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Vertical Housing Development Interventions for Sustainable Urban Development in Kigali. The Case Study on Kigali City

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Abstract

This paper analyzes vertical housing development interventions as a means to combat housing problem, inappropriate use of land and land development failures in Nyarugenge district. Interviews with Kigali City 100 residents were used to capture opinions and planning standards on vertical housing development and their influence on urban development as opposed to horizontal development. In addition, 20 site visits and observations confirmed actual development practices. Findings have shown that 87% of Nyarugenge residents view vertical development in a positive impact by providing enough space for indoor activities while saving more land for further land uses. They had also an opinion that vertical development influences proper land use in the city. Despite these opportunities, vertical housing development initiatives are prohibited by insufficient fund and technical experts to facilitate construction of many high-rise buildings while integrating the concept of smart housing which promotes smart housing management and effective use of water, electricity and internet connectivity. As a result, buildings which result from vertical developments are constructed in Reinforced concrete materials and the height of most Buildings range from 8 to 15 storeys. Density characteristics also is well arranged and connected to each other to offer easy accessibility in shot time. Therefore, these buildings take into account three components of sustainability which are social, economic and environmental. Study, recommends use of smart technologies during the construction of vertical buildings as well as in managing them for effective use of that building including remote building control.

Keywords: Vertical Development, Urban Development, Nyarugenge District, Rwanda.

1. Introduction

Urbanization is a global trend which has a potential consequence on World's society, economy, and global consumption of natural resources, community quality of life and future of equality. According to researches up to 70% of population by 2050 will live in urban areas (Kehl, Kaatz-Dubberke, & Tenbusch, 2019). In many cities, population increase put stress on limited urban land and this shakes also interactions among core cities, rural areas and suburban areas. In case this results into uncontrolled cities development. It can cause waste of great agricultural land and may cause habitat destruction. Urban sprawl normally is considered as unsustainable because it increase travel cost, travel time, environmental deprivation as well as deepens exclusion (ESPON, 2020).

Today, the World is facing a new sensation, for the first time in the history of human being from 2008 more than half of population lives in urban areas (Sobrino, Garrocho, Graizbord, Brambila, & Aguilar, 2015). Where more than 90% of urban development and growth is found in Third World Countries, which

represents almost 70% million new populations in cities every year. In 2030 Neighborhoods in Third World Countries will increase up to 80% of the World's urban inhabitants. The estimation said that cities almost 70% were already contributed of the World's GDP (ibid). Thus, urban areas are the most places for various opportunities and the major engine of the economy where cities also provide a room for innovation creation, Social development, accessibility of fundamental service, employment, entrepreneurship capabilities, interaction facilitation, experience promotion as well as generation of economies of scale (Ibid). China has avoided top down approach in housing development and supply in supporting enormous rural areas migration and rapid industrialization since the mid-1990s. Thus in 1997, 79 million square meters of new urban housing were constructed as well as over 4 billion square meters between 2000 and 2010 or even more than two times as much as required fill the gap of population growth (UNHABITAT, 2016).

For significant number of urban areas people's accessibility to housing still the major challenge. From UN Habitat 2016, around 881 million people nowadays live in informal settlements in third world countries and additional 1.6 billion people will meet housing shortages by the year of 2025. Moreover other studies have recommended that excessive land use restrictions can increase house prices and then make it difficult for urban population with limited financial capacities to access decent houses (Nkubito & Baiden-Amissah, 2019). Building costs include land acquisition (cost for land registration, cost of land purchase, cost of planning approvals or any other environmental factors) with utilities infrastructure cost for instance drainage water systems, potable water supply, road networks and electricity grid systems together construction cost of Labor and construction materials. Consequently infrastructure cost and land cost as the factor of location that why land developers take much into account land purchase and infrastructure costs suitably when they are comparing locations (WEF, 2019).

