

An Assessment of the Sustainability of flash flood risk management
strategies implemented in Kigali, Rwanda.

by

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1. Summary

Flash floods are inevitable, unpredictable and among the most harmful natural disaster. As precipitation patterns change due to climate change, population growth and urbanisation increase, many people are exposed to flash floods. The capital of Rwanda, Kigali, experiences flash floods frequently, therefore, different damages like death, houses and businesses destroyed. Flash floods are a hot topic in Kigali that endangers the population's security and the city's economy. This issue **needs attention** and **sustainable strategies**. Thus, based on a table of criteria of existing flood risk management strategies collected after a literature review, a content analysis of the Kigali Master Plan 2050 was done to evaluate the sustainability of the flash floods risk management strategies implemented in Kigali and then to gain knowledge on which ones are addressed and which one is absent. The results indicated that the Resilience strategies and the Resistance strategies were mentioned while the Response strategies were absent.

In conclusion, two of three strategies were mentioned, so the flash floods risk management strategies implemented in Kigali scored “fair” sustainability. Kigali should consider the Response strategy. Further research could consider the other relevant measures mentioned in the Kigali Master Plan that were not in the criteria table, build on these findings and add the financial pillar to search how, financially speaking, it is feasible for Kigali not only to mention but also implement the measures from the criteria table.

Keywords: Flash flood, Kigali, Flood risk management strategies, Kigali Master Plan

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2. Introduction

2.1. Background

Within this section of the paper, the context of the case study and the motivation for conducting this research will be presented.

Kigali is Rwanda's capital city, a landlocked country in East Africa, also known as “the land of a thousand hills” because of its hilly topography. Kigali occupies 730 km² and is inhabited by 1.7 million people (Kigali City, 2022). Kigali is experiencing urban population growth, urbanisation and climate changes’ impact, like extreme precipitation (MINEMA, 2018 & REMA, 2021). All these changes raise the frequency of natural disasters, such as flash floods, which are considered one of the most devastating (Li et al., 2022).

An increase in floods is a consequence of climate change which is a common experience shared by numerous urbanised cities from different countries, for example, China, the United States, The Netherlands, India, Saudi Arabia, Egypt, and Italy (Hettiarachchi et al., 2018 Ding et al., 2021 & (Bastia et al., 2021). Each country deals with floods differently and according to its financial means. For example, China uses the concept of Sponge City or Room for the River, which concerns absorbing water thanks to greenery or removing obstacles in flooding areas. In contrast, The Netherlands uses more hard engineering to prevent floods (Yin et al., 2021 & Chan et al., 2022).

Previous research on flash flood strategies often focused on the Western World or South Asia (Ding et al., 2021; Hegger et al., 2020). There is a research gap in studying how Sub-Saharan cities address flash floods. This thesis will contribute to the existing knowledge by adding Kigali as a new case study from Sub-Saharan Africa to know “To what extent are sustainable flood risk management strategies implemented to address Flash floods?”. For this, this paper used the Kigali Master Plan (KMP) 2050, which is a long-term plan that provides a framework for urban development over 20 years from 2013-2033, with an update that is done every five years. The KMP addresses land use, infrastructure, transportation, housing, environment, and social services to promote mixed-use development, compact and walkable city, and public transportation to reduce traffic congestion and environmental pollution. Ultimately, the Kigali Master Plan wants to improve residents' quality of life, attract investments, and stimulate economic growth in the city (“Kigali Master PSMEC, 2022).

The Master Plan, written in 2013, was the first master plan written after the Genocide perpetrated against the Tutsi in 1994. Before that, there had been an attempt to set up two master plans, the first time of which was in 1964, two years after the independence of Rwanda. This master plan failed because of the political and social instability, the rapid population growth for a new autonomous government, the ethical and financial discrimination and the corruption that existed back then. Consequently, no regulations led to building in organic ways and in the valleys, areas at risk of flooding.

After the Genocide, Many people who had fled returned en masse, especially to Kigali, where they hoped to have more security. However, the institutions were not standing or destroyed, which accentuated organic construction in risky areas. Rwanda needed time to reestablish a long-term vision, objectives, and reason why the first master plan dates from 2013, which makes Rwanda a “new country” in terms of planning.

Kigali faces flash floods frequently in the same way as other cities in the world as well as in neighbouring countries, such as the flash flood disaster that happened in January 2018 in Morogoro, Tanzania or Baringo County, in Kenya (Kimambo et al., 2019 & Ednah Koskei, 2020). Nevertheless, it is a unique and interesting case study because of its history, a challenging hilly topography and its high goals like becoming the “*Centre of Urban Excellence*” and positioning itself as a regional leader in city management (Master Plan 2050, 2020 p4).

