

Research Article

Discovering the Development Orientations through the Graphical Analysis of Master Plans: Case Study in Kigali, Rwanda

Rahman TAFAHOMI*, Julian NAGADDYA**

Abstract

This paper aims to analyze the master plans of Kigali City to identify the transition and orientation from 2007 to 2020. The city has passed three master plans, including those of 2007, 2013, and 2020. The revision of the master plans resulted in changes to the objectives, strategies, and output maps, such as development patterns, land use, road networks, and public spaces. The research methodology was designed based on graphical analysis, applying the diagramming and interpretation of graphical features through redrawing. Data were extracted from output maps of the master plans. The findings reveal a pattern of urban development from the eastern part of the city to the northern and southern parts from 2007 to 2020. This pattern of development shifted from an ideal village concept of development to the linear and mixed-use activities based on the street-mixed-use structure to accommodate more opportunities for businesses. The road network was based on the east-west connection, which was developed into a loop network to support the mixed-use activities at different scales across the city. The mixed-use structure integrates the public and private facilities in different scales for business and investment. Despite the positive transition in the master plans, the development pattern of the city needs to prioritize neighborhood structure, TOD (Transit-oriented Development), and public transport, walkability, and multiscale green public spaces, such as neighborhood, sector, and urban scales, with the function of gardens, forests, and green roads, for a sustainable, consistent, and balanced development.

Keywords: Development pattern; Land use; Master plan; Public green spaces; Road network

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Araştırma Makalesi

Ana Planların Grafiksel Analiz Yoluyla Gelişim Yönelimlerinin Keşfi: Kigali, Ruanda'da Vaka incelemesi

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Öz

Bu çalışma, Kigali şehrinin 2007-2020 yılları arasındaki geçiş ve yönelimini belirlemek amacıyla Kigali şehrinin ana planlarını analiz etmeyi amaçlamaktadır. Şehir, 2007, 2013 ve 2020 yıllarına ait üç ana planı hayata geçirmiştir. Ana planların revizyonu, kalkınma modeli, arazi kullanımı, yol ağı ve kamusal alanlar gibi amaçlar, stratejiler ve çıktı haritalarında değişikliklere yol açmıştır. Araştırma metodolojisi, grafiksel analize dayalı olarak tasarlanmış olup, grafiksel özelliklerin yeniden çizim yoluyla diyagramlanması ve yorumlanması uygulanmıştır. Veriler, ana planların çıktı haritalarından elde edilmiştir. Bulgular, 2007-2020 yılları arasında kentsel gelişmenin şehrin doğu kesiminden kuzey ve güney kesimlerine doğru bir yönelim modelini ortaya koymaktadır. Bu gelişim modeli, işletmeler için daha fazla fırsat sağlamak amacıyla ideal bir köy konseptinden, cadde tabanlı karma kullanımlı yapıya dayalı doğrusal ve karma kullanımlı faaliyetlere doğru kaydırılmıştır. Yol ağı, şehirdeki farklı ölçeklerdeki karma kullanımlı faaliyetleri desteklemek için doğu-batı bağlantısına dayalı olarak bir döngü ağına dönüştürülmüştür. Karma kullanımlı yapı, iş ve yatırım için farklı ölçeklerde kamu-özel sektör entegrasyonunu kolaylaştırmaktadır. Ana planlardaki olumlu geçişe rağmen, şehrin gelişim modelinin sürdürülebilir, tutarlı ve dengeli bir kalkınma için mahalle yapısına, ulaşım odaklı gelişime (TOD), toplu taşımaya, yaya ulaşımına ve bahçeler, ormanlar ve yeşil yollar gibi çok ölçekli yeşil kamusal alanlara öncelik vermesi gerekmektedir.

Anahtar Sözcükler: Gelişim modeli; Arazi kullanımı; Ana plan; Kamusal yeşil alanlar; Yol ağı

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INTRODUCTION

Master plans have long served as powerful ideological tools for shaping urban development, embedding within them the values, assumptions, and aspirations of the societies that produce them (Jacobs, 2021). Historically, planning was strongly influenced by idealist traditions, beginning as early as Plato's conception of governance in *The Republic* and resurfacing in the eighteenth-century revival of German Idealism (Firley & Gron, 2013; Tafahomi, 2024). Throughout the nineteenth and early twentieth centuries, idealism continued to structure urban planning practice, privileging orderly and utopian visions such as the City Beautiful and Garden City movements' visions, which often proved inadequate in addressing the messier, more complex realities of contemporary cities, particularly in the Global South (Graham, 2016; Hall, 2014; Mumford, 2018).

As planning evolved, master plans transitioned from static, design-oriented blueprints to more dynamic frameworks incorporating socioeconomic, political, and ecological dimensions (Firley & Gron, 2013; Mumford, 2018). Scholars such as Friedmann (1987; 2011) have emphasized the role of political power, citizen rights, and insurgent planning practices in shaping urban transformation, challenging technocratic approaches that overlook lived experiences and local governance realities. Contemporary debates increasingly call for performance-based, context-sensitive, and inclusive master planning that can accommodate rapid urbanization, informality, climate risk, and institutional complexity (Alexander, 2016; Bertaud, 2018; Steiner, 2018).

In African cities, these global debates intersect with distinct historical, socio-political, and environmental pressures. Early post-independence master plans largely replicated Western planning models, often reinforcing spatial inequality and failing to accommodate informal urban processes (Harrison et al., 2007; Turok, 2016; Watson, 2009). Over time, however, African urban scholarship has advanced more adaptive frameworks that recognize the coexistence of formal and informal systems, which Simone (2004) terms "people as infrastructure" and challenge narratives that dismiss unplanned settlements as mere disorder (Pieterse, 2010; Robinson, 2014; Roy, 2005; Tafahomi & Nadi, 2021a). This shift has encouraged planning approaches that integrate indigenous knowledge, participatory governance, and more flexible spatial strategies capable of responding to rapidly changing conditions (Bertaud, 2018; Steiner, 2018).

Within this broader African context, the evolution of Kigali's master plans from the 2007 Conceptual Master Plan to the 2013 and 2020 planning frameworks illustrates the ongoing effort to reconcile long-term urban visions with local realities. The three generations of plans reflect shifting priorities: from village-like clusters and idealized neighborhood models (OZ, 2007) to corridor-based development and refined density strategies (Surbana, 2013), and ultimately to mixed-use, integrated, and environmentally responsive planning paradigms that emphasize densification, ecological networks, and multimodal mobility (Surbana Jurong Consultants Private Limited (SJ), 2020). These transitions mirror global trends while also responding to Kigali's unique challenges, including rapid demographic growth, the persistence of informal settlements, and the need for resilient infrastructure (Goodfellow, 2014; MININFRA, 2015; World Bank, 2012). Bryceson (2014) mentioned that informality has been part of the urban growth in Africa. Masterplan 2007, mentioned that approximately "83 percent" of population in Kigali lived in informal settlement (OZ, 2007).

