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Challenges for mainstreaming climate adaptation in African cities. A case study of Kigali, Rwanda

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Highlights

- Mainstreaming adaptation measure in cities are crucial for urban climate resilience.
- Urban development and planningprocesses is one of the vital tools for integrating climatemitigation and adaptation strategies.
- Mitigation and adaptation effort at the city level needs interdisciplinary exchange of idea, resources, responsibility across different disciplines and local government department.
- Need more urban climate change case studies from Global South, especially from Africa.

Abstract

Cities in Africa are experiencing rapid urban and population growth. They are also among the most affected by global environmental challenges. The increasing frequency of extreme climate change events has significant implications and poses a serious challenge for policymakers to build resilient urban societies. In Africa, a considerable amount of effort has been invested in building a climate resilient society. This study made an assessment of current urban planning and development practices at the city level and evaluated their effectiveness in mainstreaming adaptation strategies to climate change. Based on our case study of the city of Kigali in Rwanda, we examined various urban development policies and plans. The study used an assessment framework developed by Kumar et al. (2015). This study revealed th out of the plans analyzed, only a fraction explicitly addressed climate change, with most lacking comprehensive climate adaptation measures. Our study further spotlighted Kigali's limited climate change awareness, analytical capacity, and resource allocation. This echoes a wider trend across African cities, which, despite experiencing climate risks, often overlook its integration into developmental plans. As the global conversation pivots to climate resilient planning and policies, the experiences and challenges of African cities emerge as invaluable. Their experiences highlight specific challenges and stress the need to modify development policies and planning practices with a strong focus on climate.

Through this research, we echo the urgency to not only recognize but actively incorporate these vital African perspectives, mainstreaming climate efforts into local development ambitions.

Previous Next

Keywords

Climate change adaptation; Flood risks; Mainstreaming; Urban planning; Africa

1. Introduction

Urban areas are at the frontier of climate risk. In the last two decades, the world has experienced rapid urbanisation and exponential population growth (Gu, 2019). By 2050, an additional 0.5–1.5 million km^2 will be urbanised worldwide and 2–3 billion people will live in urban areas (Huang et al., 2019, UN, 2018), making them highly vulnerable to global climate risks. Many of today's urban areas are already vulnerable to a range of climate risks such as urban heat, sea level rise, extreme rainfall, flooding and so on (Rosenzweig et al., 2011, Rosenzweig et al., 2018). At the same time, urban activities are responsible for 70 percent of the global final energy consumption and contribute between 70 and 75 percent of the global CO_2 emissions (Bai et al., 2018). Faced with rapid urbanisation and the unpredictable environmental risks such as climate change, urban areas must rethink their development strategies, especially urban areas in the Global South (Araos et al., 2016, Castán Broto and Bulkeley, 2013, Cramer et al., 2018, Watts et al., 2018).

Within the Global South, Africa is observing the fastest urbanisation trend and urban population growth (Blunden and Arndt, 2019, Lamb and Steinberger, 2017, Ritchie and Roser, 2018, UN-HABITAT, 2016). Nearly all major cities in Africa located in high-risk zones and are highly vulnerable to the impacts of climate change (Di Ruocco et al., 2015, Fraser et al., 2017, UN-HABITAT, 2016, UN-HABITAT, 2018) Particularly, those cities that have weak social, economic, and technological resources combined with limited institutional capacity (Addaney et al., 2017, Hallegatte and Rozenberg, 2017, Leal Filho et al., 2018, Pelling and Wisner, 2012). Current development endeavours in these cities are driving substantial socio-ecological transformations and altering urban functions. These changes, if guided effectively, have the potential to enhance their resilience to climate risks.

In response to the urgent and intertwined climate challenges facing African cities, nations across the continent are integrating international climate frameworks and measures into their development policies, governance mechanisms, and local development initiatives (Herslund et al., 2016). International frameworks such as the New Urban Agenda, Sendai Framework for Disaster Risk Reduction, Sustainable Development Goals, and the Paris Agreement are designed to foster sustainable and resilient cities and communities (Laros and Jones, 2014, UN-HABITAT, 2016, UN-HABITAT, 2018). Furthermore, African cities that leverage international development support can institutionalize a range of policy tools designed to mitigate climate risks and enhance resilience to extreme climate events (Laros and Jones, 2014, UN-HABITAT, 2018). This support can take the form of diverse measures that strengthen resilience in the natural or built environment, as well as strengthen the capacity of local institutions to improve urban conditions and resilience (Burton, 2005, UN-HABITAT, 2018). Many cities across Africa have already initiated the integration of various climate efforts into their local policies, particularly within spatial and urban planning processes (Adedeji et al., 2012, Laros and Jones, 2014, Simon and Leck, 2015). However, the governance of integration of climate efforts, including policy development and implementation have received inadequate research attention (Ampaire et al., 2017, Chesterman and Neely, 2015, Chuku, 2010, Simon and Leck, 2015).

Mainstreaming climate adaptation necessitates the involvement of various local government institutions (Broto, 2017, Keskitalo et al., 2016). The government institutions (i.e. national or local) assess climate risks and local resources to effectively implement developed climate policies and strategies. To determine whether these advancements contribute to climate resilience in Africa's cities, our study aims firstly to examine the characteristics of the local urban climate risk spectrum and secondly to investigate the effectiveness of the diverse development policies and plans employed by local governments in preparing cities for various climate change risks and in mainstreaming climate adaptation.

This paper is organized into five sections. In the introduction section, we have provided background information on the climate change challenges that cities in Africa are facing, and examine the efforts national and local government are putting into climate adaptation. We also outlined the research objective for this study. Section two is dedicated to the literature review, where we explore the current state of climate adaptation efforts in African cities. The method section focuses on the case study area and describes the framework we used in this study to evaluate ongoing efforts initiated by local governments in African cities. In the results section, we present the findings of our evaluation of Kigali City, which provide an example of mainstreaming climate adaptation in local development plans and policies. Finally, in the discussion and conclusion section, we interpret the results in a broader context and draw attention to several key policy recommendations. These recommendations include promoting policy coherence and harmonized climate adaptation measures in national as well as local policies and development frameworks.

2. Literature review

Climate change presents a significant threat to urban populations in Africa. Cities are particularly vulnerable due to a wide range of development challenges such as high population growth, rapid urbanization, location in often-hazard-prone areas, and limited resources for climate adaptation and mitigation (Fraser et al., 2017, Giugni et al., 2015, Wisner et al., 2015). The sudden expansion of African cities is straining natural resources and urban infrastructure. This chaotic urban growth heightens the susceptibility of these cities to climate impacts (Broto, 2014, Castán Broto and Bulkeley, 2013). The majority of African cities, especially those with populations exceeding one million, are located in areas susceptible to a range of natural hazards, such as cyclones, droughts, earthquakes, floods, landslides, and volcanoes. According to UNDESA (Bai et al., 2018, Gu, 2019), a mere 10% of these cities remain untouched by these natural threats.

The most common climate related risks in Africa are floods and drought (Adelekan et al., 2015). Most countries in sub-Saharan Africa are vulnerable to flooding with the Southern, Eastern and Central regions having the most rampant flood disasters, followed by Western regions (Ngoran et al., 2015). East African countries including Kenya, Uganda, Rwanda, Ethiopia and Sudan among others are the worst hit by flooding within the continent. In early 2018 alone, around 270, 000 people were displaced due to flooding in East Africa (Brown, 2020). Coastal cities, like Abuja, Mombasa and Dar es Salaam, are at risk from rising sea levels and storm surges, partly because many are situated near river deltas or confluences (Diop et al., 2021, Field et al., 2014). For instance, Kigali's flood-prone area, Nyabugogo, is at the convergence of two rivers, River Mpanzi and River Nyabugogo (Asumadu-Sarkodie et al., 2017). A similar scenario is also observed in other cities in Africa during heavy rainfalls such as Nairobi, a major African city, faces flash floods from surface runoff (Douglas, 2017). Meanwhile, countries such as Sudan, Somalia, Ethiopia and Kenya are prone to periods of low or no precipitation that result in prolonged drought conditions (Richardson et al., 2022). This wide-ranging vulnerability stresses the pressing need for comprehensive climate adaptation strategies tailored to the unique geographical and climatic challenges each African cities faces.

The relationship between infrastructural damage, economic loss, and loss of human lives is particularly evident in the climate disasters that cities in Africa face (Araos et al., 2016, Castán Broto and Bulkeley, 2013, Cramer et al., 2018, Watts et al., 2018). About 880,000 people died across Africa between 1970 and 2014 because of floods, droughts, cyclones, and storms (El-Batran and Aboulnaga, 2015, UN-HABITAT, 2016, Watkiss et al., 2010). A joint study carried by UN and World Bank (2010) between 1990 and 2008 highlighted that losses of on an average US $400 million per year occurred in Africa, with 460 million people directly affected by climate disasters. Today, people living in spatially vulnerable conditions remain at high risk of becoming victims of disasters (Di Ruocco et al., 2015, Masolo, 2023, Otto et al., 2017, Reckien et al., 2018). Besides extreme weather events, unchecked urban growth and insufficient infrastructure amplify climate vulnerability (Baker, 2012, Habitat, 2022, Saber et al., 2020, Salami et al., 2017, UN-HABITAT, 2016). In the absence of robust development policies and disaster resilience mechanisms, African cities are exposed to significant financial and ecological costs that disproportionately affect vulnerable groups (White and Ijjasz-Vasquez 2017).