2.2. Research Problem

Within this part of the thesis, the description of the problem, the relevance, the aim and the contribution of this paper will be stressed.

Flash floods are among the most dangerous natural disasters that happen quickly after heavy rain influenced by climate change (Ding et al., 2021). They have become an annual event in Kigali after intense precipitation, leaving harmful consequences (Ntakiyimana et al., 2022). Flash floods damage transport infrastructure, take people's lives and destroy houses and businesses (Icyimpaye, 2020). Consequently, the security of the population and the economy of Kigali are endangered.

Flash floods frequently occur in Rwanda. The last time such an event happened and left scars was between the night of the second and third of May 2023 (see appendix). 130 to 131 people died within a few hours, 5 598 houses were destroyed, water treatment plants, power stations and 14 national roads were damaged (Ufitiwabo, 2023). Flash floods are **dangerous disasters** and **hot topics** not only in Kigali but in the whole country. Furthermore, this issue **needs attention** and **sustainable strategies** to tackle flash floods' consequences.

Based on a criteria table, this paper aims to evaluate the sustainability of the flash flood risk management strategies implemented in Kigali and then to understand which ones are addressed and which are not. The main question leading this research is, “**To what extent are sustainable flood risk management strategies implemented in Kigali to address Flash floods?**”. To answer this research question, two sub-questions were asked: “*What are the sustainable flood risk management strategies?*” and “*To what degree does The master plan of Kigali 2050 refer to sustainable flash flood risk management strategies?*”.

2.3. Structure of The Thesis

The next section are structured in the following way: a theoretical framework will be presented, highlighting the maing concept of the paper. Then the methodology used to conduct this research will be explained followed by the results and finally the conclusion of this thesis.

3. Theoretical framework

This section will present and explain the key terms from the research problem and research question based on relevant academic articles to the aim of this thesis.

Ding et al. (2021) define *flash floods* as quick response to a heavy rainstorm that happens in a short duration. Flash floods start when the ground is saturated with water. Knocke et al. (2007) say it can occur within six hours. Ding et al. (2021) stated that climate change increases the likelihood of flash floods. Lu et al. (2021) further explain the relationship between climate change and flash floods. They said climate change modifies the traditional rainfall pattern, resulting in inconsistency and precipitation uncertainty. Both Ding et al. (2021) and Knocke et al. (2007) cited that flash flood is one of the most dangerous natural disasters because of the uncertainty of precipitation patterns which challenges the forecasting of flash floods according to Lu et al. (2021).

Besides high rainfall, other factors like urbanisation can influence flash floods (Ding et al., 2021). Urbanisation walks hand in hand with building more urban infrastructure, such as roads. In line with the influence of urbanisation on flash floods. Ntakiyimana (2022) mentioned that stormwater drainage systems do not increase while impermeable infrastructures do and, consequently, accelerate soil saturation.

As previously said, flash floods cause massive damage (Lu, 2021). People's lives, properties, utilities and infrastructures can be destroyed quickly (Knocke et al., 2007; Zaigham et al., 2021). So, this issue needs attention and sustainable strategies.

Klopp and Petretta (2017) discuss the concept of *sustainability* based on the United Nations development agenda and, more specifically, the Urban Sustainable Development Goal (USDG). The purpose of the USDG is "to make cities and human settlements inclusive, safe, resilient and sustainable" (Klopp & Petretta 2017, p.92). These authors claim that USDG can help to improve cities. Nevertheless, defining and practising indicators might be challenging because of the need for standardised indicators, substantial data collection and the un-universality of the goal. To face that challenge, Reichstein et al. (2021, p. 348) suggest a solution stating that "good indicators account for variability and vulnerability". According to him, USDG should be edited and be able to track the progress as climate change. It would help to detect vulnerabilities. The angle of sustainability used by Klopp and Petretta based on the USDG goal fits best to the aim of this research, given the attention it puts on the inclusivity of people, safety and resilience. As flash floods directly impact people and their safety, including them will play an essential role in implementing and evaluating sustainable strategies. According to Zaigham et al. (2021), flash floods are inevitable. Therefore, it is necessary to plan strategies to mitigate or bounce back quickly from this imminent disaster and be resilient in the long term.