While all master plans have a time horizon projecting the development of cities, the scientific aspect of master plans lies in their objectives, strategies, and orientations rather than the horizon of the plans. Despite revising master plans beyond the horizon, the knowledge gap lies in the orientation of the master plans that deal with the social, economic, and political aspects (Tafahomi, 2025) of the daily lives of people. Therefore, the research questions of this paper are formulated as follows: What is the pattern of development in the city? How did land use and the road network support the development pattern? What is the location of public spaces and green spaces in the city? In this regard, the research objectives are to analyze the master plans of 2007, 2013, and 2020 through

diagrammatic analysis to discover the patterns of development across the years. It is expected that, given these dynamics, a systematic analysis of Kigali's master planning evolution provides critical insight into how planning ideas are translated into spatial strategies, how urban form has changed over time, and how the city negotiates tensions between idealized visions and lived urban realities. By examining key thematic layers, land use, urban patterns, road networks, and green systems, this study situates Kigali's planning trajectory within both global and African theoretical debates, offering a grounded perspective on the opportunities and limitations of master planning in rapidly urbanizing African contexts.

CRITICAL POINTS ON MASTER PLAN STUDIES

Evert (2010) defined a masterplan in terms of geographical and graphical guidelines for developing an area or city that is divided into different phases or sections, and typically focuses on a location with a specific boundary. While diversity has become a common specification of master plan, Mumford (2018) highlighted a process of transition in master plans from a graphical and design-oriented approach to a focus on objectives, policies, and strategies in the 20th century. In this regard, the master plan handbook highlighted that master plans encompass political, social, and economic aspects in a geographical framework (Firley & Gron, 2013). Friedmann (1987) argued that political power shapes urban development and redevelopment in his earlier theories on urban development. He criticized the urban planning methods for paying insufficient attention to people's rights in the new set of theories in terms of insurgent cities (Friedmann, 2011).

The master plan passed the transitional processes in history. While the meaning of the plan referred to the average of something in an ideal form of government by Plato in the Republic (Firley & Gron, 2013), the term "plan" was engaged more with the utopianism and idealism in the 18th century under the influence of German Idealism (Tafahomi, 2024). The linearity and order of the City Beautiful Movement or Garden City ideals, for example, fail to address the messiness and informality of contemporary African cities (Graham, 2016; Mumford, 2018). Geddes' theory of "place, work, and folk" still holds analytical power, especially in integrating socioeconomic variables in planning, but modern urban scholarship insists on moving beyond idealism to performance-based models (Alexander, 2016; Dempsey & Jenks, 2006). Scholars increasingly argue for context-sensitive frameworks that integrate indigenous knowledge and local governance realities (Eraydin & Taşan-Kok, 2013).

Master planning today transcends its historical origins as a rigid blueprint to a strategic, iterative process that aims at managing rapid urbanization, balancing environmental concerns, and ensuring equitable development. Contemporary scholarship emphasizes the need for adaptive and inclusive frameworks capable of responding to emerging challenges such as climate change, informality, and technological disruption (Bertaud, 2018; Steiner, 2018). Levy (2016) defines master planning as a tool to coordinate long-term land use, infrastructure, and public space development. However, critics like Bertaud (2018) argue that over-reliance on top-down, design-centric paradigms can be misaligned with dynamic urban markets and social complexities. Thus, an evolving consensus now advocates for flexible planning that prioritizes urban resilience, data-driven interventions, and participatory governance.

Master Planning Across Africa

Across Africa, master planning has undergone significant evolution, reflecting the continent's unique socio-political trajectories, environmental challenges, and the interplay between formal and informal urban processes. Early post-independence plans largely replicated Western planning paradigms characterized by zoning, functional segregation, and technocratic control, often detached from indigenous spatial practices and social dynamics (Turok, 2016; Watson, 2009). Such models, while intended to modernize African cities, often reinforced inequality by overlooking the realities of

informality (Tafahomi & Nadi, 2021a), rapid urbanization, and limited institutional capacity (Harrison et al., 2007).

In recent decades, a paradigm shift toward more adaptive, inclusive, and locally embedded frameworks has emerged. African urban scholars argue for planning that recognizes the co-existence of formal and informal systems (World Bank, 2012) a concept described as “people as infrastructure” (Simone, 2004), in which everyday practices sustain urban life amid institutional gaps. Tafahomi and Nadi (2021a) criticized the terminology of unplanned settlements across African cities as simply chaotic voids rather than dynamic spaces of adaptation and innovation. They identify “transformative” public spaces—de-form, less-form, soft-form, and anti-form that evolve through user negotiation and self-organization, challenging conventional notions of design order. Similarly, Friedmann (1987) underscores the unplanned city term as a critical laboratory of urban learning, where informality embodies resilience, creativity, and resourcefulness within constrained economic systems. A new critical study found that the term ‘slum’ is not just a formal specification of buildings but rather a political, social, and economic segregation in cities (Tafahomi, 2025).

This growing acknowledgment of informality as a structuring force, rather than a failure of planning, has influenced new planning approaches across the continent. In Nairobi, participatory slum-upgrading programs integrate community mapping and co-production of space (Kyohairwe & Karyeija, 2024; Nyamu & Obala, 2024), while in Kampala, Lwasa (2010) emphasizes incorporating environmental adaptation and climate resilience into city-wide planning. South Africa’s post-apartheid planning frameworks (Oranje, 2021; Todes, 2011) similarly aim to bridge historical spatial divides through just and reflexive urban transformation, though challenges of implementation persist (Korah & Cobbinah, 2023).

Across East Africa (Kenya, Uganda, Rwanda, and Tanzania), contemporary master plans increasingly adopt hybridized approaches combining strategic spatial frameworks, digital tools such as GIS, and participatory engagement with local communities (Steiner, 2018; Turok, 2016). Nevertheless, tensions remain between imported planning ideals and the lived spatial practices that define African urbanism. The studies of Alexander (2016) and Bertaud (2018) caution that planning without grounding in local market behavior and social complexity risks producing static, exclusionary outcomes. Therefore, the future of master planning in Africa hinges on reflexivity, acknowledging the agency of informal actors, integrating indigenous knowledge systems, and balancing long-term vision with the fluid realities of African urban life.

Master Planning in Rwanda: Kigali as a Case Study

The 2007 Kigali Conceptual Master Plan, inspired by economic island urban models, emphasized zoning, new development nodes, and centralized planning (OZ, 2007). The master plan was revised and approved in 2013 based on the corridors of development toward the east and north, the new district and neighborhoods structure, and mixed-use activities (Surbana, 2013). The master plan of 2020 followed the same structure of the preceding plans with more concerns on the ecological aspects, densification, and new development zones (SJ, 2020). The transition process of the master plans transferred the urban structure not only at the city level but also at the neighborhood scale. Nonetheless, slum areas (World Bank, 2012) have been one of the key factors in shaping the minds of planners in the city. However, this terminology was later changed into unplanned settlements (MININFRA, 2015).