Addressing climate risks in African cities thus requires a deep comprehension of evolving social, economic, political, institutional, and technological dynamics (Cobbinah et al., 2015, Di Ruocco et al., 2015, Laros and Jones, 2014). Effective climate solutions demand collaboration across governments, local communities, expert, and other local stakeholders (Aylett, 2015, Broto, 2017). Globally, cities employ spatial planning and development plans to guide urban growth, enhance resilience, and co-create policies with stakeholders (Hurlimann et al., 2022, Kumar et al., 2016, Kumar and Geneletti, 2015, Wilson and Piper, 2010). Mainstreaming climate strategies into these plans is key, especially when they

align with planning methodologies. Spatial planning, in essence, guides area's land use and urban activities based on socio-ecological contexts, resource distribution, and associated risks (Hurlimann & March 2012; Ran & Nedovic-Budic, 2016; Wamsler, 2014).

Current development and planning practices in cities for Africa resonate with the "grow dirty now, clean up later" philosophy and are rooted in "colonial planning practices" (De Satgé et al., 2018, Mabogunje, 1990, Okeke and Nwachukwu, 2019). A historical perspective reveals that many cities in the Global South, spanning regions in Africa and Asia, have relied heavily on planning practices and financial assistance inherited from their colonial predecessors (De Satgé et al., 2018, Mabogunje, 1990, Okeke and Nwachukwu, 2019). Furthermore, a narrow outlook on potential developmental avenues along with inadequate citizen and stakeholder involvement further exacerbates the situation. Such Rigid, top-down planning methods have often overlooked local needs and climate realities, revealing their limitations in African cities. Addressing today's climate challenges necessitates a transition to inclusive, locally-informed planning strategies. (De Satgé et al., 2018, Ijjasz-Vasquez et al., 2021). Examples of this rigidity are evident in planning documents and strategies. For instance, the fixed space standards prescribed for drainage systems could not be modified, leaving no room for adjustments, even when essential to tackle flooding concerns (Albrechts, 2004).

In the context of Africa, the planning process can typically be outlined according to the following sequential steps: i) problem identification, ii) problem analysis iii) objective setting, iv) identification of intervention alternatives, v) evaluation of alternatives, vi) selection of the best alternative(s), vii) implementation of the best alternative, and viii) monitoring and evaluations (Schmidt-thom et al., 2017). While there have been advancements in urban planning and development policies practices, this foundational methodology has remained largely consistent (Albrechts, 2004). Simultaneously, several global development organizations, such as UNISDR, WRI, and UN-Habitat, have outlined guidelines that not only underscore the importance of risk-informed plans and policies but also highlight the significance of citizen engagement in shaping policies approach (Gencer, 2017, Molin Valdes, 2012). Such community-centric, risk-aware planning can greatly mitigate the impact of climate risks in urban settings (Kumar and Geneletti, 2015, Rosenzweig et al., 2018, Wamsler, 2014).

The complex climate vulnerabilities in African urban areas are evident today. In particular, land tenure dynamics further complicate policy-making that often leads to conflicts between marginalized groups and dominant urban stakeholders (Cobbinah et al. 2017). The rise of informal settlements emphasizes a pressing demand for vital services and infrastructure, highlighting deficiencies in urban governance and operation (Ngoran et al., 2015). Many African cities are burdened with aging and inadequate infrastructure, which hampers the effective implementation of needed climate adaptation strategies (Addaney et al., 2017, Baker, 2012, Saber et al., 2020, Salami et al., 2017, UN-HABITAT, 2016). Additionally, in the balance between urbanization and economic development, there is a noticeable trend of prioritizing economic growth over environmental concerns. Such an approach not only risks compromising long-term climate resilience but also has the potential to adversely impact already vulnerable communities (Ijjasz-Vasquez et al., 2021). Global urban areas are on the rise, but African cities face the risk of rapid, unchecked expansion without proper planning and disaster resilience measures (Herslund et al., 2016). This unchecked growth directly impacts communities, underscoring the urgency for inclusive strategies that prioritize local needs and safeguard residents.

Cities in Africa, policy and decision-makers often have insufficient awareness and comprehension of climate change and its cascading effects (De Satgé et al., 2018, Fraser et al., 2017). A primary barrier they face is the limited capacity and resources to thoroughly analyze the climate risks these urban centers are suffering. Climate risk assessment is pivotal in designing and prioritizing tangible climate adaptation measures on the ground (Argyris & Schön, 1978; Dodman et al., 2011). Compounding this challenge is the weak institutional coordination and collaboration. Effective climate adaptation within planning and policies necessitates robust collaboration among a wide range of stakeholders. Unfortunately, this collaborative spirits often lacking in several cities in Africa and as well globally (Satterthwaite et al 2018; Ziervogel et al., 2010). Africa in general is also facing other pressing challenges like poverty, hunger, and public health issues, which often overshadow prioritizing resources utilization and investments in climate adaptation at the local level (Cobbinah et al., 2015, Richardson et al., 2022). The political landscape further complicates matters; leaders may hesitate to endorse initiatives that do not align with the interests of influential groups or their electoral prospects (Biermann et al., 2022, Gore, 2021, Hickmann and Stehle, 2019). To emphasize the importance of climate adaptation, the governing bodies in the region must articulate its long-term benefits to both decision-makers and the general public (Satterthwaite et al., 2018).

Cities worldwide are aligning local development goals with effective climate resilience practices for balanced growth (Habitat, 2022). For African cities to thrive alongside their global counterparts, they must emphasize the importance of sustainable and climate-resilient planning. This means moving beyond colonial models and adopting approaches like citizen science governance, which emphasizes adaptive solutions co-designed by diverse stakeholders, adjusted to the unique challenges and climate risks of each specific city or region (Ijjasz-Vasquez et al., 2021, Pauleit et al., 2015). International frameworks and guidelines, such as the SDGs, the New Urban Agenda, and the Paris Agreement, provide a vital blueprint for cities to begin their transformation towards climate resilience (Valencia et al., 2019). Integrating these frameworks into local planning allows for effective climate mainstreaming. Furthermore, it essential to evolve beyond colonial planning methods previously dominant in Africa. A considerable amount of knowledge and development aid has been deployed in Africa by the international, regional, and national organizations to build a resilient urban area in recent years (Fonta et al., 2018, UN-HABITAT, 2018, Vink and Schouten, 2018). However, the success of these international frameworks and development assistance strategies hinges on the harmonious interplay between evolved urban planning practices and governance structures at the national, regional, and local levels (Burton, 2005).

3. Method

3.1. Case study area

Rwanda, a landlocked country in Central Africa, has been at the forefront of climate impacts such as droughts, floods, landslides and heat waves. Despite being a low-income country it ranks among the top 30 places worldwide to do business and has one of Africa's fastest-growing economies (REMA, 2017). Most of the economic growth is happening in and around Kigali City. However, rapid population growth and urbanization have put tremendous strain on resources and infrastructure in Kigali city, creating unique challenges related to urbanization and climate change. To address these challenges, Kigali has taken initial steps to integrate environmental risks into urban policy and planning, reflecting its awareness of the adverse effects that climate change can have on the built environment, physical infrastructure, and socio-economic wellbeing (Metternicht, 2017, REMA, 2017, Seitz and Nyangena, 2009). Rwanda had already adopted the Sendai Framework for Disaster Risk Reduction in 2015, making Kigali an ideal case study to identify any remaining bottlenecks preventing full implementation of climate change mainstreaming into local policies.

Kigali city, established in the early 1900s, sprawls across a mountainous landscape and forms one of Rwanda's five provinces. The city lies at longitude 30° 6′ 15.9444″ E and latitude 1° 58′ 14.0844″ S. Urban development is mostly limited to gentle slopes and flat hilltops due to floodplains, swamps, and steep slopes. Since its establishment, the population has increased dramatically from 337 people in 1907 to around 1,140,000, and its urban area has expanded from 0.08 Km2 to 730 Km2 (Manirakiza et al., 2019). With three districts – Nyarugenge, Kicukiro and Gasabo (Fig. 1) – Kigali is a mixed land use city including agriculture, commercial, residential, and public facilities such as forests, parks, rivers and lakes etc.

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Fig. 1. Study area with reference to the Rwanda and Africa.

The city of Kigali has not only experienced rapid urbanisation but has also been confronted with climate change leading to frequent floods and landslides that have caused both infrastructural and material damages. This damage has been exacerbated by encroachment of flood-prone and landslide-prone areas (REMA, 2017). Weak natural resource management and inadequate adaptive capacity of the population put the city of Kigali among the most climatically vulnerable cities. In addition, frequent erratic weather events impact the availability of fresh water, agricultural production and influence the whole process of sustainable development. According to REMA (2017), climate change events like flooding cause close to 1% of GDP loss annually. The direct impacts have serious consequences on local livelihoods, living conditions, economic loss, and physical infrastructure, leading to public health problems.

3.2. Research approach

This study used a mixed-methods approach to understand the effectiveness of local planning policies and plans - e.g., city plans, spatial plans and regional plans - used by local government to prepare cities for global environmental challenges. According to Bryman (2016), using mixed-methods allows for gathering data from different sources to validate and confirm findings, ensuring that the study is both internally valid and reliable. The use of multiple data collection methods enhances the quality of the data collected, as it ensures that the information gathered is both comprehensive and complementary, enabling researchers to identify and address the actual problems being studied.