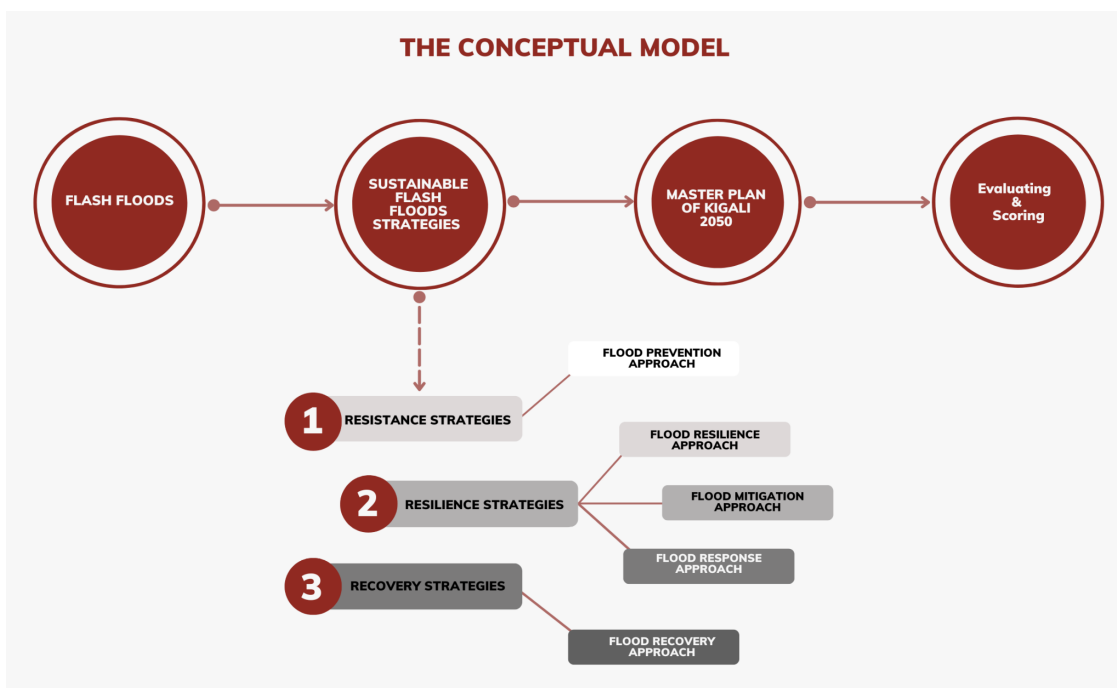
Regarding long-term planning, countries and cities use a strategic tool known as a master plan. The World Bank (WBG, 2015) defines a master plan as a “dynamic document” instructing future development and growth. It counts analysis, suggestions, and strategies for different themes like housing, community facilities, and transportation ... based on different inputs such as surveys, the public and planning initiatives. This definition suits this research, considering this paper used the Master Plan of Kigali 2050. This document is rectified every five years to use updated data to give accurate direction to the growth of Kigali (Preface 2020, p9). The Master Plan of Kigali 2050 considers variability, and as mentioned in the previous paragraph, that parameter improves sustainability indicators. Furthermore, using this document to assess the sustainability of flash flood strategies is pertinent.

The Master Plan of Kigali 2050 counts on eight themes to achieve the initial goal of the 2013 Kigali Master Plan, which is being a “Centre of Urban Excellence” in the region. Of the eight themes, the green city is the most relevant topic to this thesis on flash floods.

Flash floods, sustainability, and the master plan of Kigali 2050 defined above are at the core of this study. The concept of sustainability was used to score the sustainability of flash flood management strategies mainly based on inclusivity, safety, resilience, variability and the long term.

3.1. *The conceptual model*

Flash floods are among the most harmful natural disaster. However, they can be prevented, mitigated and recovered via different sustainable flash flood strategies. The purpose of this paper was to analyse how the Master Plan of Kigali implement those strategies and then evaluate and score how sustainable those strategies are.



3.2. *The expectations*

According to the theoretical framework, it is hard to predict flash floods which are frequent harmful hazards. Furthermore, planning sustainable strategies to mitigate and bounce back fast is essential.

The Master Plan of Kigali 2050 is an updated version of the 2013 Master Plan. These plans are relatively recent. Therefore, the expectations would be that specific strategies may lack because The Master Plan of Kigali is a new plan which would cause the sustainability score to be poor to fair.

4. Methodology

4.1. Research method.

The data type used and the research method will be stated in this part.