There are three clusters of studies and literature to analyze a master plan (APA, 2006; Baum, 2021; Chiarella, 2005; Hall, 2014). First are the qualitative and quantitative standards the refer to urban development globally (Graham, 2016) such as the density of the population or construction (APA, 2006; Alexander, 2016), urban form and structure (Friedmann, 1987; Harvey, 2013), percentage of the road networks (Nkurunziza et al., 2021), urban infrastructure (Manirakiza et al., 2025), land use (APA, 2006; Firley & Gron, 2013), flexibility (Cengiz, 2013), and resiliency (Eraydin & Taşan-Kok,

2013). The second cluster refers to the human perception of urban environment and location of life (Bertaud, 2018; Dempsey & Jenks, 2006). These groups of the studies highlighted green spaces (Evert, 2010), quality of urban life (Gehl & Svarre, 2013), neighborhood structure (Harrison et al., 2007; Levy, 2016), social aspects of urban structure (Knox, 2007), inclusivity (Kyohairwe & Karyeija, 2024), and urban green network (Roo, 2011). The third cluster refers to the African cities and contextual problems, informality, and slum specifications. In this group of studies, the historical rigidity of master planning was criticized, while advocating for adaptive, inclusive, and context-sensitive approaches suited to African urban contexts (Bertaud, 2018; Steiner, 2018). Drawing from urban scholarship across Africa, it becomes evident that future planning efforts must be both visionary and reflexive, grounded in local realities, supported by digital tools, and underpinned by institutional capacity (Alexander, 2016; Turok, 2016; Watson, 2009). Particularly, Pieterse (2010), Robinson (2014), Roy (2005; 2014), and Simon (2004) have done systemic research on the specification of the African cities to highlight the level of urban informality, effects of colonial theories on urban development, and poverty as an ingredient of urban development.

Theoretical Framework

To analyze the master plan of Kigali city, some common specifications were identified across the three generations of the master plan to examine the level of development, changes, and restructuring of urban forms to illustrate the urban structure and proposed urban quality in the master plans. Those parameters were listed as land use, urban patterns and neighborhood structure, road network, and urban green spaces patterns.

Land use analysis is equally important, offering insights into spatial allocation, zoning efficiency, and urban justice (Friedmann, 2011; Levy, 2016). In Kigali, rigid zoning frameworks have led to discrepancies between formal plans and ground-level realities, particularly in terms of informal settlement exclusion and underutilization of land (Goodfellow, 2014; Nyamu & Obala, 2024). South African and East African cities face similar challenges, and planners are increasingly turning to GIS and participatory mapping to support inclusive, responsive zoning (Oranje, 2021).

Neighborhood structure emerges as a key theme, providing a critical lens to examine spatial equity, social cohesion, and access to services (Levy, 2016; Verebes, 2013; Watson, 2009). In African cities, neighborhood design often reflects colonial planning legacies that continue to shape patterns of exclusion and inequality (Harrison et al., 2007). Kigali's current master plan promotes compact, walkable, mixed-use neighborhoods to foster sustainability and reduce congestion (Goodfellow, 2014). Analyzing this structure helps evaluate the effectiveness of such strategies, identify informal settlement patterns, and assess the realization of inclusive spatial development (Korah & Cobbinah, 2023; UN-Habitat, 2022; World Bank, 2012).

Development patterns, which reflect both planned and organic urban expansion, reveal the spatial logic and socio-economic drivers behind city growth (Dempsey & Jenks, 2006; Watson, 2009). In Kigali, growth corridors have not always materialized as envisioned, with informal dynamics often prevailing (Goodfellow, 2014; Manirakiza et al., 2025). South African cities are exploring polycentric and transit-oriented models, while East African urban centers increasingly embrace density and nodal development to manage sprawl and infrastructure gaps (Lwasa, 2010; Todes, 2011).

The road network and connectivity analysis remain central to evaluating urban functionality, mobility equity, and infrastructure alignment (Bertaud, 2018; Verebes, 2013). Kigali's road system is evolving to connect major nodes, yet secondary roads and last-mile access remain weak, particularly in peripheral areas (Goodfellow, 2014; Nkurunziza et al., 2021). Similar trends are evident in Nairobi and Kampala, where road hierarchy and public transit integration face implementation gaps (Lwasa, 2010). South Africa's transport strategies offer lessons in linking infrastructure with social equity and access to opportunity (Oranje, 2021).

The green infrastructure, green open spaces, and public spaces have also been one of the key qualities in urban life. The concept of green spaces on an urban scale was discussed in four aspects. First, the urban infrastructure and urban green dimensions (Baka & Mabon, 2022; Buckley & Kallergis, 2014; Groening & Hennecke, 2014; Jim & Tan, 2017; Miller, 2007), second neighbor scale green spaces and effects on the quality of the inhabitants (Baka & Mabon, 2022; Moughtin & Shirley, 2006), third, the road green corridors and the networks in urban structure (Horte & Eisenman, 2020; McPherson et al., 2016; Tafahomi, 2022), and fourth, public green spaces (Carmona et al., 2003; Gehl, 2007; Tafahomi, 2021a).

METHODOLOGY AND RESEARCH DESIGN

Methodology

The qualitative methods were utilized to evaluate the quality of the planning and design, particularly based on mapping (Dua et al., 2015; Jiang, 2014), graphical analysis (2021a), content analysis (Carmona et al., 2003; Jacobs, 2021), case study (Groat & Wang, 2002), and storytelling and interpretation (Hall, 2014; Hillier, 2002; Mugerauer, 1995) in historical research (Evert, 2010; Groat & Wang, 2002). Mapping and redrawing of graphical features have been among the methods used to analyze and capture the essence of the drawings (Tafahomi & Nadi, 2021b). For example, Goldschmidt (2004) emphasized that mapping and redrawing are systems of thinking and communicating in architecture and built environment programs. Despite the philosophical approach to the graphical analysis (Laseau, 2000; Lawson, 2005), the technical aspects of the mapping were more common tools for mapping data (Nyiransabimana et al., 2019; Otto et al., 2011; Umek, 2003). For example, Ghosh (2016) applied the maps of the master plan to discover the patterns of the food supply through redrawing the master plans to highlight the objectives and effects of the strategies. Amistadi et al (2022) applied the mapping to trace the public spaces in Europe. The study revealed that the drawing and redrawing of the master plan ideas and information could be presented through conceptual, schematic, or diagrammatic, and even inhabitants' perceptual maps (Tafahomi, 2021b).

Research Design

This research applied the graphical analysis technique through redrawing the maps to highlight the different aspects of the master plans in Kigali city. The mapping of maps is also called a meta-analysis of graphical features (Tafahomi & Nadi, 2021b). The applied techniques involved redrawing the key layers of the city's master plans through diagramming the objectives and strategies with the symbolic graphical features to decode the development policies and ideas. To accomplish the analysis, the research transformed the master plans' maps into interpretative diagrams and sketches with application of points, lines, polygons, hatches, and symbols (Otto et al., 2011; Reed, 2021; Tschumi, 2014; Umek, 2003).

The graphical techniques were described as a graphical system of thinking for understanding the context and built environment, even though they were presented as a simple drawing (Reed, 2021; Taketa, 1996). In this system of thinking, the non-graphical texts were converted into graphical features for presentation and communication through maps and diagrams (Kim & Ketenci, 2019; Umek, 2003). Some elements were mentioned as the criteria for creation of analytical and diagrammatic maps (Tschumi, 2014), such as colors (Brewera et al., 1997; Laseau, 2000), symbols (Goldschmidt, 1991), and graphical features (Ching, 2015; Laseau, 2000; Lawson, 2005).

Research Process and Data

This research determined four crucial layers of the master plans that represent the development process, ideas, and strategies, including land use, road network, density, and green spaces. The layers in the master plans (2007, 2013, 2020) were extracted, and through the graphical features, such as points, lines, polygons, arrows, and symbols were interpreted to expose the strategies in

the master plans. All graphical data were converted into graphical features, such as lines, polygons, and symbols, to highlight the specification of the maps through graphical and diagrammatic presentations. For example, Dua et al (2015) mentioned that all spatial objects could be converted into graphical elements to represent geographical information. In addition, Ching (2010) mentioned that all redrawing has been a system for understanding architectural and environmental elements.