Temporarily, in urban areas poverty has been known as urban phenomenon. One billion population are settled in informal urban neighborhoods, where in these places the absence of basic infrastructure affect the better productivity and quality of lives and many cities are under pressure of natural disasters and climate change (Stepputat & van Voorst, 2016). But on the other hand cities also have much potential for development projects because of various opportunities in high level of infrastructure investments, social transformation, ability to minimize densification as well as economies of scale especially in fundamental services (Ibid).When it comes to unravelling potentials and capacities, normally urban areas are location where developments exists, they enable community, society and economic transformations where the major challenge for local authorities is to plan and services provision in new development areas while creating and incorporating sustainable environmental, economic and social conditions before 3 billion more population by 2050 arrive in urban areas (ICLEI, 2015).

In Africa rapid urbanization is taking place together with deep social demographic changes with young work force increase without forgetting high economic growth based on the central natural resources and demand to speed up the process of industrialization, environmental effects and damage of natural resources the same time the negative effects of climate change need to be taken into consideration through mitigation or adaptation to it. Therefore in Africa context sustainable urbanization will need to handle different changes from integrated development and rapid growth of cities to make sure that urbanization will have positive inputs to maintain growth, urban living standards and environmental sustainability (UNECA, 2014).

However developing cities had been facing fast growing rates which affected them to meet congestions, sprawl and loss of open spaces as the main challenges of urban extension where spatial development future planning in connection with environmental, social and economic dimension of sustainability is the major tasks in spatial planning (Morales, 2013). Urban development in Kenya is made with quick urbanization and rapid growth of urban areas. Almost of this growth is taking place beyond formal planning contexts. Poor management performs together with improper investment in infrastructure and important services for urban living has caused squatter slums and informal settlements (SIDCA, 2015).

In the last years Rwanda has made so far a good progress since massive challenges faced during 1994 Genocide which destroyed the entire social and economic fabric of the Country. Thus, population in Rwanda have profited from rapid economic growth, poverty reduction, improved access to community services including education sector and health Sector, together with equity and equality in the country (EDPRS2, 2013). This was possible through hardworking, commitment and supports from Friends of Rwanda (Ibid). Based on National Institute of Statistics of Rwanda (NISR) information discovered that the country of Rwanda economy grown up to 7.3% in the first quarter of year 2016. Additionally, the Gross Domestic Product (GDP) have increased by 11% 1.384 frw trillions recorded in 2015 of the first quarter to 1.536 frw trillions registered in 2016 of the first quarter at current market prices (Knight Frank, 2016) .

According to national strategies to enhance urbanization in vision 2020 and vision 2050 plan, the importance is on making elementary infrastructure in Cities to avoid overcrowding of agricultural areas and provision of services for community better urban life . As highlighted earlier, this strategies aims the proliferation of the people living in towns to 35% by 2024. Which is the motto for Rwanda's economic transformation from Agricultural based to industrial and services-based economy (Spaliviero, et al., 2019). The main reason of conducting this study was mainly to light the major role of vertical housing development with respect to urban land saving and for further land uses such as urban agricultural activities, recreation areas, educational areas as well as industrial zones. Because most African countries use to have more horizontal housing development than vertical housing development and this vertical development creates many advantages compared to horizontal development this including space parking within the building, enough number of offices as well as a big number of building occupants in the vertical development. *Thus, the following are specific objectives for this study: (1) To explore recent situation of vertical housing development for sustainable development in Kigali city; (2) To highlight the challenges the sector face for achieving sustainable housing development interventions and urban development in Kigali city ;(3) To suggest suitable ways of interventions for sustainable urban development in cities.*

2. Methodology

2.1 Description of Study area

Kigali city is the major city of Rwanda and it is the largest city in Rwanda located in the center of the Nation. Kigali city is composed with hills and valleys created naturally between Two mountains. However the city of Kigali is made up with Three (3) Districts which are Nyarugenge, Gasabo and Kicukiro. Based on the census conducted in 2012 the city registered 1,132,686 population where the city has faced rapid development almost 4% per year over last Two decades. According to World Bank, 2017 the city of Kigali is Rwanda's economic development hub with Country GDP estimated at 41% and Kigali's GDP per capital was estimated at almost 2865$ in 2017 comparatively to national average of $772 register in 2017 (ODI, 2021). Therefore, this study was conducted in Kigali city specifically Nyarugenge District in Three Sectors of Nyarugenge Sector, Muhima Sector and Nyamirambo Sector. Thus, Figure 1 shows Nyarugenge District administrative map.