Based on secondary qualitative data, this bachelor's thesis aims to evaluate the sustainability of flood risk management strategies implemented in Kigali to address Flash floods. The question at the core of this paper is, **“To what extent are sustainable flood risk management strategies implemented in Kigali to address Flash floods?”** To answer this research question, two sub-questions were asked. The first sub-question is **“What are the sustainable flood risk management strategies?”** and the second sub-question is **“To what degree does The master plan of Kigali 2050 refer to sustainable flash flood risk management strategies?”**

Given the short time to research and write this thesis, the secondary qualitative data method was faster, more flexible and more efficient to conduct and access the data. Furthermore, descriptive input makes it possible to observe and evaluate without manipulating the variables or influencing the results.

4.2. Data collection and analysis.

The data collection and data analysis will be explained in this section.

To acknowledge **“What are the sustainable flood risk management strategies?”** an analysis and collection of existing data were done through a literature review of four academic articles titled “Resilience Indicators for flood risk management systems of lowland rivers” written by K.M. de Bruijn (2004), “Assessing Stability and Dynamics in Flood Risk Governance” by Hegger (2014), “Analysing and Evaluating Flood Risk Governance in England” by Meghan Alexander and “shaping flood risk governance through Science-policy Interfaces: Insights from England, France and The Netherlands” written by Dries Hegger et al. (2020).

The literature review helped to have a basis of existing criteria to work with further in this research. From the four academic articles, repetitive patterns were used to develop a criteria table. The criteria table was an essential tool for this paper to evaluate and then score the sustainability of the flash flood risk management strategies implemented in Kigali.

As shown in the criteria table below, it is divided into three columns. The strategies which differ in their aims, including preventing floods in advance, minimising their consequences

and recovering after a flood has struck. The approaches are the paths via which specific measures are used to achieve the strategy's goal (Hegger et al., 2014 & Van Slobbe et al., 2013).

- The Resilience strategy prevents the harmful impact of the flood **before** it happens via measures that prevent people's exposure to flooding, land use policies that influence location, proactive spatial planning that warns against flood and informative meetings that promote awareness to the population about floods would enhance the community's resilience. (De Bruijn, K. 2004 & Alexander et al.,2016 & Hegger et al. 2014 & Hegger et al., 2020).
 - Flood prevention approach
 - Reduction of buildings in risky areas
 - Land use policies
 - Zoning
 - Long term plan
 - Integration of different sectors (economy, social, environment.)
 - Proactive spatial planning
 - Mapping flood risk areas
 - Early warning systems
 - Collaboration with people (for example Informative meetings)
- The Resistance strategy minimises the negative effect of floods **while** they are taking place. This is aimed via flood defence and mitigation approach with measures that withstand and accommodate water via infrastructure, smart design and regulation of flood-prone areas (Hegger et al., 2014 & Alexander et al.,2016).
 - Flood defence approach
 - Infiltration systems for rainwater
 - Retention areas/ Storage areas
 - Use of Greenery
 - Flood mitigation approach
 - Smart design of the flood-prone area
 - flood-proof spatial planning
 - Permeable pavements
 - Regulation for flood-proof buildings
- The Response strategy approach flooding by facilitating the response and fast recovery from the consequences in the **aftermath** of flooding. This is accomplished

via measures of an emergency plan, restoring buildings and indemnifying (Alexander et al.,2016).

- Flood response approach
 - Emergency plan
 - Evacuation plan

- Flood recovery approach
 - Rebuilding plans/Updating plans
 - Compensation
 - Flood Insurance

The criteria table

Strategies	Approaches	Measures
Resilience strategies	Flood prevention approach	Reduction of buildings in risky areas
		Land use policies <ul style="list-style-type: none"> ● Zoning ● Long term plan ● Integration of different sectors (economy, social, environment.)
		Proactive spatial planning <ul style="list-style-type: none"> ● Mapping flood risk areas ● Early warning systems
		Collaboration with people (for example Informative meetings)
Resistance strategies	Flood defence approach	Infrastructure <ul style="list-style-type: none"> ● Infiltration systems for rainwater ● Retention areas/ Storage areas <ul style="list-style-type: none"> ○ Use of Greenery
	Flood mitigation approach	Smart design of the flood-prone area <ul style="list-style-type: none"> ● flood-proof spatial planning ● Permeable pavements
		Regulation for flood-proof buildings

Response strategies	Flood response approach	Emergency plan <ul style="list-style-type: none">● Evacuation plan
	Flood recovery approach	Rebuilding plans/Updating plans
		Compensation <ul style="list-style-type: none">● Flood Insurance

To answer the second sub-question, **“To what degree does The master plan of Kigali 2050 refer to sustainable flash flood risk management strategies?”** A content analysis of the Kigali Master Plan 2050 was done to inspect if the measures from the criteria table on the previous page are absent, mentioned or detailed. The Kigali Master Plan 2050 is an updated version of the 2013 Kigali Master Plan based on a new methodological approach: the participatory process and additional studies (2020, p9). The purpose of the updated version is to keep the previous plan but also to *“improve, adjust Kigali's urban development strategies and involve local planners”* (2020, p9).

