Management Activities (short and medium term) according to Medan Flood-Free Blueprint Book
7	APBN/PUPR	2022 – (?)	Construction of flood control infrastructure
8	APBN/PUPR	Under construction until 2023	Reservoir: Simeme reservoir in Sibiru-biru Deli Serdang

MUDP: Medan Urban Development Project
MMUDP: Medan Metropolitan Urban Development Project
MFCP: Medan Flood Control Project
APBD: Municipal Budget
APBN: State Budget
PUPR: Public Work and Public Housing

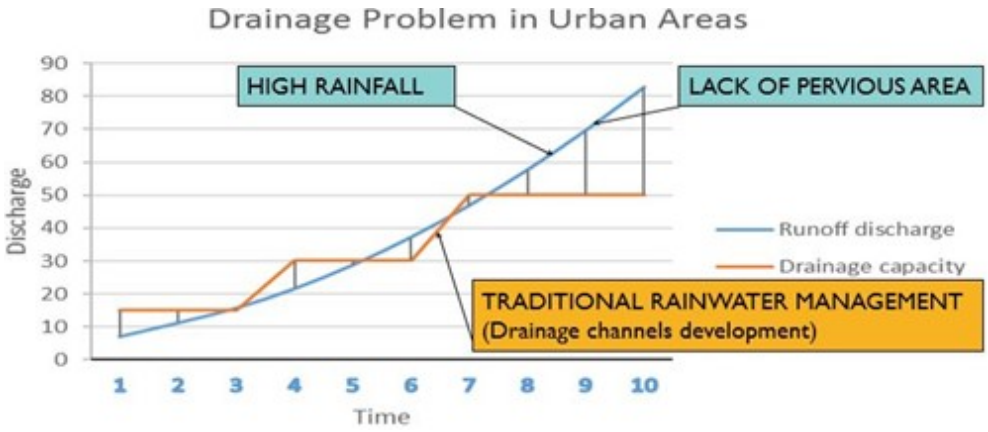

Figure 4. Runoff discharge overcomes the channel capacity (Saragih, 2020)

were limited to only increasing the capacity of the drainage channel. Meanwhile, the volume of runoff water produced in catchments is increasing rapidly in line with the growth of physical development in cities. This means the modifications made to the channel capacity are not sufficient to contain the additional volume of water as illustrated in Figure 4, thereby, leading to an increase in flooding events in terms of frequency, area, depth, and duration.

The basic principle underlying the CUDS is to dispose the rainfall runoff from the site as quickly and efficiently as possible using the road trenches, pipes, and channels to the rivers or water courses from developed areas. It is, therefore, necessary to develop drainage channels with normalization or change the shapes and size as well as line the channels with concrete to accommodate the increasing amount of runoff water (refer to the last column of Table 3).

All the Medan City flood mitigation projects constructed up to 2018 were designed based on the old paradigm of ”rapid disposal” which in the last column of Table 3 is referred to as normalization or canal repair. Normalization is an act of increasing the capacity of a channel or river. It is important to note that it is more difficult and expensive to normalize the drainage system in denser cities due to the continuous increase in buildings which causes more runoffs, thereby, creating a burden on the channel or river. Several human actions (see Table 2) have also been identified to be reducing

the capacity of canals and rivers not long after the channels are normalized and this is also causing flooding.

This research is limited by the unavailability of technical evaluation data related to the functions of different facilities built in flood control projects. Therefore, the extent to which each building achieves its function compared to the plan is not included in the discussion.

3.2.2 Existing drainage master plan recommendations

The drainage master plan (DMP) of Medan City was created in 2013 as indicated in Section 2 and the report recommends six development plans such as a network plan and flow system of drainage, division of drainage area in sub-systems, building diversion channel, establishing the border lines of channels and rivers, as well as the flood gouges, and cost and investment schedules. The report also proposes several actions which include the physical improvement of the existing drainage channels, construction of new canals, normalization of rivers and creeks, extraction of channel sediments, creation of bar screens, and the construction of culverts and building embankments. It is also specifically mentioned that an alternative solution is to build a retention pond but further explanation is not provided (PT MKJ, 2013). It was observed that all these recommendations are categorized under the CUDS except for the issue of retention ponds.