For this study, the first step of the mixed-methods approach was to establish an assessment framework and relevant criteria. The second step involved data collection, which included a review of government documents, reports, policy briefings and development policies and plans on urban development and environment issues at the city level. The final step was the conducting of open-ended, semi-structured interviews.

3.2.1. Assessment framework

An appropriate assessment framework was vital to determining the extent of local urban planning policies and development plans for mainstreaming climate change risks (particularly flooding). There are several studies and assessment frameworks in the literature that address how to engage with global environmental challenges at different spatial scales (Brooks et al., 2013, Gencer, 2017, Kumar and Geneletti, 2015, Tang et al., 2010, Urwin and Jordan, 2008).

However, the existing studies and frameworks on climate change adaptation concerning urban areas found in the literature have focused on specific sectors, analyzed larger geographic areas, and prioritized outcome measures rather than local policy processes. Furthermore, they have mostly been developed and tested in more economically developed countries. The interoperability and reusability of these studies in African cities has its structural challenges in terms of cultural dynamics, resource requirements, and political landscape. Few studies were found in the literature that understood this structural limitation and focused on process-based climate vulnerability assessment (Kumar & Geneletti, 2015).

Based on these findings, this study adopted the assessment framework developed by Kumar & Geneletti (2015), which is based on the 3As approach proposed by Moser & Luers (2008). The assessment framework is structured around three key components (i.e., awareness, analysis and action) of the overall climate change debate. In 2008, Moser & Luers' (2008) developed the 3As approach to assess the ability of city managers in California to cope with the impacts of climate change. This approach was later adapted by Kumar & Geneletti in 2015 to suit the context of the Global South and was used in Indian cities (Kumar and Geneletti, 2015, Kumar & Brewster, 2022). In assessing the effectiveness of local policies in addressing climate change, the 3A evaluation framework has proven to be an effective tool. It allows for an evaluation of the level of awareness, analysis, and action on climate change dimensions within city-level policies.

The selection of criteria is vital to the functioning of each component of the 3As framework. The selected criteria should acknowledge the socio, economic, and ecological activities expected in the local policies, plans, and planning processes. Selection of criteria follows three main stages. For this study, first, a desktop analysis was conducted on climate change concerns in cities in Africa. It involved analysis of literature addressing the overall climate risk challenges and the identification of a wider range of mitigation and adaptation efforts that have positives impact on mitigating climate risks. We utilized the Web of Knowledge and Google search engines to gather relevant literature, including both peer-reviewed and grey literature, by employing the following keywords: climate change, climate risks, climate vulnerabilities, climate mitigation, climate adaptation, urban sustainability, and related topics. We collected a diverse range of sources, such as journal articles, technical reports, development policies, and web content. As part of the process, two researchers conducted a thorough review of the literature by carefully examining abstracts, summaries, and main highlights. They cross-checked each other's findings to ensure accuracy. The results of the desktop review allowed us to gain a comprehensive understanding of climate mitigation and adaptation initiatives, as well as identify several overarching criteria for each component of the 3As evaluation framework by evaluating the different stages of policy formulation and implementation at the local level. The preliminary findings of the desktop review showed that the main areas addressed in the journal articles, reports, local policy and plans were awareness, stakeholder involvement, infrastructure development, build environment, public services, and socio-economic capacity. The preliminary findings also showed that many factors influencing vulnerability to climate change and sustainable development challenges are common and should be considered when developing plans and policies (Adger, 2010, Baker, 2012, Brooks et al., 2013, Rosenzweig et al., 2018, Wilson and Piper, 2010).

To finalize the criteria for the 3As evaluation framework, we refined the selection based on the local context of the chosen case study and feedback from key policy actors and stakeholders who play a significant role in the policy development process in the city of Kigali. These policy actors and stakeholders represented various local government departments, such as the Rwanda Housing Authority, Human Settlement Planning and Development, Ministry of Infrastructure, Ministry of Environment, Council of the City of Kigali, Ministry of Disaster Management and Refugee Affairs, Rwanda Environment Management Authority, and the Global Green Growth Institute, among others. Based on their feedback and suggestions, we selected 26 criteria for awareness, analysis, and action components for this study (Table 1).

Table 1. Criteria for evaluation framework.

Component	Criteria	Reference
Awareness	Explicitly defined climate change or environmental risk concept	(Jabareen, 2013)
	Clearly defined climate scenarios	(Meerow & Stults, 2016)
	Short- and long-term climate visions	(Kumar & Geneletti, 2015)

Component	Criteria	Reference
	Adequate climate vulnerability assessments	(Kumar et al., 2016)
Analysis	Roles and responsibility of the local development institution	(Keskitalo et al., 2016, Kumar and Geneletti, 2015)
	Engagement of relevant stakeholder	(Mees et al., 2019)
	Capacity of local development institution to act on climate change issues	(Aylett, 2015, Broto, 2017)
	Economic risk from climate change impact	(Rojas et al., 2013, Zhou et al., 2012)
	Employment and livelihood risk from climate change impact	(Connolly-Boutin and Smit, 2016, Tanner et al., 2015)
	Displacement and migration cause of climate risks	(Kniveton et al., 2012, Wodon et al., 2014)
	Assessment of natural and protected areas	(C. Mbow et al., 2014; H.-O. P. Mbow et al., 2017)
	Land use suitability	(C. Mbow et al., 2014; H.-O. P. Mbow et al., 2017)
	Climate proofing of physical development	(Serdeczny et al., 2017)
Action	Cross-sectoral/departmental mainstreaming framework	(Bishop et al., 2021, Kumar and Geneletti, 2015)
	Disaster risk monitoring framework	(Kumar et al., 2016)
	Waste water control and treatment	(Wen et al., 2017)
	Public awareness of climate change issues	(Knight, 2016, Lee et al., 2015)
	Defined roles and responsibility of stakeholders across various sectors	(Keskitalo et al., 2016, Kumar and Geneletti, 2015)
	Climate investment commitment	(Kern & Alber, 2009)
	Plans to improve basic public services	(Lamb & Steinberger, 2017)
	Climate proofing of transport infrastructure	(Chirisa et al., 2016)
	Green infrastructure standards	(Bush, 2020, Sturiale and Scuderi, 2019)
	Infill development	(Bush, 2020, Sturiale and Scuderi, 2019)
	Conservation of green areas	(Bush, 2020, Sturiale and Scuderi, 2019)
	Flood resistant land use plan and building codes	(Zhou et al., 2012)
	Exploitation plan for synergies with other climate change policies	(Hasan et al., 2020, Nyiwul, 2019)

3.2.2. Data collection

Local policies and plans

The selection of policies and plans was based on several prerequisites. The plan had to represent a geographical area of the case study, be from 2010 at the oldest, be publicly available, and be legitimate or supported by a local development institution/ government department. During the initial desktop analysis, several policy documents and plans were selected based on the above variables from different spatial scales, e.g., national, city, district and zonal. These selected plans and policies addressed various issues in the city of Kigali. However, based on initial analysis, we only considered master plans, district plans, or zonal plans for this study. For the final analysis, eight plans were selected: Kigali City Master Plan, Kigali District Development Plan, Nyarugenge Master Plan, Nyarugenge Zonal Plan, Kicukiro Master Plan, Kicukiro Zonal Plan, Gasabo Master Plan and Gasabo Zonal Plan. Of all the plans that were publicly available at the time of the data collection, the selected eight plans were legitimate policy documents developed by the development authority and available to the public. Climate change policies and strategies are frequently developed, but on a larger spatial scale. However, the selected policies and plans display a wide range of geopolitical scenes in the city of Kigali

and were developed by local development authorities or as part of the government's vision. Apart from selected plans and policies secondary data were also collected from various national and city government departments. Secondary data included land use policies, climate policies, climate mitigation and adaptation policies, and EIA/building code guidelines.

Qualitative data collection

Semi-structured interviews were conducted with key urban development stakeholders in the city of Kigali to understand their opinions on the current state of city development, vulnerability to climate change, adaptation efforts, and overall urban governance. To facilitate this, two types of interview guides were developed, targeting two categories of organizations.

Firstly, informants were selected from city development organizations directly involved in city development efforts. Secondly, external organizations that indirectly influence local climate efforts were also included, such as ministries, climate change experts, environmentalists, NGOs, spatial planning consultants, and urban scholars. Interview questions aimed to capture opinions on various dimensions of mainstreaming climate efforts at the local level. Some of the questions asked included: What kind of climate change hazards is Kigali facing? What is the level of climate awareness among various departments? How do policies and plans address climate adaptation in Kigali? Do local departments have a documented framework for integrating flooding adaptation into spatial planning? What types of collaboration and governance protocols exist between departments and agencies, and what resources do they have to tackle climate risks?

For this study, 18 semi-structured interviews were conducted with key informants who were purposefully and selectively identified through snowball selection. The researchers sought specific data from actors involved in both local development and climate change research and practice, with attention paid to ensure representation from at least one urban planning department. All key urban planning department heads in the city of Kigali were contacted, along with representatives from the immediate ministries of the lead authorities in the city of Kigali. This was necessary due to the high influence of higher authorities on urban activities in the city. As planning is a socio-political and participatory process, key informants also included representatives from the Ministry of Infrastructure, the Ministry of Environment, and the Rwanda Housing Authority.