Data in the research were selected from the published master plans in Kigali city in 2007, 2013, and 2020. All data were downloaded from the City of Kigali webpage to compare the concept of the maps based on the four important factors of development. The relevant maps were selected from the master plans' reports and analyzed comparatively. Therefore, some maps were converted into graphical shapes (Harwood & Rawlings, 2001; Metz, 1990), such as lines for road network and development orientations, shapes for land use and development patterns, symbols for green aspects, and nodes to represent the data more visible (Shive & Francis, 2008) in terms of analytical maps (Groat & Wang, 2002; Laseau, 2000). Nonetheless, the selected data were at the urban scale levels. Therefore, the analysis paid more attention to urban-scale data, such as main roads, hubs, nodes, the central point of the density, and urban-scale public spaces.

Location and Context

Kigali, the capital of Rwanda, is located in the central part of the country, in the Eastern African community. Kigali was established around 1900 as a new commercial and administrative hub during colonial times. The city flourished after independence in 1962 and was selected as the capital of the country (NWE, 2025). The city is located in a forested area with a tropical climate, although the level of urban development has fragmented the forests into urban areas (Tafahomi, 2021c).

The city is divided into three districts, including Gasabo, Kicukiro, and Nyarugenge. The first master plan, called the "Kigali Conceptual Master Plan" was developed in 2007. The second master plan (officially the first master plan) was approved and announced in 2013 with the name "Kigali Master Plan", and the third master plan, was called "Kigali Master Plan 2050". Despite the conceptual master plan in 2007 for Kigali city (OZ, 2007), the officially approved master plan was announced in 2013 (Surbana, 2013). The current master plan of 2020 was an update to the master plan of 2013 (SJ, 2020). The master plan of 2020 reported that the city includes 1.3 million people over 729.6 km², with a density of 1780 people per km², and was supposed to reach 3.5 million people with a density 6000 people per km² (Figure 1).

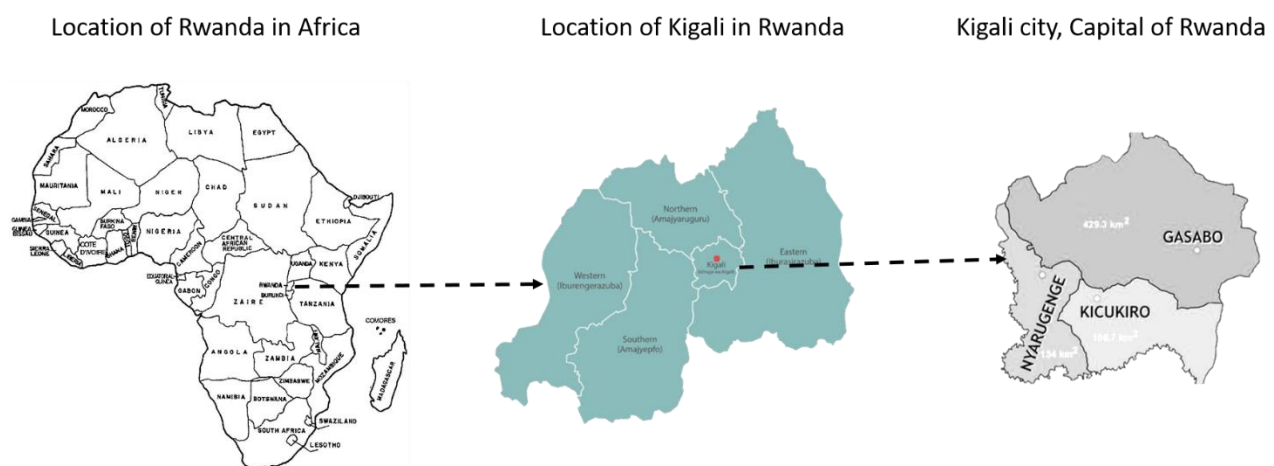


Figure 1. The Location of the Kigali city in Rwanda and Africa

RESULTS

The result section included the maps of master plans, graphical analysis, and explanations for each cluster of data (Tables 1-4).

Table 1. Land-use maps analysis (Reference: OZ, 2007; SJ, 2020; Surbana, 2013)

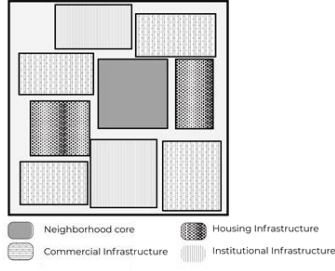
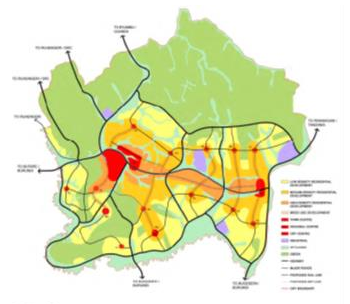
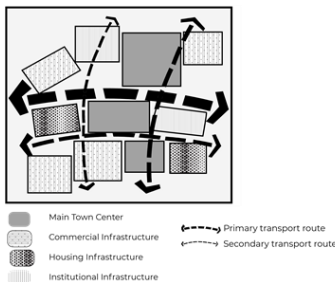
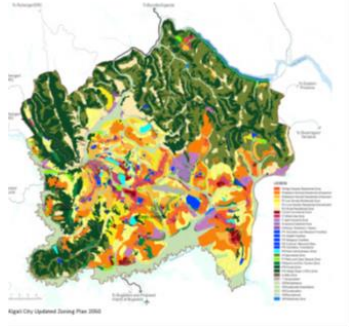
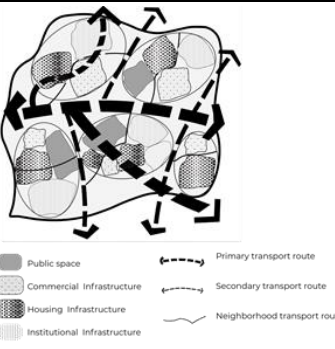
Year	Master Maps	Graphical Analysis	Explanation
2007			The 2007 master plan proposed land use in clustered arrangements based on an ideal village or small community in the neighborhood scale, with the essential functions. All communities, as housing areas, included a center with the proposed clusters, such as educational, commercial, administrative and open spaces.
2013			The 2013 master plan for Kigali illustrated a primarily linear land use pattern that followed transport routes, but varied along the way. Some segments were designated as commercial zones, others expand into different uses, creating differences in the functional layout along this line. For instance, one area might be entirely commercial, while another could have housing situated behind commercial spaces.
2020			The 2020 Kigali Master Plan adopted a mixed land-use approach, emphasizing integrated zoning with "clusters within clusters" or "zoning within zoning." This layered system shows multifunctional areas by blending educational, residential, and commercial uses within each zone.