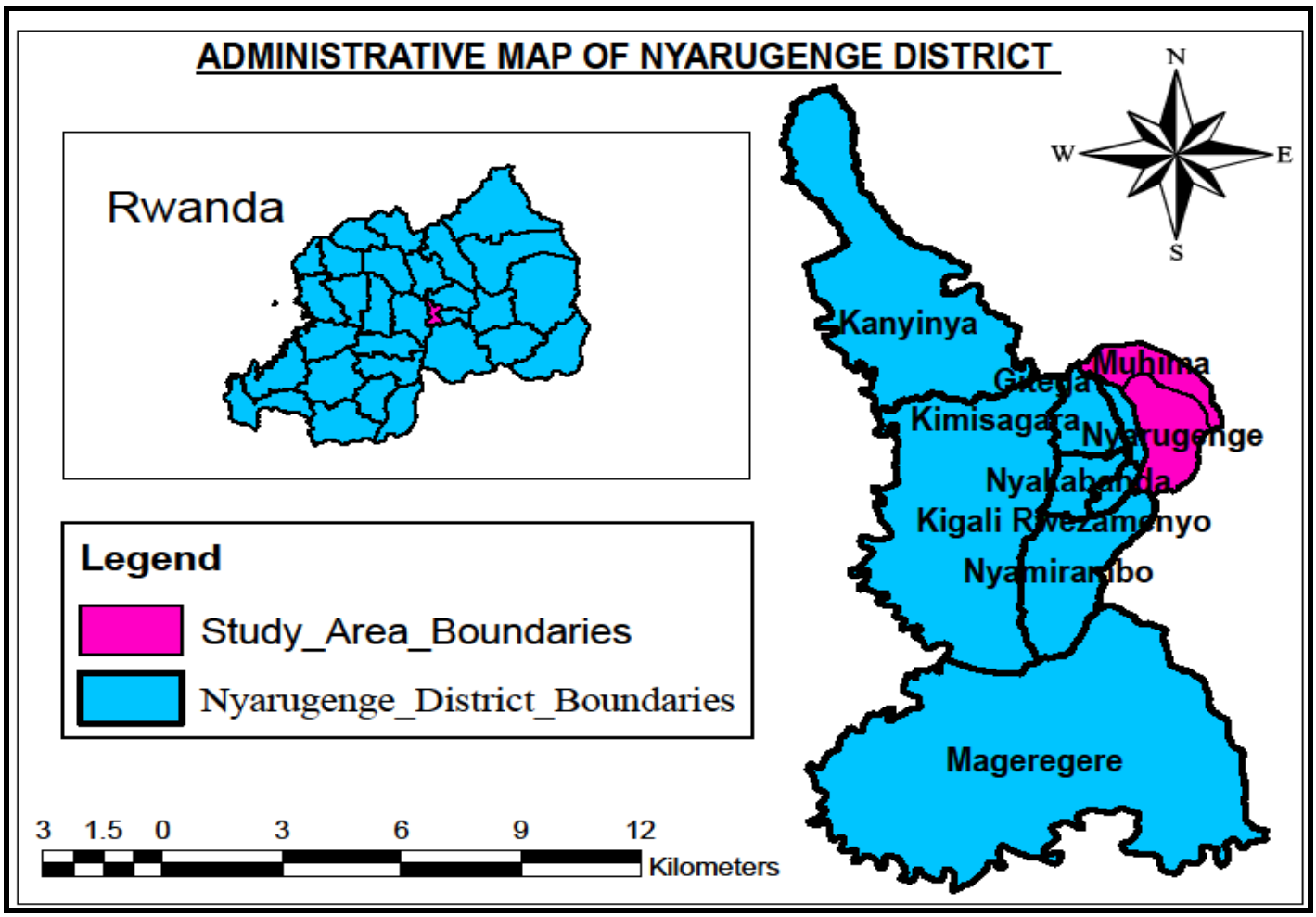

Figure 1: Nyarugenge District Administrative Map
Source: Author, 2022

2.2 Data Collection procedure and analysis

Based on National Institute of Statistics of Rwanda (NISR) 5th population and housing census done in 2022, the total population of Kigali city is 1, 745, 555 (female and male) where female is 856,673 and 888,882 males. In this study also, researcher adopted Yamane formula (1967) to determine the sample size for this study. Therefore, the formula is detailed in the following way:

$N=\frac{N}{1+N(e)^2}$

Then

n=sample size;

N=Size of targeted population;

e=Margin error= (here is 0.1) or confidence level of 90%.

