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**Towards a sustainable urban development: the satellite city project of Kigali,
Rwanda**

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Abstract

In the last decades, Africa's rapid urbanisation rate and growing metropolises have attracted the attention of urban studies pointing the need of preventing the cities' collapse (re)thinking their urban future. Kigali - the capital city of Rwanda, reacted first in 2008 with the adoption of a Masterplan recently revised and approved in 2020. The main objective of the Kigali City Masterplan is the transition to a sustainable satellite city composed by green settlements introducing at the same time a flexible zoning plan, boosting the mixed use structure in the CBD and supporting the green growth. The purpose of the paper is to examine the response given by an African City to address the issues raised by the 11th SDGs (Standard Development Goals) - titled "Sustainable Cities and Communities", through the vision of the city as a project. It is studied the use of a well-known urban development plan, the satellite city in the East African Region combined with the needs of "make cities inclusive, safe, resilient and sustainable" - as stated by United Nation in 2019, in a specific built and unbuilt context where tradition and modernity have to find the way to establish an architectural dialogue. The paper explores case studies of polycentric plans proposed over time in the Region and retrieved from the overall Kigali Master Plan two settlements - namely Kigali 2020, Kigali Vision, analysing them through a comparative method. In conclusion the research provides an analysis on how the relationship city-architecture continues to play a founding role in shaping the urban development by adopting a precise model: the satellite city.

Keyword: Rwanda, Kigali, satellite city, sustainable architecture, tropical architecture

Introduction

In 2050 the total world population is projected to grow by 2.1 billion to 9.8 billion, while urban population is expected to rise by 2.5 billion people to 6.7 billion. The significant share of that urban population growth is taking place in African continent, with 40.4% of its population living in cities, with some exceptional megalopolis, among them: Cairo, Lagos and Kinshasa. These three conglomerations are predicted to grow by 38 million, 35 million and 32 million people respectively, by 2050 (Hoornweg & Pope, 2020). Within Africa, while East Africa is still the least urbanised sub-region, its annual rate of urban growth of 4.17% is very high, with Rwanda among the fastest urbanising countries at 4.5% (Hoornweg and Pope, 2014) Rwanda, with its population of 12,600,000, growing 2.8% yearly, and with significant investments in the infrastructure and construction sector in its capital city Kigali and six secondary cities, aims to achieve a 35% urbanization rate by 2024 from today's 18%. This has started a series of revisions of master plan in 2020 after the first master plan set up in 2007 and the second in 2013. Rwanda's capital Kigali accounts for almost 60% of the Rwandan population with an annual incremental rate of 9% and it forecasts an incremental growth of its population from 1.3 million up to 3.8 million by 2050 (Republic of Rwanda, 2020). Rwanda is tackling the effects of the

rapid urbanization through the adoption of a national land use plan and master plans for the capital and six secondary cities: Huye, Muhanga, Musanze, Nyagatare, Rubavu and Rusizi. In the Government led process of preparing District Development Strategies 2018-2024 and revising master plans 2020-2050, global and regional development agendas were consulted and localized, one of them being New Urban Agenda, in order to plan their implementation through District Development Strategies and Master Plans for achieving Sustainable Development Goals, in addition to national visions, plans and policies.

The paper analyses a very peculiar city development type – the satellite city, arguing its role in shaping a sustainable urban growth in which planned green areas in the satellites and in between them become the structural *leitmotif*. Particularly attention has been given to the private and public green spaces provided in two settlements, Kigali 2020 and Kigali Vision as part of the Gacuriro Satellite. The historical *excursus* on Rwanda and Kigali is followed by the analysis of precedents of satellite cities in the East African Region, a development city model that Ernest May carried in the area after his experiences in Germany and URSS. The qualitative assessment of the case studies as well as the settlements realized in the Rwandan capital leads to a comparative study of Kigali 2020 and Kigali Vision in order to identify the most suitable model to be replicated and proposed in the future projects.

Background

The case of Kigali as satellite city has not yet been adequately explored by scholars and researchers. Few publications can be found on the specific topic, more can be collected about the rapid sub-Saharan urban growth. The paper mostly focused on the need of intending the city as a project of architecture composed by contextualized structured or appropriate to the tropical climate.