Table 2. Development patterns (Reference: OZ, 2007; SJ, 2020; Surbana, 2013)

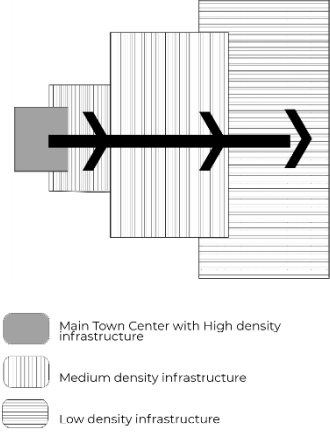
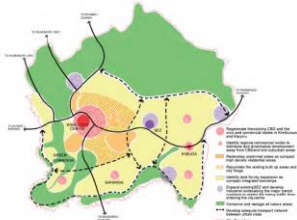
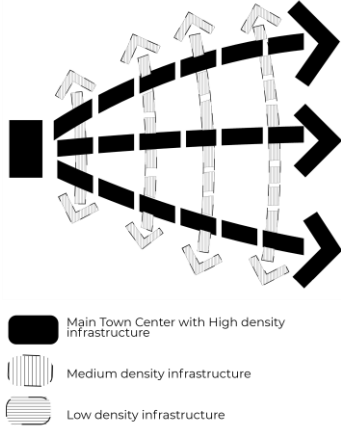
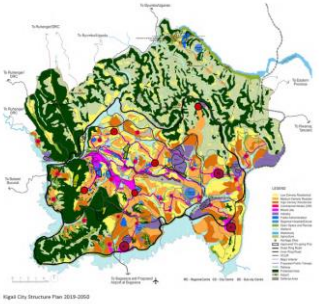
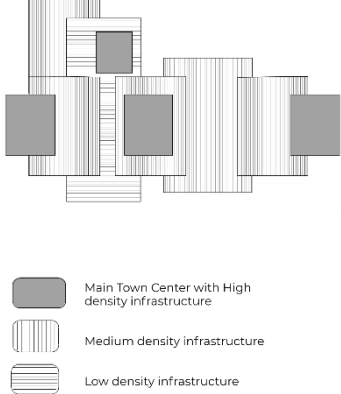
Year	Master Maps	Graphical Analysis	Explanation
2007			2007 shows an urban structure with high-density zones at the center, medium density in surrounding areas, and low-density zones at the edges. This flexible approach blends residential, commercial, and recreational spaces within each zone.
2013			The 2013 Master Plan refines the 2007 model, maintaining high-density zones at the center, medium density in the surrounding areas, and low-density at the edges. However, it includes high density centers along major transport routes.
2020			The 2020 Kigali Master Plan introduces a layered overlapping density model. As one moves away from the city core, these density clusters overlay one another, with each having high, medium and low-density infrastructure creating interconnected layers within the city.

Table 3. Road network patterns (Reference: OZ, 2007; SJ, 2020; Surbana, 2013)

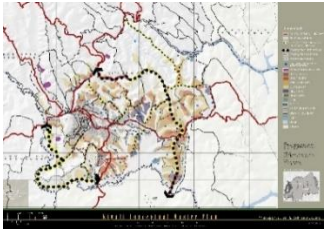
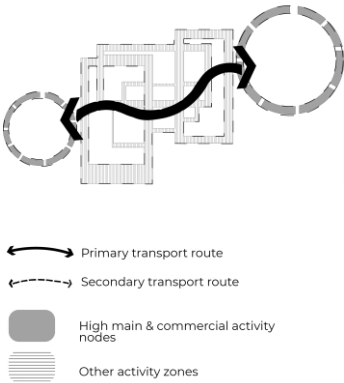
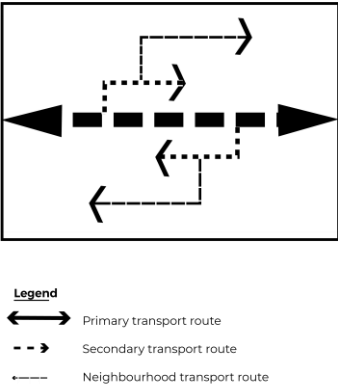
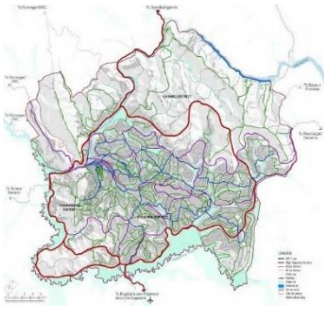
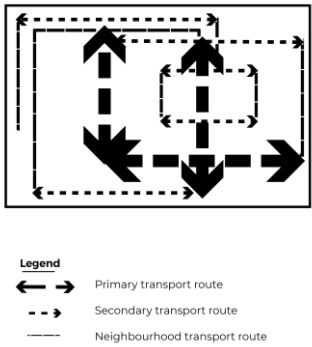
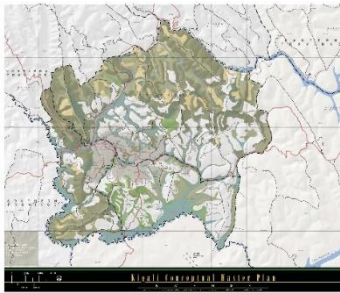
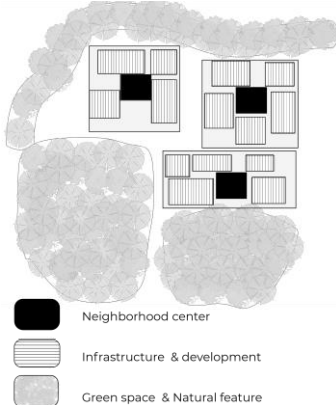
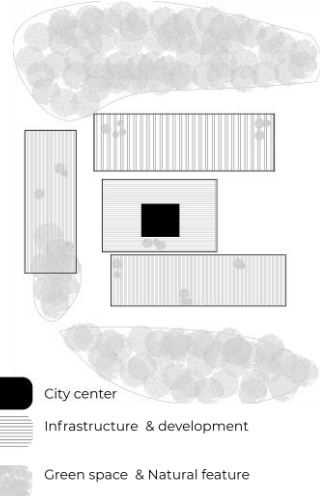
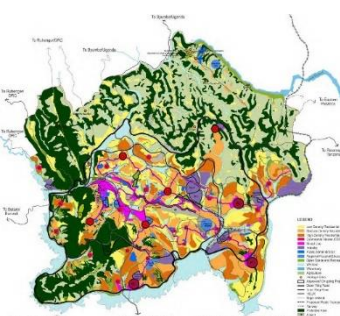
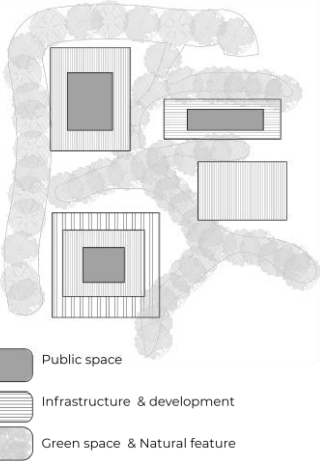
Year	Master Map	Graphical Analysis	Explanation
2007			In 2007, the network was designed to create routes to connect different activity nodes as one moves out of the city.
2013			The 2013 plan introduced enhanced connectivity and diversified road types, applying varying road weights.
2020			The 2020 master plan expanded 2013 designs, adding specialized transport layers, such as non-motorized pathways, pedestrian zones, and a bus rapid transit (BRT) system. The latest plan also introduced green buffers around non-motorized routes and designated parking areas, prioritizing sustainable, multimodal connectivity throughout the city creating a loop like network.