By replacing in the formula sample size will be: $N = \frac{N}{1+N(e)^2} = \frac{1,745,555}{1+1,745,555\ (0.1)^2} = 100$ respondents.

Additionally, the sample size is made with 100 Kigali city residents from Nyarungenge District in Three Sectors which are Nyarugenge Sector, Nyamirambo sector and Muhima Sector. Where all of the interview participants were chosen arbitrarily without any consideration may be of color or any other factor, simply according to their willingness in offering their responses on vertical housing development interventions for sustainable urban development in Kigali city. Gender inclusiveness was taken into consideration during

field work and data collection where both men and female had offered their point of views regarding the study.

Concerning data collection tools that were used including review of literatures associated with this study, city of Kigali residents' interview as well as 20 deep field observations employed for this study to bring together necessary data for the accomplishment of this study. In additional to this closed and open questions were used in this study during the interview with city of Kigali residents for the reason of collecting their views on vertical housing development interventions for sustainable development by using the case study of Kigali city. Thus, secondary and primary data were also used especially secondary data were gathered from researches, technical reports and other related reports with this study to generate important information on vertical housing development interventions for sustainable urban development in Kigali city. Where primary data were collected from interview with city of Kigali residents through formulated questionnaire directed to the respondents for taking their opinions on the concept of vertical housing development in Kigali city, country of Rwanda. This study used qualitative data analyzes where responses received from interview were assembled together, summarized and reported by using Microsoft word and Excel for table production. Moreover, after data collection, data collected were analyzed and interpreted to achieve the study objectives. During data collection procedure responses received from interviews were noted down for proper information reception. Also, data cleaning was done by confirming in the structured questionnaire if all answers were received and written in their appropriate place and for further presentation of study research results during office work.

2.3. Data Analysis

2.3.1 Socio-demographic characteristics of the respondents

Both women and men participated in the interview to contribute in this study while providing their answers on Vertical housing development in relation to urban development in Kigali City where 67% of the participants were women and 33% were Men. The main raison of having a big number of women than men during data collection was because women were present at the time researcher collected the data. On the other hand, in Africa most of the time women stay much at home compared to men as many of them take care of the houses including doing small activities at home such as cooking for family, house cleaning, cultivation or food products shopping at their nearest shops. They also like to stay at home for the reason that they take care of children the same time taking them to and from school. This shows that Gender Inclusion was respected in this study where both Men and Women had a voice to participate in the study. Based on their education background 57% participants took their University education where 33% studied their secondary education then the remaining10% took the primary studies, having education information in the study play crucial role because it helps and give hope that a least those with study background can give good answers comparatively to uneducated respondents. Occupation was another element mentioned in socio-demographic characteristics of the respondents where 64% of the respondent were from private sector such as businesses or self-employed persons, then others 36% were from public sector. Thus, regarding respondent's job occupation a big number of participants were from private sector only because many of them were present at the time researcher was moving around during data collection and be able to capture their views. Then public respondents most of them use to be busy with their government jobs and have less time for interview. Table 1 summarizes socio-demographic information of the respondents who participated in the interview.