There is very limited information on the level at which these recommendations have been implemented (PT MKJ, 2013), except those related to the retention pond construction. Medan City government through the Public Works Agency (PWA) realize the importance of building retention ponds to prevent flooding and collaborated with three consultants in the 2017 budget year to conduct a feasibility study (FS) in five sub-districts including the Medan Polonia, Medan Tuntungan, Medan Sunggal, Medan Selayang, and Medan Johor (Konsultan Rekayasa Utama, 2017a; Nefta Consultan, 2017a; Pemeta International, 2017; Nefta Consultan, 2017b; Konsultan Rekayasa Utama, 2017b). This led to the proposition of nine locations for the retention ponds, as shown in Figure 5, but only five were selected by the city government. Meanwhile, private communication with Medan PWA Office (PWA Office, 2022) showed that the plan is still at the stage of proposing land acquisition.

The current flood control activities or projects in Medan City are based on the old paradigm through the normalization of drainage channels which has proven ineffective as indicated by the frequent flooding being reported in the mass media up to the present time.

3.3 Effective Efforts to Prevent Flood

3.3.1 Paradigm shift

Civil and environmental engineering experts have realized that conventional urban drainage is ineffective and inefficient due to the development of urban culture. This is observed from the impacts of the increment in flooding and erosion quantity as well as other losses associated with decreased runoff quality. This encouraged the development of different rainwater management and urban drainage practices in some countries such as America and Canada's Low Impact Development (LID), Australia's Water Sensitive Urban Design (WSUD), and United Kingdom's Sustainable Drainage System (SuDS) which are all generally categorized as modern rainwater management (MRM).

The application of the MRM in the urban area is perceived as a sustainable urban drainage system (SUDS) to reestablish the natural water cycle by storing the runoff water for a certain period (retention and detention basins), recharging groundwater (infiltration basin), and utilizing the stored water for different purposes (irrigation and household use). Moreover, the SUDS was implemented based on flow attenuation with the assumption of a zero increase in peak discharge to ensure the environment is free from flooding caused by rain (Armitage et al., 2013).

The paradigm shift presented in Figure 6 shows that the old paradigm identifies the city drainage using the term "normalization" while the new paradigm uses "naturalization" or "conservation". The experience in several countries or cities proves the failure of the "throwing away as soon as possible" concept in handling rain runoff with many city managers observed to have switched to "ab-

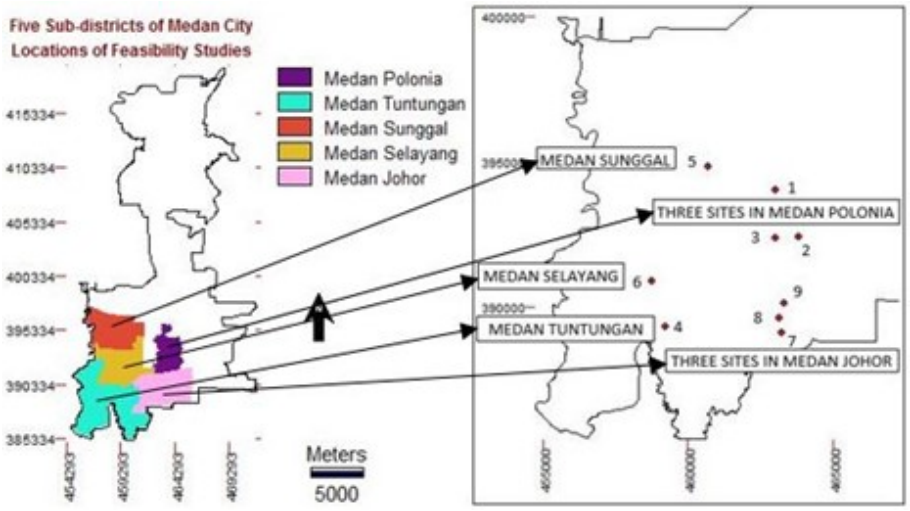

Figure 5. Detail of proposed retention pond locations (Konsultan Rekayasa Utama, 2017a; Konsultan Rekayasa Utama, 2017b; Nefta Consultan, 2017a; Nefta Consultan, 2017b; Pemeta International, 2017)

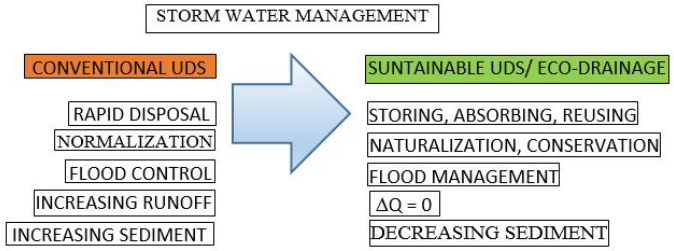

Figure 6. Illustration of paradigm change in storm water management

sorb, store, and discard after the rain stops". This change has also been declared in Indonesia through the Minister of Public Work Regulation (MPW-RI, 2014, 2015a,b).