Thanks to the table of criteria created after the literature review, keywords and sentences related to the column of “measures”, which has the most precise variables, were highlighted and copy pasted below each approach(see appendix) . Then each keyword or sentence was highlighted in red, orange or green. The orange indicated that the measure was absent in the Master plan, so sustainability was scored poorly. The orange pointed out that the measure was mentioned, and then the sustainability of the measure was considered as being fair. Color of green meant that the measure is more than mentioned and is more sustainable. The degree to which each measure was referred in the Master Plan 2050 of Kigali allowed for scoring the sustainability of each approach, and so ascend and concluding to what extent each strategy implemented in Kigali is sustainable.

5. Results (1000)

The following sections will present and explain the results from the content analysis and annotation of the Master Plan of Kigali 2050, which was intended to inspect if the measures of each approach from the criteria table were absent, mentioned or detailed to answer the second sub-question, ” **To what degree does The master plan of Kigali 2050 refer to sustainable flash flood risk management strategies?**”.

5.1. Flood prevention approach

The flood prevention approach prevents harmful consequences of floods in advance by the following four measures: the reduction of buildings in risky areas, land use policies, proactive spatial planning, and collaboration with people.

The first measure, the reduction of buildings in risky areas, appeared in eight ways (see appendix) in the Master Plan of Kigali 2050. Four of the eight sentences were highlighted in orange, a colour code representing that the measure is "mentioned" and scored “fair” concerning sustainability. For instance, on page 116 of the Master plan, it is stated, “Relocation and Resettlement of Households Inhabiting Restricted (>30% slope) and Hazardous Slopes sites at risk of landslides and flooding”. This measure does not detail where the people would be relocated or when the implementation would start. the time it would take and the budget.

The four other measures were highlighted in green, representing that the measure is "detailed" and scored “good” regarding sustainability. As an illustration, on page 102 of the Master Plan of Kigali, it is said, “ allowing for regulated sustainable use in less fragile areas for recreational activities, agriculture, and local material extraction in agreement with authorities”. It precisely says what can replace the building in the risky area, such as recreation or agriculture.

The definition of sustainability used in this paper considers inclusivity of people, safety and being resilient in the long term. Based on that definition the reduction of buildings in risky areas score half “fair” and “good” because it is at least mentioned however, people are not included and there is lack of long term and timeframe in general.

The second measure is land use policies and was divided into three categories: zoning, long-term and Integration of different sectors (economy, social, environment.). The three categories were highlighted in orange, meaning they were “mentioned” and so scored “fair” regarding sustainability. For example, on pages 18 and 101, “Developing a Water Master Plan for the City of Kigali” and a “City-Wide Watershed and Stormwater Management Plan” are cited without specifying the time frame.

The land use policies measure scores “fair” for sustainability because the idea of being resilient in a long run misses.

Thirdly the “Proactive spatial planning measure” was divided into two parts the mapping flood risk areas and the Early warning systems. Both part were highlighted in orange therefore “mentioned” and score “fairly” sustainable. for example, for mapping the flood risk areas, it is mentioned that “Inventory of illegal activities in all urban wetlands (mapping, identification, photos). Monitoring system to be designed” there is not an exact time frame which reduces the sustainability scores because we cannot, therefore, speak of resilience in the long run.

The “collaboration with people” which is the last measure of the flood prevention approach were mentioned twice and therefore highlighted in orange. This measure appeared on page 101 and 115 of the Master Plan of Kigali 2050 in the following form “Umuganda (community service) street clean ups, reforestation and erosion control, and protection of river banks. ” and “Awareness Campaign and Capacity Building Trainings on Slope Hazards and Slope Management Best Practice;”. These two citation that refer to the idea of gathering people to collaborate and so to include them does not directly concern flash floods but some of it consequences like erosion and landslide reason why this measure score half “fair”. On the other hand the measure score half “good” because there are all the components of the definition used for the concept of sustainability. The population is included to let them know how they can improve their safety and this would happen the last of the month, when Umuganda (community service) occurs (Uwimbabazi and Lawrence, n.d.)2013).

In brief, the flood prevention approach scored fairly regarding sustainability mainly because of the lack of details on the timeframe.

5.2. Flood defence approach

The flood defence approach's purpose is to withstand rainwater with the help of infrastructure.