3.3. Data analysis

The collected data was analysed in three phases. The first phase focused on thematic content analysis of policies and plans. We began the content analysis by selecting eight plan and planning documents (i.e., master plans, district plans, and zonal plans) as our primary documents. We carefully investigated plans and policies to identify themes and topics related to the finalised criteria under awareness, analysis, and action components for this study as as well as any specific targets or goals mentioned within these components. After categorizing the identified themes and topics with a scoring system we were able to systematically analyze the plans for any patterns or trends in policies or goals related to climate change. Based on the scoring system, each criterion was given a score on a scale of 0–2 (Table 2). In the end, the original scores for each criterion and component were standardised on a scale of 0–1. The selection of the score and their assigned criterion was based on the information gathered during the desktop literature review where level of score was based on the extent of integration of each criterion within the local policies and plans.

Table 2. Scoring description.

Score	Tag	Description
0	Missing	If the criterion or its proxies are not mentioned at all in the selected policy or plan.
1	Implicit	If a policy or plan mentions a criterion or its proxies but does not provide any details on how it will be implemented, who will be responsible for it, and when it will be done, then the criterion can be considered implicit.
2	Explicit	When the criterion is well recognized, provides details on how it will be implemented, who will be responsible for it, and when it will be done, then the criterion can be considered explicit.

After scoring selected plans, we conducted both quantitative and qualitative data analysis. We calculated how frequently each criterion was commonly addressed in the given plans. Additionally, we conducted a qualitative analysis of policies and goals to better comprehend their nuances as well as any gaps or areas for improvement. The quantitative and qualitative data were used to analyse the process and possible outcomes of the selected local development plans and their impacts on the climate change challenges in the city of Kigali (Norton, 2008, Saraisky, 2016).

Overall, the content analysis provided valuable insights into how various plans in Kigali city are addressing climate change mitigation and adaptation. By identifying key themes and topics addressed in the plans, we were able to gain a better understanding of priorities and strategies for the city as well as identify areas for further research and action.

In the second phase of the study, the researchers assessed the performance of each criterion in all the selected plans. They used a depth and breadth performance analysis method, which has been used in previous studies (Kumar, 2015, Kumar and Geneletti, 2015, Tang et al., 2010). Depth performance refers to how explicitly an individual criterion was addressed in the plans and was analyzed using the scores assigned in Phase-I, as per Equation (1). Breadth performance, on the other hand, examines how many of the selected plans address a particular criterion, either implicitly or explicitly, as per Equation (2). The researchers also analyzed the distribution of fitness across all selected plans, using the scores assigned in Phase-I. The quality of the selected plans for integrating flood risks was higher if the scores for depth and breadth performance were higher. This approach was essential to assess the ability of local policies to integrate climate change issues, which cannot be reflected in descriptive statistics.

$$\boldsymbol{DepthScore(DS)j} = (\sum_{j=1}^{Pj} Ij/2Pj) * 100 \quad (1)$$

$$\boldsymbol{BreadthScore(BS)j} = (Pj/N) * 100 \quad (2)$$

In the context of this study, Pj refers to the number of plans that address the jth criterion. N is the total number of policies or plans in the study that are being evaluated. Ij is the jth criterion which receives a score on a 0–2 scale to represent the level of integration or acknowledgement of that criterion in the policy or plan.

In the final phase, feedback from the semi-structured interviews was analysed. These findings were then cross-referenced with the results from the 3A assessment framework to determine the overall performance of the plan, its components, and criteria.

4. Results

Our study embraced the 3A assessment framework to critically evaluate how policies and plans mainstream climate adaptation in Kigali. Simultaneously, insights from semi-structured interviews provided a rich context, unveiling underlying social, political and economic factors.

4.1. Spatial development and climate adaptation in Kigali City: A policy perspective

To understand the development trajectory and climate adaptation efforts in Kigali, it is essential to examine the policies and urban plans driving its growth (MINIFRA, 2015). Post the 1994 Rwandan genocide, Kigali faced rapid urbanization marked by random informal development, prompting governmental intervention. This saw the emergence of various spatial policies, notably the Rwanda Vision 2020, the National Land Use and Development Master Plan (NLUDMP), and the Kigali City Master Plan (KCMP), each charting a course for poverty alleviation, participatory development, environmental conservation, and opportunities for reforms in urban planning practices. In this study, it was essential to investigate how these policies and plans shaped physical development while taking into account climate change implications. By examining these policies and planning processes, we aimed to determine whether climate change risk and adaptation measures were central themes. Nevertheless, a predominant observation indicated that the insufficient focus on climate change and flood resilience within Kigali's urban planning processes impedes the efficacy of the final plans in addressing climate adaptation challenges.

Rwanda's urban development landscape, underscored by pivotal policies such as Rwanda Vision 2020 and the National Land Use and Development Master Plan (NLUDMP), indicates a strong inclination towards sustainable growth and an appreciation for environmental conservation. Vision 2020, launched in the early 2000s, anticipates significant population growth, emphasizing diverse developmental facets from governance to infrastructure. Vision 2020 is a

comprehensive policy document focusing on poverty eradication, participatory development, and formulation of sectoral plans (including urban planning) to guide holistic development. Crucially, environmental conservation and sustainability are underscored in this document, with climate change adaptation measures anchored in various city and district development plans. However, many disparities were observed, notably where private sector-led developments sometimes diverged from citywide developmental objectives. Whereas, NLUDMP determines large scale future plans, overlays and national level zoning.

NLUDMP is designed to guide the growth of urban areas and address common challenges facing them. It has also identified climate change as a current and future threat to development, local livelihoods, plus investments in infrastructure, agriculture, and business. The plan even mentions climate projections and identifying vulnerable areas, including areas prone to erosion and flooding and areas with settlements on steep slopes above 20% incline. For each map and environmental issue, the plan also provides a narrative on interventions and guidelines to mitigate risks and requirements to implement the District Level Land Use Plans (DLUPs) such as limiting development on steep slopes. While the DLUPs set short-term targets, intertwining sustainability and climate change adaptation, they also now include environmental and sustainability elements as part of a national directive within the MINIRENA. However, many DLUPs lack concrete steps to promote climate adaptation.. While some propose actionable strategies, such as expanding forest cover to combat erosion from intensified rain or designating budgets to tackle environmental issues and avert climate-induced disasters, the majority offer nebulous measures to integrate climate considerations. During the plan review, we noted that DLUPs now mandate the recognition of climate change as a hindrance to progress, linking it directly to a surge in catastrophic events.

The Kigali City Master Plan (KCMP) similarly demonstrates lapses in addressing the broader implications of climate change, despite acknowledging specific environmental challenges like flooding. This, combined with the continued unauthorized land use, accentuates the need for a more cohesive and anticipatory approach in Kigali's urban policies to ensure resilience against escalating environmental threats.

Overall, Rwanda's current development policies and planning practices follow a hierarchical structure, spanning from national to district governance levels. This structure, while facilitating a coordinated multi-sectoral and multi-agency approach, has implications for climate change adaptation mainstreaming. The advantage lies in the potential for aligning development and adaptation objectives coherently, provided the national framework is grounded in evidence and awareness of the local climate-related challenges. Conversely, top-down directives pose many challenges. If national guidelines overlook climate concerns, this omission can cascade down to grassroots levels, leading to heightened vulnerabilities and reduced resilience, as evidenced in Kigali. The rigidity of this system can limit localized adjustments, potentially amplifying risks for urban landscapes and inhabitants.

4.2. Overall performance of the plans

To evaluate the performance of the selected policies and plans in mainstreaming climate adaptation in the city of Kigali, we used the 3A assessment framework, which assesses the awareness, analysis, and action components. Based on the 3A assessment framework, the policies and plans evaluated are scored on a scale of 0–52. A score between 0 and 2 was assigned for each of the 26 criteria in every selected plan, with 0 being the lowest and 2 being the highest score. The scores were then normalized to a value of 0 to 1. Our findings, previously illustrated in Fig. 2, disclose a challenging scenario. All eight evaluated plans scored within a range of 0 to 0.67. Breaking down these scores by the 3A components, the highest scores were observed as 0.67 in action, 0.59 in analysis, and 0.50 in awareness.

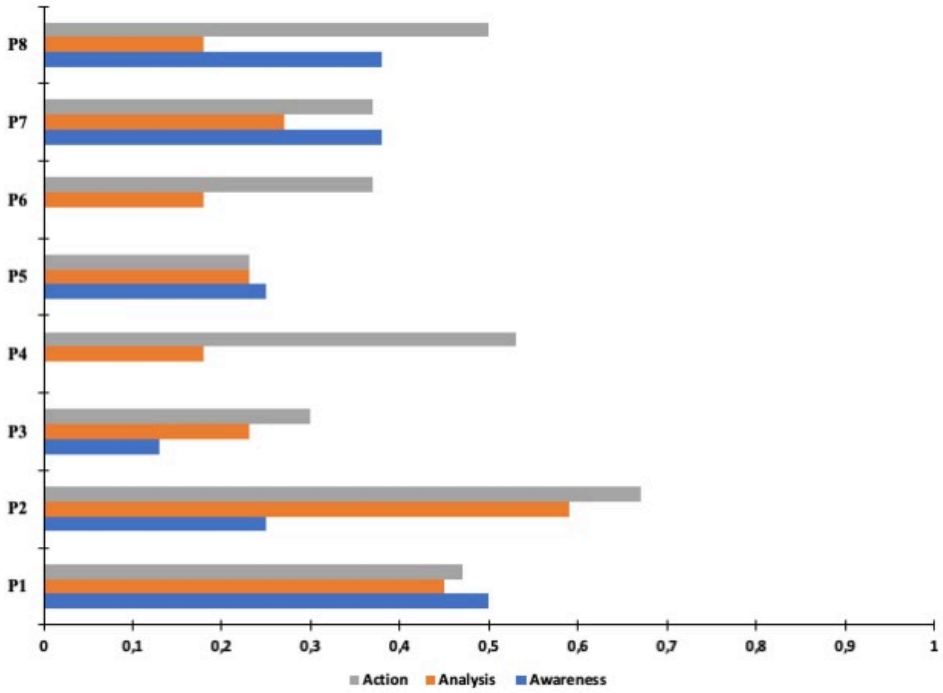

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Fig. 2. Overall Performance of the Plans: Kigali city Master Plan: P1; Kigali District Development plan: P:; Nyarugenge Master Plan: P3; Nyarugenge Zoning Plan: P4; Kicukiro Master Plan: P5; Kicukiro Zoning Plan: P6; Gasabo Master Plan: P7; and Gasabo Zoning Plan: P8.