The facilities used to support the SUDS system include 1 green roof, 2 rainwater harvesting facilities, 3 soak aways, 4 permeable pavements, 5 filter strips, 6 swales, 7 infiltration tranches, 8 bioretention areas, 9 sand filters, 10 detention ponds, 11 retention ponds, and 12 constructed wetlands which are all categorized as conservation measures.

It was unfortunately observed that the SUDS is generally inadequate or not implemented in developing countries (Le Jallé et al., 2013). For example, it has not been comprehensively applied in any Indonesian city but some large cities have started implementing some related facilities specifically to cope with flooding. This is indicated by the existence of retention ponds in Semarang, Bandung, and Palembang as well as the report in the mass media that several municipal or provincial governments are planning to build moderate ponds but this has not been realized mainly due to the cost factors. Therefore, these activities are required to be conducted gradually.

3.3.2 Public Perception of Medan City Flood Control

A poll was conducted to determine the perception of the people concerning the flood prevention programs in Medan City and the results are presented in Table 4.

The average answer score for question 1 is 3.1 and this means the people's confidence in the ability of the government and related apparatuses to deal with floods in Medan City is at a moderate level. This is not much different from the answer provided to question 2 which is focused on the level of public trust in the commitment of the government and related apparatuses in overcoming the problem of flooding. Moreover, question 3 shows that the community is ready to support the flood control program which is similar to the response provided to question 4 and the results of the poll earlier described in Figure 2. It was observed that the answer to question no.5 shows there is weak socialization of the flood prevention projects. This simply shows that the residents of Medan City fully support flood control programs such as building retention ponds and this is considered important for successful implementation.

Table 4. The survey results of community perception for the handling of floods in Medan City

No.	Questions	Average answer score	Perceptions
1	Are you sure that the government and related officials are able to overcome the problem of floods that are still common in the city of Medan?	3.1	“quite sure”
2	Do you believe that the government and related apparatus are committed to overcoming the flood problem in Medan City?	3.3	“quite believe”
3	Do you agree to play a role in supporting city government efforts to address/reduce flood levels in your neighborhood?	4.2	“agree”
4	Do you agree that the government should build a retention/detention pond (flood control) in your neighborhood?	4.3	“agree”
5	Have you ever been informed about plans to build a retention pond around your place or residence?	1.4	“almost never”

3.3.3 North Sumatra Provincial Government Flood Control Program

Medan City and its surroundings are part of the Medan - Binjai - Deli Serdang - Karo (abbreviated as Mebidangro) metropolitan or urban area which has been designated a National Strategic Area (NSA) in Presidential Regulation No.62 of 2011 (SRI-DEA, 2011). The city is also the capital of North Sumatra Province which is the center of global-scaled national activities and required to have a quality urban environment which is free from flooding. This led the Governor of North Sumatra province to launch a program to deal with floods in Medan City and its surroundings as contained in the 2019 blueprint published (TKTPB, 2019).

Flood prevention management is divided into two categories which include the physical and non-physical countermeasures as presented in Table 5. All items in Column 1 are associated with physical handling which are categorized as the old paradigm of ”rapid disposal” or normalization due to their focus on increasing the capacity of the urban drainage system. Meanwhile, those in Column 2 indicate non-physical handling and are considered important to support the success of flood prevention programs.

A flood control program has also been prepared according to the new paradigm which focuses on conservation as indicated in Table 6. It was observed that one of the eight policy directions is watershed conservation management from upstream, middle, and downstream as stated in the first column.

The flood management activities are designed to be implemented in three stages including the short term (2019-2020), medium (2019-2022), and long term (2023-2033). A total of 16 programs are included in the short-term such as the conservation of the river border and residential areas in urban areas (TKTPB, 2019) as presented in the second row of Table 7 and which is in line with the watershed conservation policy in Table 6. All the technical activities listed in Table 7 are categorized as a sustainable urban drainage system or Eco-drainage as indicated in Figure 6 and this is highly recommended because it is believed to be relatively more capable of preventing flooding compared to conventional methods. Meanwhile, those designed to be achieved in the medium and long term clearly fall into the category of the new paradigm as observed in the watershed conservation theme presented in the third and fourth rows of Table 7. This conservation does not only guarantee the success of flood management but also ensures the protection of the environment.