Tropical Architecture

Tropical architecture is a chapter of the history of architecture depicted in few written works where a contextualised and appropriate analysis has been traced. Books in the form of projects' collection: *New architecture in Africa* (Kultermann, 1963) and *African Modernism* (Hertz, 2015). Books in the form of treatise: *Village Housing in the Tropics with special reference to West Africa* (Fry and Drew, 1947) and *Tropical Architecture in the Dry and Humid Zones* (Fry and Drew, 1964). Books in the form of Historical text: *Modern Architecture in Africa* (Folkers, 2010). Books in the form of manual: *Manual for Tropical housing and building* (Koenigsberger, 1974) and *L'Architecture Tropicale. Théorie et mise en pratique en Afrique tropicale humide* (Dequeker and Kanene, 1992). This last book is the leading work completely dedicated to the tropical architecture in central African region. The first paragraph of the introduction deals with the fundamental question of a correct reading of the buildings, namely to define an architectural grammar appropriate to the context: "We have tried to define an architectural grammar capable of uniting twentieth century technology with the particular conditions of region, to local materials and construction techniques available, to the human scale and to a climatic and geometric rigor" (Dequeker and Kanene, 1992). Moreover, it describes and

illustrates in an exhaustive and complete way the constructive process in the humid tropical Africa: climate approach, wind and ventilation, shading, protection against heat transmission and natural lighting. This climatic problem, connected with the composition of the constituent parts of the buildings, gave birth to an identity that must not forget that “simple life forms are the closest to perfection” (Dequeker and Kanene, 1992).

Kigali as a project

The city as a project (Aureli, 2013) guides and orients the paper’s approach on reading the city as an architecture and therefore, paying tribute to the precedent urban theories developed in *The Architecture of the city* (Rossi, 1982) and *La città di Padova* (Aymonino, 1970). The typological and morphological analysis of the urban artefact leads to the understanding of its history towards the future evolutions. A city needs first to be shaped, it needs a project that can continue to tell us its history even if the history has a “green” background.

Methodology

The research has been conducted applying a mixed-method approach by employing historical data obtained from literature and archival materials retrieved both from the historical evolution of the city of Kigali and the regional urban development. A qualitative method has first been applied to analyse the historical context and using case studies that focus on the composition of settlements in satellites as part of a more complex plan thus, examining the relationship between the past and current situation. In studying the historical background, an analysis is conducted on very peculiar case studies of satellite city plans developed in the region and attributable to the German architect Ernst May and realized around the first half of last century. Pictures and drawings are used to present the findings above all through site layouts of the settlements. Then the research polarizes the issue of designing the estates in accordance with the urban sustainability comparing on one side the applied dwelling solutions and on the other the provided green spaces, mostly in the Kigali 2020 and Kigali Vision settlement as components of a green urban rebirth.

Results and Discussions

Kigali 1907-2007

The German East Africa (Deutsch-Ostafrika) was the German colony located in the Africa’s Great Lake Region and comprised by the territories today occupied by Tanzania, Burundi and Rwanda. In 1907, the colonizing power appointed Dr. Richard Kandt who was familiar with the region, as an administrator and tasked him to identify a location for the new capital. Kandt choose an area on the top of the Nyarugenge hill, and in the following year he put up the very first building of the capital called “Boma” (fortress in Swahili) on the north-west side of the hill (Figure 2), looking over the valley of Nyabugogo that was, by that time, the most practical passage for the merchant caravans (Sirven, 1984). In 1916, the World War I determined the passage from

the German to the Belgian administration. Kigali on that time counted 500 inhabitants with an extension of 40 hectares and only after the Independence achieved in 1962 it became the official capital city of the country. In 1970, Kigali counted 117,000 inhabitants that led to the adoption of the Schéma Directeur d'Architecture at d'Urbanisme (SDAU) in 1982. This was set up under the vision of 20 years of urban development and based on a provision of reaching a half million inhabitants by 1995 but the Genocide against the Tutsi in 1994 drastically changed the number of Kigali inhabitants to around 50,000.

Kigali master plans 2007, 2013 and 2020

The urban rebirth process, followed by the first Kigali Conceptual Master Plan (KCMP) in 2008, was done by the Singapore based company, Surbana. Thereafter, the municipality approved an integrated and detailed plan for the entire city as part of the Vision 2040, also named the Kigali Master Plan 2013. Since 2018 the same Singaporean firm has been chosen to lead the revision of the present master plan extending its validity under the strategic Vision 2050. Revised master plans of the city of Kigali are emphasizing the inclusive nature of the participatory approach to shape a polycentric city that has to take into account its iconic cultural and context values. The overall masterplan follows the satellite city development model (Figure 1).