Table 4. Public green space patterns (Reference: OZ, 2007; SJ, 2020; Surbana, 2013)

Year	Master Map	Graphical Analysis	Explanation
2007			The 2007 Kigali master plan outlined green spaces mainly as surrounding the city, particularly north and east, as natural and village areas to form a green buffer for the city.
2013			By 2013, the approach had evolved to incorporate additional, smaller green spaces, including town parks and identified wetland areas, with the potential for the green spaces to be developed within the urban areas and urban centers.
2020			In 2020, the green space plan selected an integrated approach for internal and external green spaces with emphasizing both ecological and recreational aspects. It introduced a larger green buffer around the city core and enhanced the inclusion of environmental corridors that extended from the core into residential areas.

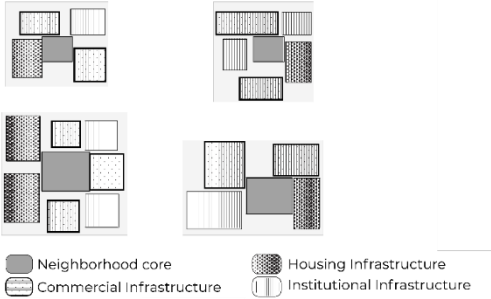
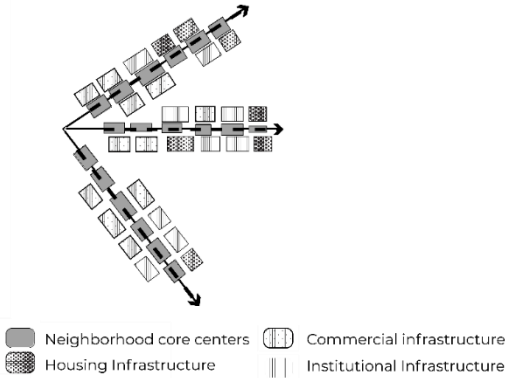
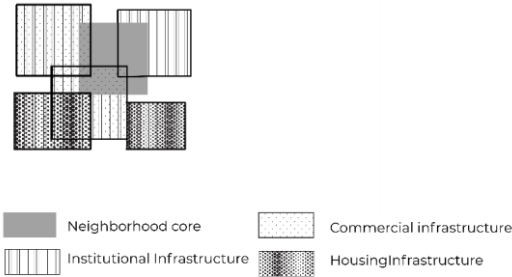
Analyzing the Results

The analysis of the Kigali City Master Plans (2007, 2013, 2020) reveals a progressive evolution in urban planning approaches, reflecting changes in priorities, technological advancements, and urban management strategies. However, potential challenges and dangers accompany these advancements. This section presents key findings and associated risks across the four thematic

layers: Land Use and Function, Urban Density and Development Patterns, Road Network and Connectivity, and Green Networks and Open Spaces.

The “Ideal Village” concept offered a structured and community-oriented framework for land use, creating neighborhoods organized around shared identity and cohesion in 2007. By 2013, the shift toward organizing functions along linear corridors introduced clearer spatial structure, aligning development with major routes and strengthening urban form. Still, ensuring that all residents have equitable access to services and amenities across these corridors would further enhance vibrancy and reduce disparities. The 2020 plan introduced even greater complexity through integrated zoning and multifunctional clusters. This creates significant opportunities for mixed-use development and more adaptable urban spaces. This process densified the central points and linked those core areas during the revision of the master plan (Table 5). According to the mixed-use and commercial road-oriented development, prioritizing the privacy of the neighborhoods should be the next step in the detailed development plans to support communities.

Table 5. Findings from land use and function (The figures were designed by the authors)

YEAR	DIAGRAMTIC ILLUSTRATION	
2007		The 2007 Master Plan envisioned the area as a constellation of clustered, village-like neighborhoods, each designed to echo the intimacy and coherence of an ideal rural settlement. This approach emphasized community-scale planning, where land use was organized around shared spaces and local identity.
2013		By 2013, the vision evolved into a more linear land use pattern that followed major transport routes. This shift created a clearer functional differentiation along these corridors, with specific activities and services aligned to mobility, accessibility, and emerging economic flows. The landscape became more structured by movement, introducing a spine-like organization of space.
2020		The 2020 Master Plan further refined the earlier concepts by adopting a “clusters within clusters” framework. This model sought to enhance integration across different zones and promote multifunctional land use. Rather than separating activities, the plan encouraged layered, interconnected clusters that support diverse uses within a cohesive structure, deepening the emphasis on integration and resilience.

The development pattern of the city worked simultaneously with the land use map to develop the Ideal Village pattern into an ideal form of living in the future, with some exemplified models of development, such as Vision City, and special development zones. Master plans led the city to strengthen the central core while shaping outward growth through the concentric density model. In 2013, placing higher densities along major transport routes aligned growth with mobility, enhancing efficiency and encouraging more organized expansion to link the different points and centers of development. The 2020 approach, characterized by overlapping densities and interconnected clusters, supports the creation of more dynamic and flexible urban environments. The plan facilitated the reconstruction of the central core of the city as a symbol of modernism with commercial zones and mixed-use activities (Table 6). Both development and redevelopment plans need to pay more attention to the urban design framework and urban landscape qualities to see the urban areas as a whole, not individual plots.

Table 6. Findings from urban density and development patterns (The figures were designed by the authors)

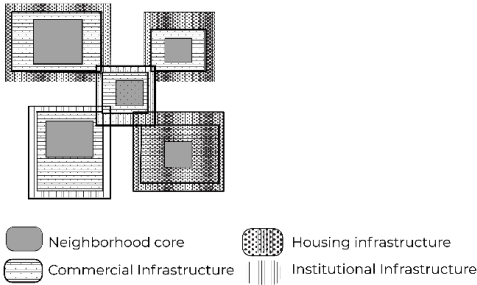
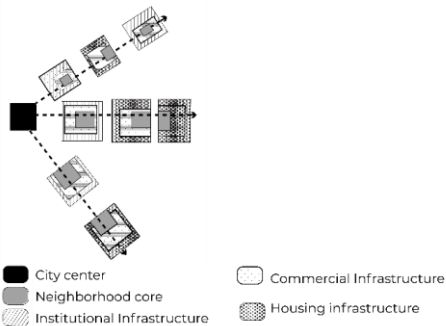
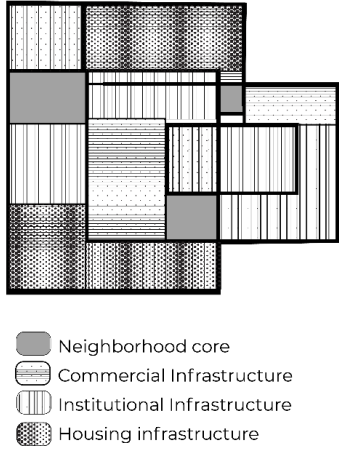
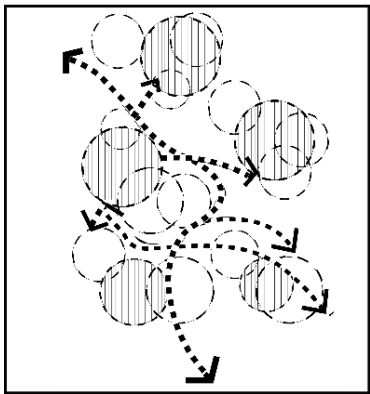
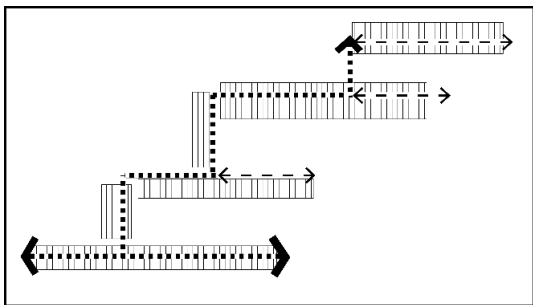
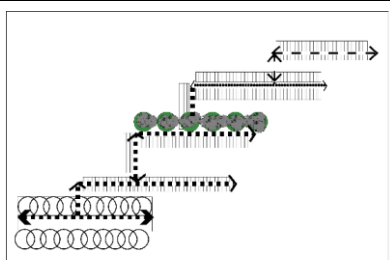
YEAR	DIAGRAMATIC ILLUSTRATION	EXPLANATION
2007	 Legend: - Neighborhood core - Commercial Infrastructure - Housing infrastructure - Institutional Infrastructure	The concept of the development pattern in 2007 envisioned the city growing outward from a highly concentrated core, where the greatest densities were intentionally placed at the center and gradually tapered off toward the periphery in terms of the "Ideal Village". This concentric model created a clear hierarchy of space, reinforcing the importance of the urban core as the primary hub of activity.
2013	 Legend: - City center - Neighborhood core - Institutional Infrastructure - Commercial Infrastructure - Housing infrastructure	By 2013, planning priorities shifted toward a more distributed structure. Instead of concentrating density solely in the center, the plan introduced high-density nodes along major transport routes. This approach allowed development to follow the corridors of movement and accessibility, encouraging growth in strategically connected pockets across the city.
2020	 Legend: - Neighborhood core - Commercial Infrastructure - Institutional Infrastructure - Housing infrastructure	The 2020 Master Plan advanced the idea of distributed density even further by adopting a layered and overlapping model built around interconnected clusters. Rather than functioning as isolated nodes, these clusters were designed to work together as part of a networked system, supporting multifunctional spaces and more adaptable urban patterns.