The proper implementation of these programs according to the plan would have the signaled 2022 as the last year for the medium-term plan. It was, however, discovered from mass media that no program was implemented till the end of 2020 (Sumutcyber, 2020) and none of the 12 working groups established worked according to the plan. There was no further information on the constraints to the non-implementation of these pro-

Table 5. Medan City Flood Management (TKTPB, 2019)

Physical Handling	Non-Physical handling
1. Land acquisition 2. Normalization of the river 3. Building and elevation of embankments 4. Construction of flood gates 5. Handling of the urban main drainage 6. Build flood embankments 7. Redesign hydraulic cross-section of box culvert 8. Normalization of secondary drainage systems 9. Normalization of tertiary drainage systems 10. Construction of culverts	1. Socialization with the community to be relocated 2. Control of buildings on the riverbank 3. Rearrangement of the urban drainage system 4. Relocation of residents on the banks/borders of the river 5. Arrangement of Governor Regulation related to the cooperation during flood control in Medan City and its surroundings 6. Review of the previous Master Plan for flood prevention, the conduct of FS for flood control plans, and production of DED

Table 6. Watershed conservation management of flood control (TKTPB, 2019)

Policy direction	Strategy	Program	Activities
Watershed conservation management from the upstream, middle, and downstream	Land conservation in all districts in the Belawan- Ular-Padang river area	Land and water conservation program	1. Construction of retention ponds, ponds, reservoirs, absorption wells, wells in rivers, reservoirs 2. Making pore holes, pore drums, interception parks, infiltration wells, rooftop garden, permeable treads 3. Conservation of agricultural land and plantations in Deli Serdang district (construction of mini ponds, etc.) 4. Conservation of forest land and vacant land, critical land with reforestation in watersheds Deli, Belawan, and Percut 5. DED preparation and construction of city parks on the Deli-river border.

Table 7. Short, Medium, and Long-term Activities for Watershed Conservation in urban areas

Terms	Technical Activities	Non-Technical Activities
Short	Establishment of pore holes, pore drums, infiltration wells, deep wells in rivers, retention ponds, storage tanks, reservoirs, permeable sites, garden of perception, green roofs, situ-site development, and so on.	Raising the public awareness
Medium	1. Construction of polders in KIM, Mabar village, and Labuhan Deli; 2. Soil and water conservations in the upper watershed: Mitigation of flooding in forest land and cultivated land through community empowerment	1. Preparation of the North Sumatra Provisional Integrated Flood Management Masterplan; 2. Compilation of Regional Regulations related to flood management in Medan and surrounding areas
Long	Dam construction, conservation efforts, restoration of water recharge sites, and water retention	Law enforcement

grams. Meanwhile, it was reported that the 2022 Flood Free Medan program could not be realized due to funding constraints (Viva.id, 2022).

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

There are two types of Medan City floods, river flooding and environmental flooding. The cause of river flooding is forest destruction in the upper reaches of the river, while the causes of environmental flooding are high rainfall, reduced infiltration land, and poor performance of the city drainage system. The performance of the city's drainage system is exacerbated by community actions that violate the drainage system boundary lines and dispose of litter into the city drainage system.

Efforts to deal with flooding through increasing the capacity of the Medan City drainage system, which so far have been pursued only through the normalization approach, have not been able to compensate for the increase in runoff discharge, which has led to greater flooding. The capacity of a drainage channel is permanent and even decreases due to garbage and sediment, while the flow discharge that must be channeled (rainfall runoff) is always increasing by changes in land use.

Actions that need to be taken to make the city's flood control program more effective can be summed up in two words, namely normalization and naturalization, which are detailed in the recommendations below.

4.2 Recommendations

Based on the descriptions and discussions above, as input to support flood management programs of Medan City and surrounding, several recommendations are presented as follows:

1. Stakeholders (Governors, Regents and Mayors and all their ranks) should have the same paradigm regarding flood management;

2. The proposed flood management paradigm is SUDS with two main steps, first maintaining the optimum capacity of the city drainage system and second building various types of soil and water conservation facilities, as listed in Table 6;

3. Flood management activities as listed in Tables 7 should be realized as well as possible, in order to achieve optimal system performance;

4. The flood prevention program as contained in (TKTPB, 2019) should be integrated with the retention pond development plan in the five districts which are now in the process of land acquisition;

5. Make and enforce regulations related to the principle of "zero ΔQ": Guidelines for the construction of facilities (houses, offices, etc.) so as not to dump rainwater runoff into the city drainage system, but instead absorb it into the ground;

6. Assist the community in establishing facilities related to SUDS in their respective parcels

7. Prevent the community from throwing garbage into the urban drainage system by means of good urban waste management;

8. Educate the community to independently and together create and protect the quality environment, including flood-free;

9. Promote reforestation in urban areas and upstream rivers that pass through the cities;

10. Completing regulations and carrying out all law enforcement efforts against all relevant statutory provisions.

DISCLAIMER

The authors declare no conflict of interest.

AVAILABILITY OF DATA AND MATERIALS

All data are available from the author.

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