Table 1: Socio-Demographic Characteristics

№	Respondents Characteristics		Results		
			Frequency	Percentage	Total
1	Gender	Female	67	67	100
		Male	33	33	
2	Age	18 - 28	15	15	100
		28 - 38	35	35	
		Above 45	50	50	
3	Level of education	University	57	57	100
		Secondary	33	33	
		Primary	10	10	
4	Employment Sector	Public	36	36	100
		Private	64	64	

Source: Field work (2021)

2.3.2 Vertical Hosing Development Intervention in Kigali City

Commercial Vertical Development

In general community responded that Vertical development have positive impact in providing enough space for work while saving much of land for extra land uses and vertical development could influence proper land use in the City of Kigali mentioned by 87% of Kigali City residents. In the Figure 2 building in white color with Blue windows is the biggest building in Kigali City and it can accommodate different businesses opportunities or activities including restaurants, office rooms, Pharmacies, Clinics etc…, this saved much land in the city center for further use where this house also can receive more than 100 persons whom are looking for service in the City Center. Therefore, the space occupied with that building in case couldn't be constructed there could be horizontal development which could not give out many rooms as this building storey as well as services development in place. The Figure 2 displays more about the vertical development explained above including neighboring vertical houses which also have various commercial activities taking place over there. Also, there are other vertical development or building taking place in Kigali city such as construction of Equity Bank building in Front of Makuza Building similarly which will have many rooms for different services, activities and parking yards for vehicles in the city.

Figure 2: High raised commercial building in the city of Kigali
Source: (The Economist, 2017)

Figure 3 also demonstrate Champions Investment Corporation (CHIC) Commercial Building with enough parking area of Cars and Motorcycle for business men and clients who come to get service, to buy or for other goods transactions. This building is new and is playing critical role in Kigali City while offering better services for buyers and sellers the suitable place to do their businesses which staying outside and be affected by rain or sun in their daily activities. It is for this opportunity where small business owners can have small rooms depending on their business and investment and may associate with other sellers to form a good team and manage to rent a room according to their financial capability. On the other hand, this kind of commercial houses can manage to accommodate any type of venders including informal sellers in case they can come together and organize themselves to afford a room where they do their businesses for future development of the Country without excluding them in sustainable development as most of development in developing countries for instance Dar es Salaam-Tanzania have these businesses in their cities.

Figure 3: Champions Investment Corporation Building for Commercial activities in Kigali CBD
Source: (HYGEBAT LTD, 2021)

2.3.3 Meeting Halls Vertical Development in Kigali City

Very important to have such kind of development especially for Countries in development process to receive both national and international meetings and conferences which have much contribution in the development of the national and continent in General. Example there was Africa Drone Forum 2020 (ADF 2020) took place in this building which had almost One Thousand Five Hundred Participants (1500) from various countries where they enjoyed technologies of Unnamed Aerial Vehicles (UAV) that are bringing to the community while saving community lives in delivering different light medical items in hard to reach areas and hospitals not only in Rwanda but also other African Countries including Tanzania and Ghana though Zip line Drone Company and many other Drone Companies in this sector. The name of this building is Kigali Convention Center and it is having meeting rooms inside and Hotel for those who wish to stay in the same area without joining other hotels neighboring this Convention Center. The building is located in Gasabo District and connects Kimihurura Sector, Kacyiru Sector and Kimironko Sector Road almost near the City Center of Kigali city. Other buildings neighboring Kigali Convention Center Including Kigali

Business Center (KBC) and Kigali Height which give better view and a good bond for better business partnership among them. Figure 4 is Kigali Convention Center building in blue, yellow and green

Figure 4: Kigali Convention Center in Kigali city – Rwanda.
Source: (Radisson Blu Hotel, 2021)

2.3.4 Residential Vertical Development Intervention in the City

The Country of Rwanda also considered residential vertical development in Kigali City and other Provinces to solve challenges and problems linked with community living in high risk zones or in informal settlements. Figure 5 determines planned settlement in Gacuriro Sector and Gasabo District in Kigali City. This settlement offer opportunities for people with high income to buy suitable houses they wish and place their families there or even them live in the same place as well as medium income earners can afford those houses there for them to live in protected place. This Neighborhood Drainage system is well planned and connected for improper water removal and rain water which might stagnate in the road within the settlement. In additional to this the government of Rwanda is trying to construct several houses and settlements in vertical form for the purpose of saving its land as well as removal of its population from high risk zones into well planned neighborhoods such as River side homes as you go to Ruyenzi driving through Nyamirambo sector.