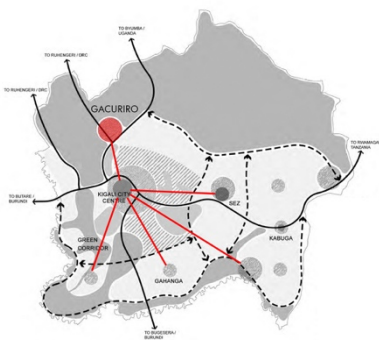


Figure 1. Kigali satellite city development plan and Gacuriro satellite. Drawing by Manlio Michieletto.

The Satellite City in the East African Region

Ernst May worked for the Uganda Government in the definition of the Kampala Extension Scheme and in 1945 he signed a contract for the British colonial authorities in order to conceive a plan including “large settlements for low and middle-income Africans, one of the first in East Africa to do so” (Gutschow 2009). The founding architectural element is the so-called *Zielenbau* or row house adapted to the tropical context: main axis facing east-west sides; use of local materials; employ of features to enhance the sun protection and the cross ventilation; a flourishing greenery surrounding the dwellings. In 1952 was offered by the oil company Shell the opportunity to design a settlement in Port Tudor, west of Mombasa in Kenya. Port Tudor was intended as a satellite for workers characterized by a large common green zone around which he located different housing typologies. Analysing these completed projects, the intention of May to introduce some architectural principles typical of the tropics is evident: orientation, wind and ventilation, shading, protection against heat transmission and large use of natural lighting. The climatic problem, connected with the

composition of the constituent parts of the buildings, gave birth to a renewed identity. These features reveal also a sort of green approach or a sustainability before sustainability and around fifty years later in the same African Region the City of Kigali is building its urban future following these past traces: satellite city development model that can guarantee green rooms between the settlements and tropical architecture features for the buildings in order to the country Renaissance towards making cities inclusive, safe, resilient and sustainable.

The Gacuriro Satellite

Kigali builds itself and its green future over time. The 21st century has seen the re-shaping of the capital city directing its development through a very peculiar project: the satellite city. The paper is focusing on the analysis of three settlements, Kigali 2020, Kigali Vision and Green City Kigali that represent the quintessential green urban examples of the Masterplan. All located in the north- east side of the Capital, Kigali 2020 and Kigali vision are part of the Gacuriro area (Figure 2) instead, Green City Kigali is a project under realization on the Kinyinya Hill. In the Satellites the single-cell is articulated in different dwelling types and jointly with the public facilities constitute an entire settlement, and the three *Imudugudu*, in Kinyarwanda, shape the whole City design. They seek also to address issues related to urban sprawl, poor connectivity, singular urban functions, poor allocation of social infrastructure, lack of socioeconomic mix and poor connectivity of movement, infrastructure and ecological networks. These principles are designed to ensure that socioeconomic and environmental sustainability is protected and promoted as urban growth occurs through controlled expansion and upgrading/densification of existing and future areas. In addition, the promotion of a sustainable economy via local production, employment and consumption is a key area of development within the Planned City Extension (PCE) principles (UN-Habitat, 2015). All these aspects are strictly connected with the initial assumption of a green urban development.

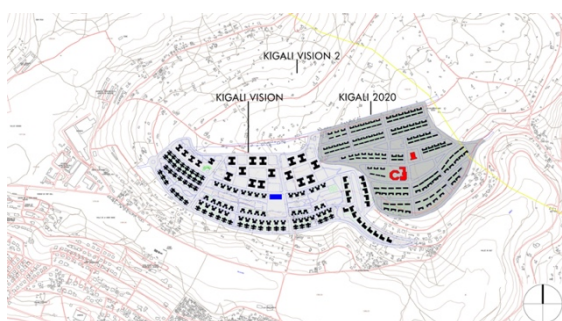


Figure 2. The Gacuriro satellite composed by Kigali 2020 and Kigali Vision. Drawing by Manlio Michieletto.

Kigali 2020

The Kigali 2020 represents the first compositional element of the satellite city. Located in the Gacuriro hill the settlement is characterized by the aggregation of 4 different semi-detached housing typologies placed along the contour lines in order to protect the existing context from invasive site works. The available public

facilities – the church and the Schools, build the central green area that serves as community main space. All the edifices are realised making use of locally produced materials thus augmenting the environmental protection such as granite stone for the foundations, fired bricks for masonry, tiled/pitched roof, timber ceiling and other details that guarantee high indoor environmental quality comfort. Moreover, the use of clay increases the thermal mass and at the same time decreases energy consumption. The main elevations of the units follow the north-south orientation while the east-west facades present few and small openings due to the more sun exposure during the day. The typical overhanging roof protects from the north side heat but unfortunately is not exploited to harvest rainwater thus reducing the water efficiency. Each unit is provided by a front and back yard, two traditional spaces that enhance the outdoor life and activities and residents should be able to enjoy the social and economic benefits of urbanization while minimizing ecological footprints (Figure 3).