Table 7. Findings from road network and connectivity (The figures were designed by the authors)

YEAR	DIAGRAMTIC ILLUSTRATION	EXPLANATION
2007	  Main road route  Main activity node  Secondary activity nodes	The 2007 Master Plan placed emphasis on extending connections outward from the city center, linking key activity nodes in a way that reinforced the dominance of the central core. Movement patterns were primarily radial, with major routes channeling activity from the heart of the city toward outlying areas.
2013	  Main road route  Secondary road route  Infrastructure developments	In 2013, the approach to connectivity became more diversified. The plan introduced a broader range of road types, creating a more nuanced and flexible circulation network. This shift supported growth in multiple directions, enabled better distribution of traffic, and strengthened links between emerging neighborhoods and commercial zones.
2020	 LEGEND  Main road route  Secondary road route  Infrastructure developments  Boulevard  Rapid Bus Transport route  Pedestrian corridor	By 2020, connectivity evolved into a fully multimodal vision. The plan prioritized Bus Rapid Transit corridors, non-motorized pathways, and green buffers, aiming to create a more inclusive, sustainable, and environmentally responsive mobility system. Movement was no longer defined solely by roads but by an integrated network designed to support different modes of travel while enhancing ecological resilience.

The road network's focus on centralized connectivity, improved access to the urban core in 2007, but it could be strengthened further by expanding and upgrading secondary and tertiary routes, improving connections to peripheral zones. By 2013, the transport system had developed into a network well-suited for motorized travel, enhancing mobility across major corridors. Integrating non-motorized transport options—such as safe walking and cycling networks—would further improve

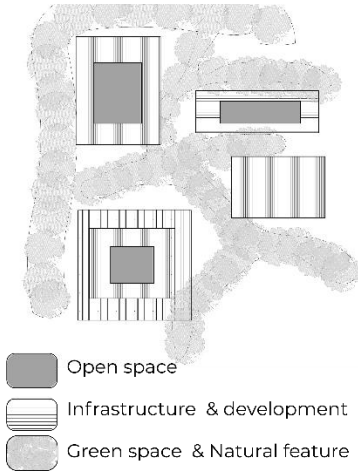
inclusivity and support more sustainable mobility choices. The 2020 plan's embrace of a fully multimodal system, including BRT routes, pedestrian infrastructure, and ecological buffers, offers significant potential for a more resilient and efficient transport network. The finding shows an orientation from the first master plan to improve the East-West connection in the city for commercial activities. This orientation has developed since 2013 toward the southern border, particularly the potential airport in the south and north parts, as a spot for new development in the city, which recommended multilayer roads to connect east and west (Table 7). Nonetheless, the new master plan needs to be supported by a TOD (Transit-oriented Development) strategy based on the public transport, such as BRT (Bus Rapid Transit), Metro, and integration of the stations and buildings.

The public and green spaces were not a central topic in the 2007 master plan, which recommended that peripheral green spaces be established to help maintain ecological balance and establish a protective boundary around the city. In 2013, the inclusion of smaller parks, wetlands, and urban green pockets in the land use and development plans offered residents more immediate access to natural spaces. By 2020, the protection of the wetlands and their conversion into urban public green spaces had changed the approach of the master plan to the central part of the city and the lifestyle of the inhabitants. In addition, protecting the urban green belt and urban forest are some of the new approaches in the master plan to enhance ecological quality in the future (Table 8). Furthermore, the master plans need to develop urban landscape plans for the city and neighbors to activate all lost spaces into public space, green space, and open spaces.

Table 8. Findings from green networks and open spaces (The figures were designed by the authors)

YEAR	DIAGRAMTIC ILLUSTRATION	EXPLANATION
2007		The 2007 Master Plan placed most of its emphasis on green spaces at the periphery of the city, using these large edge buffers as protective zones that separated urban development from the surrounding natural landscape. These outer green belts acted as a structural frame for the city's growth, defining its boundaries and offering ecological relief at its margins.
2013		By 2013, the vision for green infrastructure became more internalized. Instead of concentrating greenery only at the edges, the plan introduced smaller parks, wetlands, and town-level green spaces within the urban fabric itself. This shift brought environmental benefits closer to where people lived and worked, making nature a more integrated feature of everyday urban life.

Table 8. (continued)

2020		The 2020 Master Plan advanced these ideas by adopting a fully integrated green system composed of larger buffers and interconnected environmental corridors. Rather than treating green spaces as isolated pockets or edge features, the plan wove ecological networks throughout the city, enabling continuous natural flows, enhancing resilience, and positioning environmental systems as foundational to the city's overall structure.
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DISCUSSION

The findings of the research identified a transitional process from an ideal form and utopian concept, such as an ideal village in planning and development in 2007, to multilayered planning approaches in 2020, which transformed Kigali city (Graham, 2016; Mumford, 2018; Tafahomi, 2024). The master plan in Kigali city was similar to other cities, progressing from a zoning concept for a village to a mixed use (Alexander, 2016; Dempsey & Jenks, 2006). This complex approach could be observed through environmental criteria that were added to the master plan, such as climate change, wetlands, and unplanned settlements (Bertaud, 2018; Steiner, 2018). In addition, the master plans applied some approaches to invite the stakeholders to discuss the objectives and strategies resulting in mixed-use and green public spaces in the city to mitigate the top-down planning (Bertaud, 2018; Hall, 2014; Levy, 2016).