Figure 5: Vertical Residential development in Kigali city
Source: (Karuhanga, 2020)

Set back Principles and Sky exposure plane

Zoning regulations gives for new constructions to be made at the limit of the access road, or to respect a certain distance, which they determine. This makes it possible to produce an urban landscape, consistent to the desired and existing urbanization modes. If buildings are naturally located at the edge of the street lot line, villas are always set back a few meters, and villas and townhouses are not located in the same way in a densely populated area and in a peri urban area with less density. High rise buildings in mixed land use zones must have a base and upper element. The primary street façade must have a strong sense of verticality and set backs are proposed as a tool to preserve the sky exposure plane. For Basement setback at least 3 meters will be kept from the plot boundary neighboring the road to allow any services which may be required and ensuring the viable growth of plants.

The setback regulations are based on:

1. Aesthetic/design considerations: it is a question of "shaping the urban landscape"
2. Considerations for hygiene, sanitation, and public safety.
3. Protection and respect for the neighborhood (sunshine and privacy).

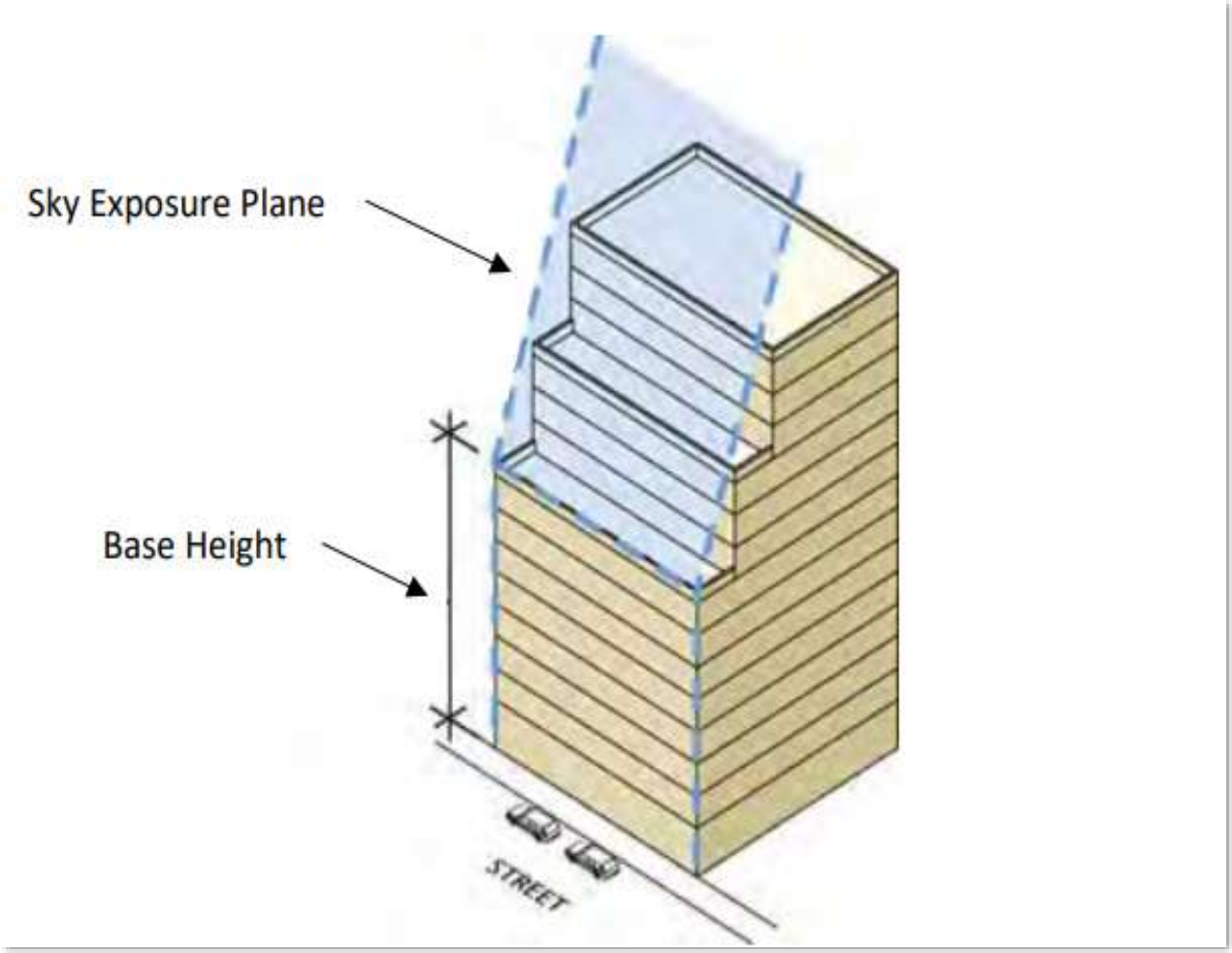

Figure 6: Sky Exposure Plane

Source: (Morriello, et al., 2020)

2.3.5 Challenges

In the data collection with city of Kigali residents on housing development in Nyarugenge District the following are some of the challenges which this construction sector facing for having vertical development which are in line with sustainable development:

- ✓ Lack of sufficient money to construct many high raised building
- ✓ Building Technical Experts to construct them taking into consideration the concept of smart housing into action.
- ✓ Building Construction materials import from developed countries in Rwanda for instance from China, Dubai, Turkey, Dar es Salaam etc. Some takes time to arrive in Rwanda while others it is costly to import them for construction purposes.

2. 4. Discussion

Construction and Housing Development is essential globally for different functionalities like shelter for community, place for businesses and area for meetings and Conferences. Without this people might face difficulties including heavy rain and sun coming on them together with many other challenges connected with lack of housing or shelter. Thus vertical development with respect to urbanization is needed especially in countries with small area of land like Rwanda with (26,338 Km^2) for the purpose of suitable land use

planning and management while saving land for other purposes including agricultural purposes for inclusive sustainable development in the future, this was argued by (Smith, 2024) that vertical cities hold the key to solving overcrowding and overpopulation, rather forest removal and marshlands to construct houses, industries and shopping malls can be replaced by vertical development serving to reserve the environment. Moreover, Urban and Regional Planners together with