Concurrently, feedback analysis from stakeholders unveiled a contradiction. On the one hand local planning departments and community or area representatives promised commitment to environmental stewardship within urban planning, anchored firmly within government's operations. On the other hand, there is an acknowledgment of implementation hiccups and inter-agency misalignments, corroborated by the overall performance of the plans based on the 3A assessment framework. As the 3A assessment was carried out for each policy and plan, the scores showed a weak performance of all policies and plans across the city of Kigali's jurisdiction. Amongst the evaluated policies and plans, the Kigali city Master Plan (i.e., P1) and Kigali District Development plan (i.e., P2) performed modestly. Distressingly, Fig. 2 also demonstrates that none of the policies and plans comprehensively addressed all of the 3A components.

Although the 3As components had a poor overall performance, the action component for P2 had a relatively higher score of 0.67. However, the low scores in the analysis component, ranging from 0.18 to 0.59, indicate that the proposed flood risk management actions were not rooted in actual evidence from local assessments. Kigali's urban planning practices reveal a noticeable inclination towards stormwater management, potentially downplaying the pressing climate risks associated with flood management. This observation is also supported by feedback from stakeholder interviews, which resonates with the low scores recorded for the analysis and action components based on 3A assessment. A frequent issues emerged from stakeholder feedback and discussions and pinpointed inter-institutional coordination as a significant barrier. While individual institutions might exhibit efficiency independently, their institutional priorities sometimes conflict and can lead to clashes with others, often stretching already scarce resources. The lack of alignment disrupts prompt execution, emphasizing the overarching challenge of fostering seamless collaboration. These inconsistencies undeniably hinder the integration of climate initiatives in Kigali.

4.3. Performance of 3As component

The study had anticipated that effective integration of climate change issues would lead to a full score of 100% on each of the 3As components. This would imply that the awareness, analysis, and action components were thoroughly incorporated throughout the policy and planning process. However, Kigali's urban plans and policies appear to place insufficient emphasis on flood risk adaptation, a prevailing issue shared with many African cities. A low score of 0.35

for all evaluated plans and policies underscores this oversight. Compounding this concern is the uncertainty surrounding the implementation of the proposed measures. Fig. 3 strongly underscores gaps in climate awareness, thorough analysis, and operationalization of the actions. Considering the wide range of climate vulnerabilities in Kigali city, the descriptive statistics of different components gave a stark image of the city's capacity to mainstream climate efforts within urban plans and policies.

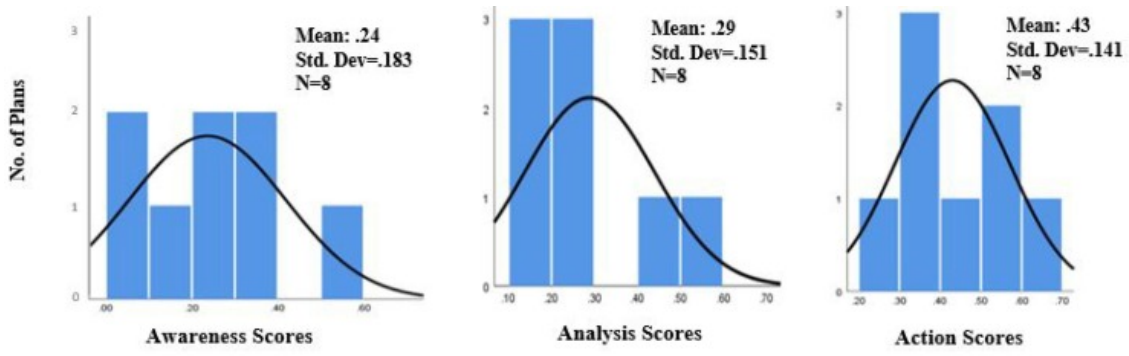

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Fig. 3. Descriptive statistics of the overall performance.

While our ideal expectation was a comprehensive 100% score across the 3As, the results illustrated in Fig. 3 are troubling. None of the 3A components have high score or even average scores. Of all the three components, the action component has a mean of 0.43, followed by analysis at 0.29 and lastly awareness at 0.24. These results suggest that climate change and its associated risks were not a priority during the plan and policy making process. The low score for the awareness component suggests that the policies and plans did not adequately consider climate change issues and their potential impact on the socio-ecological fabric and infrastructure of city. This sentiment is also verified by few stakeholders: *"The city, with its autonomy and mandate, can only influence land use or economic development"*. Additionally, the analysis component received a low score. This indicates that the proposed interventions either were not anchored in comprehensive evidence or failed to incorporate insights from local climate risk observations, as further emphasized by a stakeholder: *"A distinct gap appears between* stormwater management *and flood management. The city's strategies seem disproportionately angled towards the former, potentially neglecting the significant risks posed by the latter."* However, during the stakeholder feedback and discussion, it was also observed that there was a variance in the depth of understanding among key informants regarding climate challenges, particularly flooding. This gap between data and expert sentiment might originate from the more visible recent climate effects, whereas the evaluated policies might originate from an earlier phase. A significant 80% of our respondents clearly advocated for well-informed policies, prioritizing expertise, enhanced funding, unified regulations, and citizen involvement into the decision process.

4.3.1. Performance by criterion

To further assess the performance of each plan, we analyzed performance on each criterion under the three components of the 3A framework. The results showed that none of the criteria under the awareness component received a satisfactory score. For instance, the criterion "climate vulnerability assessment" was missing in all plans, indicating a lack of attention to the identification of vulnerable areas and populations in the city. On the other hand, the criterion "clearly defined climate scenario" received the highest score for both breadth and depth performance in the awareness component, indicating that plans recognized the importance of understanding the climate scenario to inform climate adaptation strategies (Fig. 4).

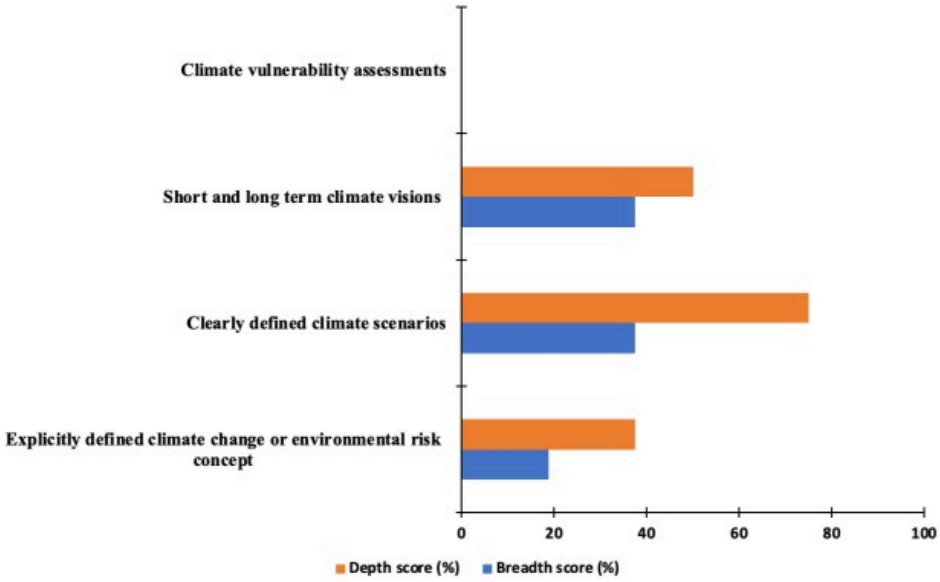

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Fig. 4. Criteria performance of awareness component.

Awareness (Fig. 5) is a crucial determinant in the success of mainstreaming climate efforts into planning and policy processes. Several factors influencing this awareness have been identified. The effectiveness of mainstreaming climate change adaptation largely hinges on the stakeholders' awareness and intellectual capacity to comprehend and integrate these considerations. Regrettably, key informants in Kigali city exhibit a lack of awareness regarding crucial climate change risks, such as floods and landslides, which obstructs the process. Furthermore, nearly 90% of the informants cited the absence of scientific data for risk-informed planning and a lack of understanding of the methodology needed for mainstreaming as significant barriers to this shift in approach. As one of the respondents noted that, *"flooding is often viewed as a natural occurrence without attributing it to climate change. The focus is mainly on the immediate effects of the floods such as washed away houses and roads, without considering the underlying causes and anticipating future scenarios."* This attitude limits the ability to develop responsive strategies to address the impacts of climate change. Effective mainstreaming of climate considerations into plans and policies pivots on the accurate understanding and framing of climate risk issues at the local level. This approach ensures that strategies are contextually relevant, resonate with local stakeholders, and address specific vulnerabilities unique to the community or urban area.