The infrastructure measure was split into two categories: the infiltration systems for rainwater and the retention areas/storage areas. The two categories were mentioned in the Master Plan of Kigali and scored “fair” in sustainability. Some examples of the infiltration systems for rainwater measure were on page 105 in the Master Plan, like “designing resilient infrastructure”, “stormwater drainage system integrated swales, and constructed wetlands” Those examples were not more explicit or illustrated with map or images to show the vision. The use of greenery as a retention area was represented as a way of mitigating and not as a defence, “emphasising the green growth approach for climate change mitigation “, and “Green growth mitigating environmental pressures”. Furthermore, there is no specification on where exactly to add greenery.

The flood defence approach scored “fair” in sustainability because it was mentioned but not in more detailed ways with, for example, illustrations to visually show the idea presented.

5.3. Flood mitigation approach

The mitigation approach minimizes the impact of the floods while they are taking place.

The reduction of floods consequences could be done thanks to two measures, the smart design of the flood prone area and having regulation for flood proof buildings. Both measures were mentioned and scored “fair” sustainable. “Increase in impervious surfaces “ is an example of how smart design measure appeared in the master plan. There is no detail on where, how, or with what type of material that measure could be implemented.

The mitigation approach was marked “fair” in sustainability because it is mentioned but without clear details.

5.4. Flood response approach

The response approach act in response to the damage of the floods.

The response approach correspond to the measure of the emergency plan. This measure was absent in the Master Plan of Kigali, therefore, scored “poor” in sustainability. On page 105 the following idea : “Preparation of disaster response plans” was cited but without more details on how the response procedure would go and if it would be about rescuing people or restoring buildings .

The flood response approach scored “poor” in sustainability because of its absence.

5.5. Flood recovery approach

The recovery approach accelerate the recovery from the consequences of flooding.

The purpose of this approach is to restore the buildings and indemnifying the victims via the following measures: rebuilding/updating plans and compensation through flood insurance. Both measures were absent and scored “poor”in sustainability.

6. Conclusion

This thesis aimed to evaluate the sustainability of the flash flood risk management strategies implemented in Kigali and then to understand which ones are addressed and which are not. Based on a qualitative analysis of the Kigali Master Plan 2050, it can be concluded that the flash flood risk management strategies implemented in Kigali scored “fair” sustainability, according to the used this paper, which says that sustainability “makes cities and human settlements inclusive, safe, resilient on the long run and sustainable”. The results indicate that apart Response strategies was absent and scored “poor” sustainability, while the Resilience strategies and the Resistance strategies were mentioned and scored “fair” because of the lack of details on the implementation nor the timeframe. This lack of details could be explain by the fact that the KMP was written ten years ago and since then, only one update was done.

This findings partially meet the expexctaion, which was that the sustainability was going to score poor to fair based on the assumption that the Master Plan of Kigali was a new plan and that would be the reason .

Kigali should consider more details on how they are implemented (e.g. : in different phases), where (precise geographic location) and adding Response strategies in the KMP would increase the score of sustainability of the flood risk management strategies.

This research enrich the existing theory by adding a case that was not studied before on the topic of flash flood and it illustrates that the Kigali Master Plan mentioned most of the flash floods strategies, which means that the capital of Rwanda is aware that it seems impossible to avoids flash flood but it is possible to mitigate them by taking them into consideration in the planing phase (Zaigham et al., 2021). Including floods strategies in the planing stage is a helpful idea that other cities which face the same natural disaster could implement as well.

As Klopp and Petretta (2017) said, sustainability indicators have no standard, which compromises the results and transparency of this paper because the results could change according to the indicators set for by each researcher.

Further researches could consider the other relevant measure that are in the KMP that were not in the criteria table used in this paper, build on these findings and add the financial pillar to search how financially speaking, it is feasible for Kigali to implement the measures from the criteria table.

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8. Appendices

letter from the president and underline words from the indicators



Republic of Rwanda
OFFICE OF THE PRESIDENT
Communications Office

UBUTUMWA BW'UMUKURU W'IGIHUGU KU BIBASIWE N'IBIZA

Kigali, ku wa 3 Gicurasi 2023 – Nyakubahwa Perezida wa Repubulika yihanganishije imiryango yabuze ababo n'abakomerekeye mu biza byatewe n'imvura nyinshi yaguye mu bice bitandukanye by'Intara y'Iburengerazuba, Amajyaruguru, n'Amajyepfo mu ijoro ryo ku wa 2 rishyira ku wa 3 Gicurasi 2023, bigateza inkangu n'imyuzure byahitanye abantu benshi, abamaze kumenyekana bakaba bagera kuri 127.