Figure 3. Kigali 2020 settlement site layout. Drawing by Manlio Michieletto.

Kigali Vision

The Umudugudu Kigali Vision completes the second phase of the Gacuriro Satellite. It is made by a variety of dwelling typologies: apartment blocks, townhouses and villas. The 544 units composing the settlement are located in different areas of the hill side with the highest building at the top and the lowest at the bottom between a narrow green strip that physically connects the east and west parts of the project. Unlike the Kigali 2020 project where the common facilities are located in the middle of the settlement are grouped around a main green cluster the ones in Kigali Vision are scattered all along the green common area. The whole settlement is surrounded by a fence, giving it a protected compound nature and at the same time rejecting the connection with the future urban expansions. The main goal of Kigali Vision is to bid for the modern citizen a modern lifestyle in a safe, quiet and natural environment, but despite these premises its construction reveals some criticality in terms of green innovation (Figure . First of all, the design of the houses does not comply with the basic principles of the tropical architecture found in Kigali 2020. The rule of orienting the main facades facing north-south and the shortest east-west dwellings is not always respected as well as following the contour lines of the slope in order to achieve adequate environmental protection. The fact of not orienting the buildings correctly affects the indoor environmental quality with an increase in

temperature that required an inevitable increased trend in energy consumption. As seen for Kigali 2020 also the Kigali Vision settlement doesn't adopt a harvesting system for rainwater with the roof not adequately sized to protect the elevations.

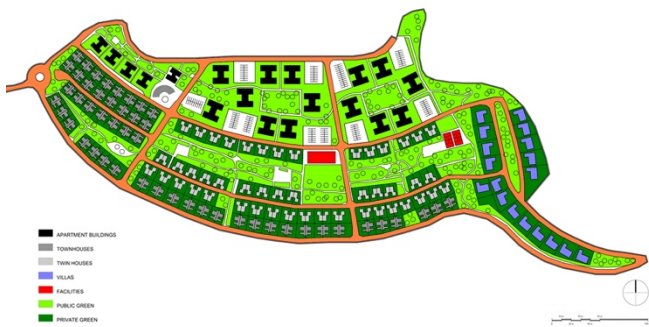


Figure 4. Kigali Vision settlement site layout. Drawing by Manlio Michieletto.

The Green City Kigali Project

Green City Kigali (GCK) is a 600ha project of sustainable community intended to be occupy the Kinyinya Hill site and that will be realized as part of the Vision 2050. The aim of the Green Vision Kigali project is to combine social, economic and environmental targets with strong governance to create a liveable and resilient urban community – a shining example of the future sustainable urban community in the East Africa Region. Residents of the updated Kinyinya Hill should be able to enjoy the social and economic benefits of urbanization while minimizing ecological footprint for environmental protection and optimizing green innovation. It will be mostly composed by affordable housing, that is linked with climate change adaptation and mitigation measures setting standards for sustainable urban development in Rwanda. The new city will assist also in healthy urban growth, maintaining Kigali's low carbon footprint by using local materials and resources both for the indoor environmental quality and for the construction of energy efficient buildings. Another goal is to promote a sustained and inclusive economic growth cycle for an economic wellbeing supported by a non-vehicular internal and external connectivity.

Conclusions

Ernst May introduced the experimented model of the Satellite City in the East African Region with the Kampala Extension Scheme, a model that Kigali has tried to reapply 60 years later through different master plan stages targeting one of the major problem of African Cities: providing mass and affordable housing for an increasing urban population. The Gacuriro Valley Satellite is an architectural piece of the city aiming to solve the mentioned issue and to reshape the development of Kigali, but it is above all an architecture interpreted and executed through two different projects, or *imudigudu*: Kigali 2020 and Kigali Vision. Kigali 2020 is more anchored to the morphological, topographical and geographical context, and is more Rwandan

when compared to Kigali Vision, which is misleading in its interpretation of the concept of ‘modern’, using an architectural language that is less global and less sustainable than the local language. The construction materials used, the overall orientation related to the cross ventilation and the sun path as well as the proposition of a concept of living that is traditionally practiced in the Country are the missing elements in the Kigali Vision Settlement. The variety of housing typologies and the infrastructure provided within the design allows different categories of people to be accommodated in the Satellite becoming a valid example for a sustainable urban growth. *Trabantestadt* and mass housing remain effectual components in the development of a modern city.

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