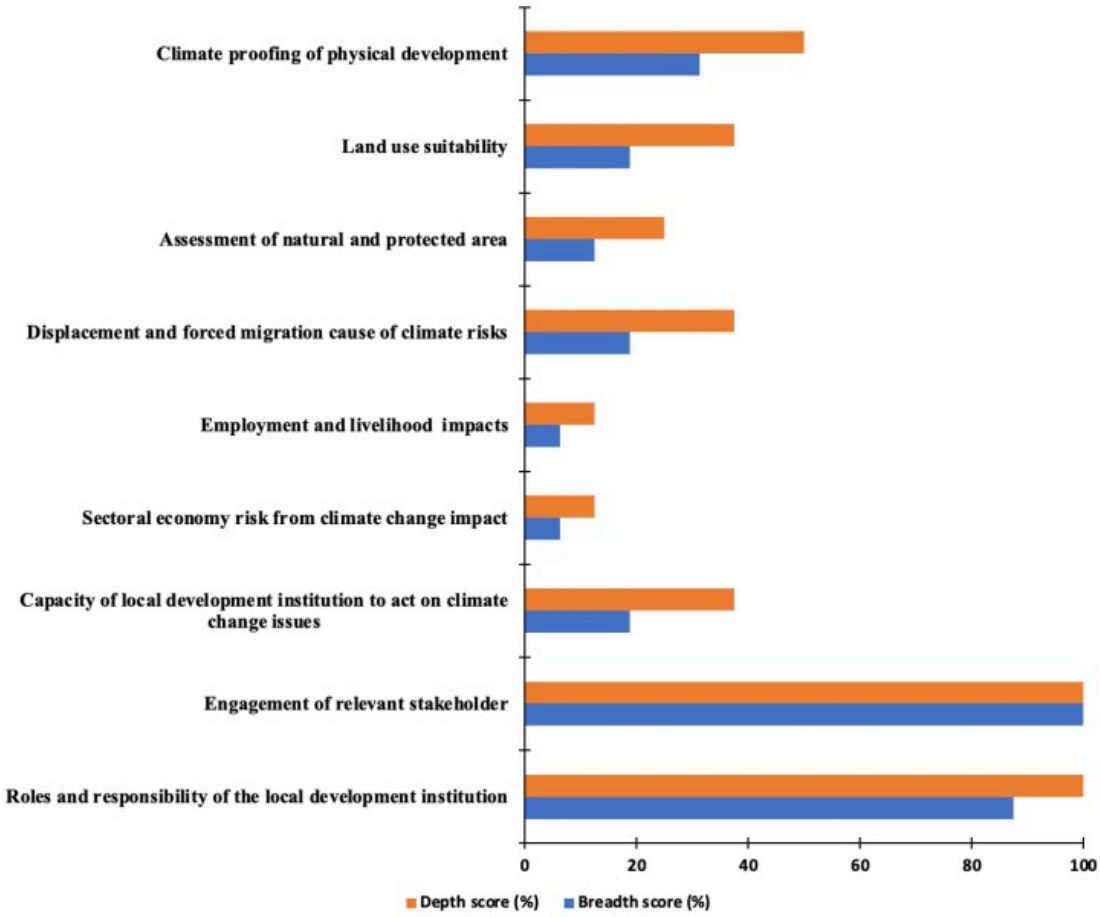

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Fig. 5. Criteria performance of analysis component.

Kigali, despite experiencing a rise in intense precipitation events and consequent flooding, has yet to adequately recognize and address these emerging trends as significant challenges. While stormwater is a typical occurrence during rainfalls and often carries minimal impact, addressing flooding requires more comprehensive strategies. To mitigate flood risks adequately, it is essential to evaluate factors like vulnerability to flooding, exposure levels, coping capacities, and flood intensity. However, Kigali's current policy and planning practices failed to incorporate these crucial elements, leading to an oversimplified measure. Such a narrow approach neither sufficiently captures nor addresses Kigali's climate vulnerability.

In the analysis component, “Engagement of relevant stakeholders” and the “Roles and responsibility of the local development institution” received a higher score of 100% for all plans. In contrast, the study revealed that most of the plans failed to meet 75% of the other analysis component criteria. This suggests a deficiency in relevant data, expert input, sufficient awareness of climate risks, and the financial resources necessary for a comprehensive investigation into climate-proofing policies and plans. These observations were further corroborated by interview outcomes. Several respondents pointedly remarked: *“there is a shortage of climate risks awareness and data to conduct comprehensive risk assessments and advise policy makers.”* When stakeholders do not feel a sense of ownership or responsibility for the plans and policies, their commitment and prioritization of climate adaptation measures may be compromised.

Cognitive factors also limited the extent to which climate change issues were integrated into policies and plans as witnessed by the key informants. The intellectual understanding of the actors to mainstream climate efforts partly determined the effectiveness of the entire process. There exists a sense of urgency to address flood risks in Kigali. However, the most acknowledged challenges were the capacity for accurate anticipation of future climate vulnerability to inform decision-making. The inherent uncertainties within the methodologies and tools employed during the planning process hinder the effective mainstreaming of climate efforts. Even though mainstreaming was never explicitly addressed in the plans and the planning processes, the inclusion of nature-based strategies like green and blue plans, wetland protection, urban forestry, storm water management and Natural Environment Management plan

in the KCMP 2013 all point to an implicit mainstreaming. Thus, a collective sense of urgency is needed in planning and implementing risk-informed urban plans. A notable 80% of Kigali's key informants exhibited a restricted grasp of fundamental climate change impact concepts such as risks, floods, and damages. For example, certain respondents characterized flood damages as merely *"a large volume of water flowing downstream, resulting in the destruction of homes and roads…"*. Beyond these conceptual deficiencies, an overwhelming 90% of the informants underscored the lack of scientific data imperative for risk-informed planning. Moreover, a lack of familiarity with the necessary methodologies for effective climate integration was highlighted as a major barrier to adopting this new approach in Kigali.

Most criteria within the action component performed well in terms of breadth and depth performance, showing how many policies and plans have tried to address climate change concerns (flood risk). About 45% of the criteria in the action component had a depth score above 75% (Fig. 6). This means that all selected plans have tried to propose measures to adapt to flood risk, such as conservation of parks, infill development, green infrastructure, and climate proofing of infrastructure. However, about 70% of the action component criteria had a breadth score of less than 50%, showing a lack of implementation of environmental or climate measures in the policy or plan-making process to mitigate environmental and climate risks.

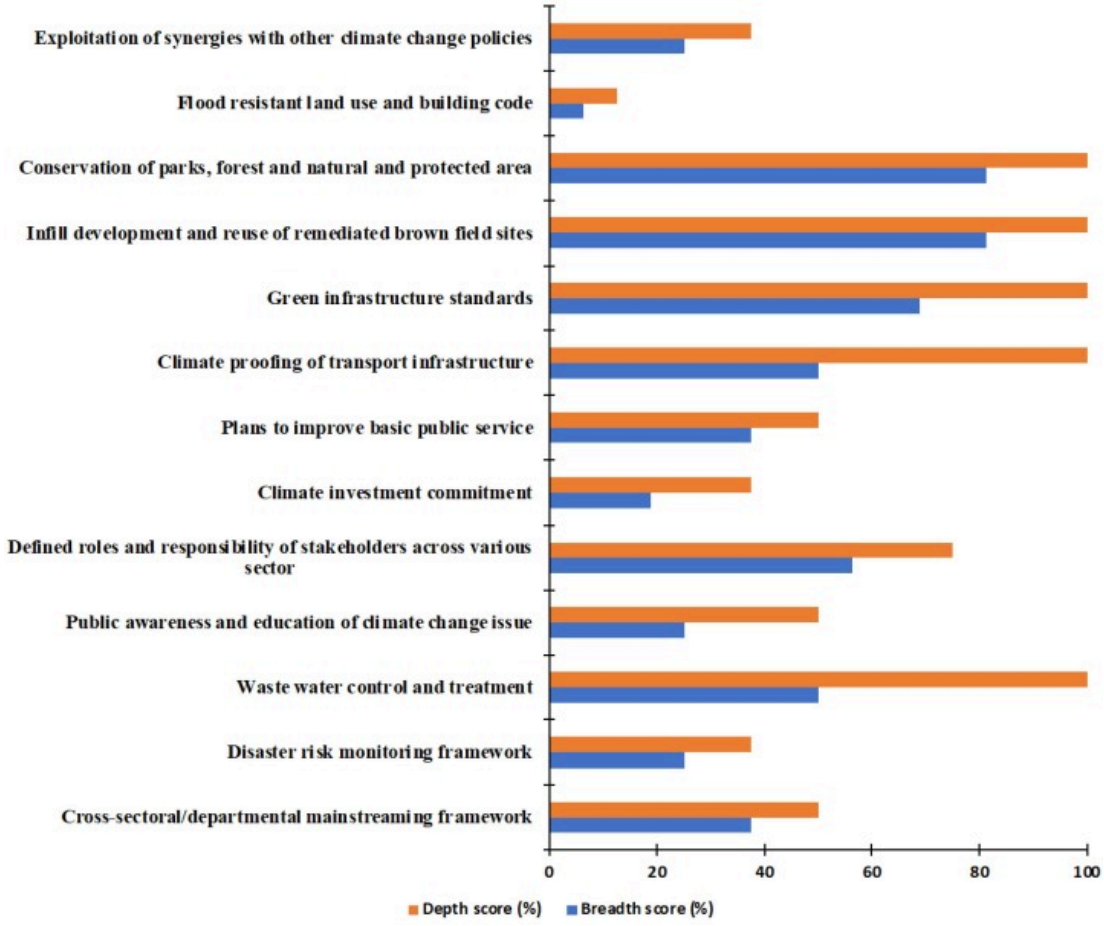

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Fig. 6. Criteria performance of the Action component.