Ibikorwa by'ubutabazi birakomeje mu turere twibasiwe cyane ari two Rubavu, Ngororero, Nyabihu, Rutsiro, Karongi, Gakenke, Burera, Musanze na Nyamagabe; hibandwa ku bagizweho ingaruka n'ibyo biza ndetse no kwimura abaturage bari mu bice byibasiwe n'ibishobora kwibasiwa n'imyuzure n'inkangu mu gihe imvura ikomeje kugwa.

Urwego rwihariye rushinzwe ibikorwa by'ubutabazi ruri gukurikiranira hafi ibikorwa byose bijyanye no gufasha no gutabara abaturage. Inzego bireba zirakomeza gukorana n'uturere mu gukora ibyo bikorwa by'ubutabazi byose bikenewe.

Turashimira abaturage bari mu duce twibasiwe ku bufatanye bagaragaje, kandi turakora ibishoboka byose kugira ngo tubabungabungire ubuzima.

MESSAGE FROM H.E. THE PRESIDENT TO POPULATION AFFECTED BY **FLOODING AND LANDSLIDES**

Kigali, 3 May 2023 – H.E. the President of the Republic of Rwanda expresses his solidarity with those affected and wounded, as well as his deepest condolences to the families of the victims of landslides and floods caused by heavy rains that affected different parts of Western, Northern, and Southern Provinces, during the night of 2-3 May 2023, so far **claiming the lives of 127 people**.

Rescue interventions are ongoing in the most affected districts: Rubavu, Ngororero, Nyabihu, Rutsiro, Karongi, Gakenke, Burera, Musanze and Nyamagabe, in order to secure endangered citizens. They include evacuation and temporary relocation of residents from affected and high-risk areas while rains are ongoing. Teams are already deployed to affected districts to provide required assistance.

The command center is actively coordinating emergency response. Relevant institutions will continuously liaise with districts to coordinate all required interventions.

We thank the residents of the affected districts for their collaboration, and we are making every effort to **ensure their safety and wellbeing**.

END

Is the measure just mentioned, detailed or implemented in the Kigali Master Plan 2050?

code colour	Indication
●	Absent
●	mentioned
●	Detailed

How sustainable is the approach X?

code colour	Indication .	Indication of sustainability.
●	Absent	Poor
●	mentioned	Fair
●	Detailed	Good

Flood prevention

Reduction of buildings in risky areas

1. protection of steep slopes
2. use of wetlands for agriculture and clay extraction; and adaptability to climate change. p102
3. allowing for regulated sustainable use in less fragile areas for recreational activities, agriculture, and local material extraction in agreement with authorities p102
4. Restoration of wetlands, waterbodies and forests encroached upon by human livelihood and urbanisation activities and relocation/resettlement of households inhabiting restricted and hazardous areas; p102
5. restriction of development and activities in high risk areas, p105
6. Reduce exposure to flood risk by avoiding hazardous, uneconomic or unwise use of floodplains, thereby protecting life, property and community infrastructure, divided into high, medium and low risk zone p107
7. which are 30% or greater in slope as undevelopable areas. p115
8. Relocation and Resettlement of Households Inhabiting Restricted (>30% slope) and Hazardous Slopes sites at risk of landslides and flooding p116

Land use policies

Zoning

1. Clearance of development in Steep Slopes wetlands and acquire land for relocation p102
2. Prepare redevelopment schemes to relocate people from steep slopes and wetlands p102
3. land conservation (slope management and management of impacts on sensitive areas); p105

Long-term plan

1. Develop a Water Master Plan for the City of Kigali p18
2. City-Wide Flood Management Plan, City-Wide Watershed and Stormwater Management Plan (including Slope Management Plans) p101

Integration of different sectors (economy, social, environment.)

1. Disaster risk reduction, resiliency to natural disasters, integrated environmental management plans.

Proactive spatial planning

Mapping flood risk areas

1. Inventory of illegal activities in all urban wetlands (mapping, identification, photos). Monitoring system to be designed;

2. Monitoring of urban wetlands using drones and establish drone-based imagery - orthophotos of wetlands and their buffer zones;
3. Identification and mapping of natural disaster risk and hazard areas p105
4. Assessment and Mapping of HighRisk Slopes in Kigali to improve landslide disaster risk avoidance and mitigation p115

Early warning systems

1. preparation of early warning system, p105

Collaboration with people

Informative meetings

1. Umuganda (community service) street clean ups, reforestation and erosion control, and protection of river banks. p101
2. Awareness Campaign and Capacity Building Trainings on Slope Hazards and Slope Management Best Practice; p115