This transition also could be observed from the policies regarding informality and unplanned settlements (Todes, 2011; Turok, 2016). While the master plan of 2007 took into account informal settlements as one of the categorical living forms in the city, the policies of upgrading and unplanned settlement were added into the subsequent master plans to deal with the urban restructuring (SJ, 2020; Surbana, 2013; UN-Habitat, 2022). Nonetheless, Huchzermeyer (2011) found that there was a trend to change the name of slum areas into informal, unofficial, and unplanned settlements to naturalize ineffective policies in urban development. In addition, recent critiques on slum terminology revealed that all examples of urban poverty were rooted in political and economic policies rather than urban development (Tafahomi, 2025). Despite the policies being oriented toward the geographical and physical specifications (Surbana, 2013; SJ, 2020), dealing with them in the master plan policies and development pattern presented a concern on the consequences of the informality on the city area (Firley & Gron, 2013; Friedmann, 2011; Tafahomi, 2025). Nonetheless, recognition and acknowledgment of the existence of informality, unplanned settlements, and the areas with a need for upgrading referred to responding to the post-colonial theories in urban development (Pieterse, 2010; Robinson, 2014; Roy, 2005; Simone, 2004) to acknowledge the social, economic, and political gaps which challenge urban development (Goodfellow, 2014).

The findings revealed that the land use policy started from a rigid zoning policy (APA, 2006; Firley & Gron, 2013) and changed into a more flexible and mixed-use approach (Cengiz, 2013; Eraydin & Taşan-Kok, 2013) from 2007 to 2020. The composition of the mixed use in the land use policy changed the pattern and structure of urban growth from a central point in terms of the ideal village into a linear form of development. This form was better suited to the lifestyle of the inhabitants,

with the communication based on the roads and accessibility rather than a central community (Harrison et al., 2007; Levy, 2016). The changing structure of urban expansion, based on the streets, changed the lifestyle of the people (Gehl, 2007; Gehl & Svarre, 2013) from a village concept into street formats that resulted in a pattern for active streets. The mixed-use pattern of development was noted as a supportive system for flexibility (Cengiz, 2013), resiliency (Eraydin & Taşan-Kok, 2013), and inclusivity (Kyohairwe & Karyeija, 2024) in urban areas. However, studies criticized the linear form of urban development for reducing social cohesion (Verebes, 2013; Watson, 2009), which contradicted neighborhood structure theory (Goodfellow, 2014). In some examples in South Africa, a polycentric model of development answers to the informality rather than a linear form (Lwasa, 2010; Todes, 2011).

The road structure in the master plans was developed from a linear form to a network to facilitate urban development toward the south and north as a new center for development, which was supported by infrastructure development (Bertaud, 2018; Verebes, 2013). Despite the city's topography as a barrier to network development, increasing the number of secondary and tertiary roads and upgrading some secondary roads to main roads were the main processes of the city's master plan to provide a hierarchy in the network (Lwasa, 2010). In addition, the last version of the master plan acknowledged walkability, safe transport, public transport, and electronic model of transport (Goodfellow, 2014; Nkurunziza et al., 2021). The upgrading of road levels was related to the mixed-use activities in the adjacent sides of the streets and the densification of the buildings (Manirakiza et al., 2025). However, walkability and the safety of pedestrians still need to be reconsidered (Nkurunziza et al., 2021).

Despite the movement of public space at the end of the 20th century (APA, 2006; Carmona et al., 2003; Chiarella, 2005), the master plans of Kigali city progressively and conservatively applied the public space concepts (OZ, 2007; SJ, 2020; Surbana, 2013; Tafahomi & Nadi, 2021a). Importantly, the master plan of 2020 addressed public spaces, green spaces, walkability, and recreational activities in the city. Some qualities, such as wetlands, green belts, and public green spaces, were new concepts that got a specific section in the master plan. The green public spaces referred to the quality of urban life (APA, 2006; Carmona et al., 2003; Gehl, 2007), green infrastructure (Groening & Hennecke, 2014; Horte & Eisenman, 2020; Miller, 2007; Roo, 2011), and urban green aspects (Baka & Mabon, 2022; Jim & Tan, 2017; Moughtin & Shirley, 2006; Tafahomi, 2021a). However, the private green spaces such as courtyards, gardens, and small forests in both private and public sectors, as well as public green spaces at different scales, were not covered in the policies.

CONCLUSION

Master plans of Kigali city have been transformed and developed over the past 15 years to project the structure of the development of the city. The direction of the development was initially eastward, and then it was shifted into east, north, and south due to the process of urban expansion. The pattern of the development started with the ideal village form as a combination of different livable villages with a pattern of the internal connection between urban elements, such as schools, houses, shops, and administration buildings. This form transformed into a connected network of development over the 10 years, and some new areas emerged as the city's central hub of development. The nodes of the development were linked to construct a linear form of the development based on the road and connectivity.

To support the linked pattern of the development, both land use and road structure were adapted to the development structure. The road hierarchy was upgraded, and some new roads were added to complete the loops of the circulation in the city. This structure was supported by the secondary and tertiary roads to create road networks. Despite the topographical limitation on the orthogonal road structure in the city, the road structure was developed around loops, districts, and sectors. This structure facilitated the connection between different areas of the city. Moreover, the land use changed from a zoning policy to a mixed-use policy to connect the new central hubs of the city to

the sectors with mixed-use planning to value the linear structure of urban development. Nonetheless, the new development requires support by TOD (Transit-Oriented Development) based on public transport, sufficient parking areas for private cars, and railway transport.

Attention to public and green spaces increased gradually from the first master plan to the last one. Despite the policy targeting large-scale public lands, those initiatives provide basic examples for the public spaces, such as streets and wetlands. The scale of public spaces, such as urban, district, and neighborhoods, was limited to the spaces of the administrative units, churches, and schools. In this case, public squares, parks, and plazas received less attention in the implementation. It is of great importance that the city takes action to install buffers along streets, rivers, and wetlands through linear landscape design to vitalize them as a potential for the public green spaces.

Despite the progress in the master plan's ideas, objectives, and strategies, the city is under rapid development, and the pace of development has outpaced the infrastructure and control of the unplanned settlements. At such speed, not only the quantitative criteria for the development but also the qualitative indicators are important for monitoring the quality of urban life based on social, economic, and political enhancement in the future.

DECLARATIONS

Acknowledgments

There was no item in relationship to acknowledgement.

Ethics committee approval

As this study does not involve direct human participation or data that requires ethics committee approval, approval from the ethics committee was not obtained.

Contributions of authors

Rahman Tafahomi: Writing – original draft, Writing – review & editing, Investigation, Conceptualization, Methodology, Data analysis, Data curation, Validation, Mapping/Visualization, Resources.

Julian Nagaddya: Writing – original draft, Writing – review & editing, Investigation, Conceptualization, Methodology, Data analysis, Data curation, Validation, Mapping/Visualization, Resources.

Declaration of competing interest

The author(s) declares that there is no conflict of interest with any person, institution, or organization during the preparation, conduct, or publication of this study.

Funding statement

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Declaration of AI use

The author(s) declares that the paper did not use AI in the research.

Data Availability

The source of the data (maps) are available on the website of City of Kigali.

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