In Kigali city, the mainstreaming of climate measures faces significant capacity hurdles. The inclusion of climate change adaptation strategies is still in its early stage within many development sectors including urban planning. This often necessitates specific technical know-how and appropriate financial allocation, both in terms of expert recruitment and budget provisions.

Almost all the key informants (90%) alluded to the lack of experts as a main limiting factor. While the planning process claims to incorporate climate specialists from government entities like MIDIMAR, the absence of comprehensive flood risk assessments suggests an expertise gap in this domain. Presently, the city primarily conducts slope analysis to identify high-risk zones with slopes exceeding 40%, marking them as restricted zones and relocating inhabitants

accordingly. This method, focusing solely on physical vulnerability indicators, reinforces the evident expertise shortfall in risk-informed planning.

From a financial perspective, Kigali has not allocated a distinct budget for integrating flood management into its planning framework, a finding that is also reflected in the low score for the "climate investment commitment" criteria. Implementing this process necessitates supplementary assessments, such as those focused on potential climate vulnerability derived from forecasted scenarios. For instance, a key informant highlighted the financial constraints hindering the seamless integration of climate change adaptation into urban planning: *"One major challenge is securing timely funding. For example, if we've earmarked a project for execution in a seven-year program but aim to roll it out in a two-year span, there's a bottleneck. If the Central government delays the funding, the city finds itself in a tight spot. They're unable to independently support such projects while awaiting these funds…".*

On an optimistic note, the city provides incentives for residents by subsidizing rainwater harvesting tanks. While this initiative is commendable, its actual impact on flood prevention is debatable, especially considering that many residents live in informal settlements. Concurrently, the existence of FONERWA, despite its constrained budget, presents a potential funding avenue for adaptation projects in Kigali. Yet, the city has not tapped into this resource. A significant strength that Kigali possesses in terms of urban management is its autonomy. The city holds the autonomy to dictate its operations, although adherence to nationally determined policies is paramount, especially given that the majority of their funding comes from the government. This perspective is echoed by all the key informants in our study. Highlighting this autonomy, one informant mentioned, *"The city is autonomous and has the mandate for example to change the land use. Yes; for example, we propose a forest here, the council can sit and decide that-no. This forest is not needed here we need something else maybe commercial there or we need a park there or we need something else. So, they have that mandate."*.

Incorporating climate action into policy and planning heavily hinges on the underlying governance structure, which dictates decision-making and establishes lines of accountability and responsibility. Successful climate change integration necessitates a suitable institutional arrangement to navigate the process. Essential ingredients include harmonized regulations, plans, frameworks, multi-agency collaborations, and championing the climate cause, which in the case of Kigali city was ambiguous. Our investigation into the action criteria reveals that Kigali's plans and policies contain limited and disjointed climate measures. With local institutional roles being unclear, the objective of mainstreaming climate adaptation is fuzzy.

The investigation of plans, policies, and feedback from interviews reveals that Kigali city adopts a highly participatory approach in its urban planning practices. This approach ensures that a wide range of stakeholders are involved in the decision-making process, thereby addressing diverse interests. Key players in Kigali's planning landscape include ministries that span various local government departments, such as infrastructure, finance and economics, environment, and industrialization, among others. Leading agencies such as the Rwanda Housing Authority, Rwanda Transport Development Authority, and Rwanda Environment Management Authority are integral to this process. Furthermore, collaborations with the private sector and international entities like GGGI and UN-Habitat fortify the planning mechanism. Yet, despite this inclusive participation, it is evident that the concept of mainstreaming climate change adaptation has never been explicitly addressed.

A pivotal challenge hindering mainstreaming climate adaptation is the absence of an interdepartmental and multi-sectoral framework. Despite the Kigali City Master Plan (KCMP) 2013 possessing a sustainability framework, it falls short in detailing strategies for successful mainstreaming. A significant 73% of respondents agree that disjointed coordination among stakeholders hampers the planning process. This lack of coordination is primarily attributed to the collective oversight in prioritizing flood risk. A key informant pointed out, *"Each institution operates with a degree of independence. At times, what they prioritize might not align with our objectives, leading to hurdles in fostering inter-institutional collaboration"*. To tackle coordination issues, the KCMP review framework has introduced and conducted a thematic approach for problem identification and resolution. This has led to the incorporation of around 12 specialized group discussions in the planning procedure, with a distinct emphasis on environment and climate change. Although the KCMP recommended the inception of an environmental department within the CoK, it did not distinctly address climate adaptation. Therefore, there is a pressing need to institute a department dedicated solely to climate change to streamline and enhance decision-making.

Furthermore, political dynamics significantly influence climate action in cities specially in Africa. In Rwanda, a strong political commitment to addressing climate change consequences has spurred the development of nationally directed strategies. Likewise, interviews with key informants in Kigali revealed a prevailing trend of political backing. Every informant acknowledged the city's political support towards addressing climate risks. One respondent articulated, *"City planning in Kigali is highly prioritized by the government, from top officials to local levels, emphasizing its importance in addressing environmental, social, and economic factors. This political backing presents a significant chance to enhance the city's climate-responsive measures".* On the contrary, while the national government's support is generally perceived as an advantage, there have been instances where it incidentally hindered city planning, particularly in land use decisions and management. Several key informants highlighted occasions where national ministries, like the Ministry of Environment, proposed land uses in Kigali that did not align with the city's visions and plans. For instance, recommendations to establish urban forests in certain areas have sometimes conflicted with the city's objective of afforestation on steep terrains, especially after relocating residents from those areas.

Approximately 70% of respondents voiced concerns over discrepancies in vision between the national and city authorities, suggesting that these differences could hamper the implementation of projects aimed at reducing vulnerability. The challenges seem to arise when transitioning from policy design to execution. One informant expressively summarized this sentiment, *"Certainly, there are vision disparities, and that is not unique to us. It is one thing to draft a policy or design on paper, but actual implementation on the ground can reveal unforeseen challenges. Even if you adjust based on updated visions, the practical application of these policies might still face hurdles."* Equally, national policies and planning directives, though well-intentioned, occasionally fail to resonate with the ground realities in Kigali. There are indications that such directives might not be sufficiently rooted in empirical evidence, leading to a misalignment between theoretical strategies and practical needs. This disconnect occasionally results in contradictions between national and city directives, making the transition from theory to practice challenging.

In summary, our use of the 3A assessment framework, we found that Kigali city's plans do not adequately address climate change adaptation. The investigation of various components and interview findings point to political, organizational, cognitive, and timing factors as both obstacles and catalysts for mainstreaming climate change adaptation into the city's urban planning.

5. Discussion

The findings our study demonstrate the critical importance of mainstreaming climate change into spatial planning and development policies in cities of Africa. Nearly all African cities big or small are located in areas exposed to varieties of climate risks. These cities are already witnessing economic repercussions and direct human impacts due to climate-related disasters (Bank and Nations, 2010, El-Batran and Aboulnaga, 2015, Habitat, 2022, Pauleit et al., 2015, Watkiss et al., 2010). Simultaneously, the effort of mainstreaming climate adaptation into the spatial planning and development strategies of African cities faces significant hurdles. These include a limited understanding of climate risks, weak institutional collaboration, and the clash of competing priorities alongside political pressures. Presently, policy-making is deeply rooted in traditional ideas and is driven by a governing institutional hierarchy and its associated stakeholder network. For effective climate change incorporation into local developmental activities, there is a urgent need for national and local development initiatives to foster cohesive policy actions. If national and local development policies overlook climate change concerns, it might result in significant gaps in addressing these challenges across various spatial scales.

The study conducted on the city of Kigali shows the potential repercussions of not explicitly incorporating climate risk into national and local plans and policies. How the lack of explicit consideration of climate risks in national and local plans and policies can inadvertently amplifies climate vulnerability while reducing adaptative capacities of socio-ecological system including urban dweller. When plan and policies examined in a broader context, the city of Kigali's approach to mainstream climate risks also reflects the challenges faced by many cities in Africa (De Satgé et al., 2018, Ijjasz-Vasquez et al., 2021). While some cities have initiated steps toward addressing these concerns, Kigali's efforts are noticeably limited at this stage. This is not just a policy weakness but it also exposes Kigali to serious climate risks including intensified flooding, economic setbacks, and public health risks.

Notably, despite the significant role development policies, spatial plans, and programs plays as immediate adaptation strategies at the city level, Kigali's effectiveness in mainstreaming climate risks and efforts were found weak. The assessment of the components and various criteria exhibit a significant deficiency, especially in the awareness and analysis components of the plans and policies. This means that many criteria for developing climate change scenarios and risk assessments are absent or only implicitly mentioned. To illustrate, 80% of the assessment criteria performed sub optimally with less than 40% depth and less than 20% breadth. This limited scope in the planning process has as anticipated overlooked flood risks in Kigali.