Flood defence

Infrastructure

Infiltration systems for rainwater

1. stormwater drainage system integrated swales, and constructed wetlands, p105
2. Design of resilient infrastructure p105
3. Combine stormwater detention facilities with open spaces, parks, sports fields or other public recreational facilities that have minimal building developments p108
4. Integration of natural drainage channels into the urban landscape and citywide green network; p108
5. Design of resilient infrastructure and services to minimize the impacts and disruptions from common natural disasters p119

Retention areas/ Storage areas

Use of Greenery

1. emphasising the green growth approach for climate change mitigation
2. Green growth mitigating environmental pressures
3. Upgrade of informal settlements with access to public green space, enhanced climate change and disaster resilience,

Flood mitigation

Smart design of the flood-prone area

flood-proof spatial planning

1. Integrating climate and disaster resiliency into planning and design of buildings, infrastructure, and urban services p105

Permeable pavements

1. Increase in impervious surfaces
2. permeable pavement and stormwater p105

Regulation for flood-proof buildings

1. The legal and regulatory framework has progressively been established, along with the institutional framework to enforce the regulations and plan and implement programmes and projects for environmental protection and restoration

Flood response

1. Preparation of disaster response plans p105

Emergency plan

Evacuation plan

Flood recovery

Flood insurance

Rebuilding plans

Compensation

Relevant

1. Preservation and restoration of the natural drainage channels across the catchments in Kigali is an important strategy for managing flooding, especially in the absence of developed stormwater drainage infrastructure in much of the City p106
2. Integration of natural drainage channels into the urban landscape and citywide green network; p108
3. Protect existing natural drainage channels and propose implementation of a 20m buffer from the development activities, similar to the buffer requirement for wetlands; p108
4. The natural drainage channels in the city's catchments serve an important stormwater drainage function, limiting localized flooding if properly restored and maintained. p110

Table ES1: Some of the current measures employed in FRM, England

Flood Risk Management Strategies (FRMSs)	Flood Risk Management Measures (FRMMs)
<p>Prevention</p> <p>This strategy aims to minimise people's <i>exposure</i> to flooding, this is achieved via measures that keep people and property away from water.</p>	<ul style="list-style-type: none"> ▪ Spatial planning to influence location and layout of future development. The <i>sequential test</i> is a mechanism to reduce development on the floodplain. ▪ Multi-functional land use <i>i.e.</i> space is designated for several purposes (e.g. a park may also function as a flood storage area and is expected to flood during heavy rainfall)
<p>Defence</p> <p>This strategy aims to minimise the <i>likelihood and/or magnitude</i> of flooding, via measures that keep water away from people <i>i.e.</i> measures that act to <i>resist</i> water.</p>	<ul style="list-style-type: none"> ▪ Tidal surge Barriers and sluices ▪ Embankments ▪ Flood walls ▪ Conveyance engineering (e.g. dredging) ▪ Demountable defences
<p>Mitigation</p> <p>This strategy aims to minimise the <i>likelihood and/or magnitude of flooding</i>, via measures that <i>accommodate</i> water.</p>	<ul style="list-style-type: none"> ▪ Flood storage areas / retention basins ▪ Natural flood management measures e.g. peatland restoration, wetland creation, tree planting and restoration of riverside corridors ▪ Managed realignment

Flood Risk Management Strategies (FRMSs)	Flood Risk Management Measures (FRMMs)
	<ul style="list-style-type: none"> ▪ Property <i>resistance and resilience</i> measures ▪ Green roofs ▪ Living walls ▪ Permeable pavements ▪ Designated floor heights above flood level
<p>Preparation & Response</p> <p>This strategy aims to minimise the <i>consequences</i> of flooding via measures that strengthen societal capacity to prepare and respond to a flood event.</p>	<ul style="list-style-type: none"> ▪ Flood forecasting ▪ Range of communication methods for disseminating flood warnings (e.g. Floodline warnings Direct service; local flood wardens) ▪ Targeted flood warning service for infrastructure ▪ Emergency management ▪ Promoting risk awareness amongst organisations and the public ▪ Community flood action plans ▪ Promoting activities at the household scale (e.g. property <i>resistance and resilience</i> measures)
<p>Recovery</p> <p>This strategy aims to minimise the <i>consequences</i> of flooding via measures that seek to strengthen societal capacity to recover from a flood event.</p>	<ul style="list-style-type: none"> ▪ Private market insurance ▪ Bellwin Scheme ▪ Local Authority to support community recovery post-flood ▪ Involvement of voluntary sector (e.g. National Flood Forum)