Examining the fundamental barriers, such weaknesses can be attributed to a lack of resources, an absence of expertise, limited political will, or potentially a general lack of awareness among policymakers. Furthermore, the city's commitment to traditional policy-making processes, shaped by a hierarchical structure and a complex network of stakeholders, were essential ingredients for the successful mainstreaming of climate efforts in the city of Kigali (De Satgé et al., 2018, Mabogunje, 1990). To bridge this systemic gap, it is paramount for Kigali, and similar cities in Africa, to incorporate climate change awareness and efforts into both national and local development interventions. Such harmonization of policy measures could be instrumental. If overlooked, the city risks a systemic and multi-scaled disconnect in addressing climate change.

Lastly, it is worth noting the limitations of this study. The 3A assessment framework, while robust, might have its constraints. The poor performance in the 3A evaluation highlighted the need for improvements in the development of climate-smart and flexible urban planning frameworks that can be adapted to current climate challenges. Nevertheless, many interviewed stakeholders from the city of Kigali expressed a need for awareness and a sense of urgency regarding climate change. In recent years, there has been a rise in flooding occurrences despite having pre-existing plans in place. However, no steps were taken to incorporate climate change considerations into these plans. At the policy level, there is no established framework to integrate flood risk management into Kigali's plans. Additionally, urban and district planning processes have shown limited flexibility and capability to tackle climate change concerns.

The findings from the awareness and analysis components, along with other studies from Africa, indicate that climate change challenges, such as flooding and landslides, were neither adequately assessed nor systematically incorporated within Kigali's and Rwanda's overall planning frameworks (Gu, 2019, Henderson et al., 2017, Ijjasz-Vasquez et al., 2021, Pauleit et al., 2015). Furthermore, monitoring of these challenges at all levels of planning appears to be lacking. The National Land Use and Development Master Plan lacks a standardized structure for integrating climate change at different spatial scales, and its significance in addressing climate change issues, particularly at the local level, is limited. This policy gap leaves planning and development authorities to address climate change issues on their own without guidance and support. Similar results were also observed in the Global North, particularly in flood-prone countries such as the Netherlands, Germany, France, UK, Italy, and so on (Stiller and Meijerink, 2016, Uittenbroek, 2016). Uittenbroek's (2016) study conducted in Dutch municipalities and Stiller and Meijerink's (2016) study in Northern Hesse, Germany, have demonstrated that the absence of a coordinated approach to mainstreaming climate change between planning institutions and departments can result in ineffectiveness and hinder the efforts of urban municipalities to mainstream climate change adaptation. These observations also showed that higher-level authorities implicitly incorporate climate change in policies and development plans. As claimed by all key informants, urbanization in the city of Kigali is a new concept and addressing emerging challenges like climate change has become even more complicated.

The findings of this study suggest that the decision-making process in Rwanda, and Kigali city in particular, is limited due to the top-down planning approach. Researchers have suggested that the national government should draft planning laws and regulations for disaster risk areas, resolve conflicts in settlement planning, and provide resettlement and compensation (Adger et al., 2011, Bai et al., 2018, Pelling and Wisner, 2012). In the same context, the national government and institute of national importance are expected to advise municipalities and urban authorities on planning and development issues, monitor planning regulations, and mediate disputes. The municipalities and city level governments should have the mandate to make decisions on conducting climate vulnerability assessments for risk-informed planning, defining planning responsibilities, and developing climate-resilient spatial strategies to mitigate vulnerability to climate change (Nyiransabimana et al., 2019, REMA, 2017). However, the semi-structured interviews also pointed that unclear institutional responsibilities pose a greater challenge to developing a coherent groundwork for mainstreaming climate issues into different spatial scales and planning processes. Unfortunately, in the

case of the city of Kigali, when higher authorities do not consider climate change, this gap may have percolated down to the local level of the planning process.

In many African cities, planning processes and development plans have traditionally prioritized conventional urban needs such as housing, transportation, basic services, and the economy. Climate change and its potential impacts on urban areas have not been given adequate attention in these planning processes (Adelekan et al., 2015, Fraser et al., 2017, Pelling and Wisner, 2012). Failure to consider climate change challenges in planning approaches can exacerbate severe climate risks in flood-prone and landslide-prone areas, as was the case in the city of Kigali. This can lead to negative impacts on urban development. The city of Kigali is also currently under pressure to integrate climate change challenges and adopts a set of climate adaptation approach because of regular flooding and landslides. Wamsler (2014) and Runhaar et al.(2016), propose that effective climate adaptation strategies need to be well-structured and prioritize immediate contextual factors, such as local vulnerability, adaptive capacity, and development priorities. Yet, in Kigali, climate change adaptation is not at the forefront of the city's development agenda. This indicates a potential misalignment between recommended practices for climate adaptation and the current priorities within the city's planning processes. The city of Kigali heavily relies on external financial and technical resources, such as the National Fund for Climate Change and Environment and various ministries. However, these resources and policies are broad in nature and do not address the specific challenges of local governance of climate change issues. As one respondent noted that many climate adaptation strategies and projects are never fully implemented or funded, which further exacerbates the issue. As a result, they often lack coordination, ownership, and accountability. This approach can leave the city even more vulnerable to climate risks..

The use of the 3A assessment framework on selected policies and plans in Kigali revealed a limited integration of climate change considerations into its existing urban plans and prepared strategies. This observation also aligns well with the findings from Kumar and Geneletti (2015) in India, which emphasized that for spatial planning processes intending to address climate change concerns, it is crucial to comprehensively incorporate all three dimensions - awareness, analysis, and action. Kruse and Pütz (2014) work suggested that urban planning can boost awareness and flexibility towards climate change challenges. However, this study reveals that the quality of plans in Kigali is very poor, with both the awareness and analysis components performing poorly. Many essential elements, like climate scenarios and risk assessments, are often missing or vaguely mentioned in the plans. Though some plans hint at adaptation strategies, it is not consistent across Kigali's planning areas.

Local governments and development authorities need to recognize the global environment challenges like climate change and its impacts on their administrative jurisdictions and initiate necessary actions to make their cities and citizens more resilient to a variety of climate change risks (Adenle et al., 2017, Henderson et al., 2017, Simon and Leck, 2015, UN-HABITAT, 2018). Many studies also show that cities around the world are already taking proactive measures, such as urban vulnerability assessments, climate resilient infrastructure, local GHG emissions inventories and scenario development, and green infrastructure adaptation measures (Bai et al., 2018, Bush, 2020, Corner et al., 2014, Liu and Shi, 2017, Seaman et al., 2014, Ullah and Khan, 2017). Many local governments and urban municipalities are drawing insights and resources from global climate initiatives like Global Environment Fund (GEF), the Green Climate Fund, Collective Commitment to Climate Action Fund (CCCA), the International Development Association (IDA) and the International Bank for Reconstruction and Development (IBRD) (Fonta et al., 2018, Vink and Schouten, 2018). Such global collaborations are pivotal in enabling regions and cities in Africa and their policy maker to seamlessly integrate climate considerations into their planning and action. By doing so, they can harness international expertise, secure necessary funding, and tailor global best practices to local contexts, thereby accelerating their journey towards a resilient urban future.

6. Conclusion

In conclusion, this study analyzed the mainstreaming of climate change adaptation in the city of Kigali, Rwanda. The findings of this study highlight the need for policy coherence and harmonized adaptation measures to be promoted in national as well as local urban policies and development frameworks. The lack of explicit consideration of climate change issues in national and urban development policies leads to a potential increase in climate vulnerability and weaken the coping capacities of the socio-ecological system. Development policies, urban plans and climate programs are examples of immediate adaptation strategies and interventions at the city level. There is an urgent need to change

the way current development and climate policies are positioned and prepared across cities in Africa, and to change the capacity of urban plans and planning practices to respond to climate risk. Climate change awareness, analysis and action need to be improved. The poor performance in the 3A evaluation highlighted the need for improvements in the development of climate-smart and flexible urban planning frameworks that can be adapted to current climate challenges. Based on the findings of this study, the following policy recommendations are proposed:

- National, regional and local plans should include explicit consideration of climate change impacts and should establish comprehensive risk assessments and climate adaptation strategies that are flexible and adaptable.
- Capacity building programs and training should be established to improve climate change awareness and analysis among urban planning practitioners, policy makers, and the general public.
- Coordination and cooperation between different stakeholders should be strengthened to ensure effective implementation of climate change adaptation policies and plans.
- Urban planning strategies should be climate proofed with short and long-term climate scenarios in order to identify areas for improvement and to promote evidence-based decision-making.
- In order to finance climate change projects, urban authorities should actively seek out and utilize financial resources from international and national and their funding mechanism.
- The involvement of the private sector in climate change adaptation initiatives should be encouraged, through public–private partnerships and incentives for environmentally sustainable practices.

Overall, this study emphasizes the urgent need for mainstreaming of climate change adaptation in African cities, and for comprehensive, flexible, and adaptable climate change adaptation strategies to be integrated into urban planning practices. Such strategies can help to mitigate the risks and impacts of climate change on urban populations, infrastructure, and ecosystems, and to ensure that cities are able to adapt and thrive in the face of future climate challenges.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data will be made available on request.

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