Constructors must control the problem of housing development in developing countries while avoiding informal housing development and inappropriate use of land while constructing where structure will provide effective services on community whom are surrounding the area. On the other hand, vertical housing development in Kigali City and developing countries in general for some people sees that as challenge while being used by them especially in having high raised building for example offices where they can rent and do their works for entrepreneurs or private company owners due to high office rent cost and not easily accessible by their clients may be from villages or countryside to major cities. Thus they think that affordable and moderate high raised buildings to their financially capabilities can be constructed for their development and national as whole. For sustainable Construction existence demountable structures were also mentioned for easy and building replacements in case new development is needed due to various changes taking place in Construction industry and for future generations too. Reinforced concrete structure are hard and difficult to demolition once someone want to replace a certain building with another type of the building. Vertical development integrated with suitable liquid waste drainage and solid waste management is another aspect to take into consideration in our neighborhood plans without forgetting services provision before all construction activities starts in any construction sites or parcels.

2.5. Conclusion and Recommendation

2.5.1 Conclusion

This research analyzed the Vertical Development interventions and its influence on Urban Development as well as on the society in general to handle the problem of housing, inappropriate use of land, and inappropriate land development which can make cities into informalities and lack of space for various uses as Neighborhood plans must have different land uses not only Build up areas but also recreational areas both in Rural and Urban areas. Finally this study was aiming to explore the role of vertical development and its influence on urban development in developing countries where we have seen that this type of development could not only accommodate more people in small space but also in saving land for future uses and future generations.

2.5.2 Recommendation

After conducting this study, the following are some of the recommendations and suggestions for future researchers and vertical development in the city of Kigali as well as developing countries in overall without forgetting developed countries where it can be adopted:

1. As many cities recently, both in developed and developing countries are integrating digital technologies in all sectors to optimize the efficiency and effectiveness, researcher would like to recommend vertical housing development in line with smart city concept development where most cities activities will be connected for better community services in the near future.
2. High raised demountable buildings are also highly recommended for future development and sustainable vertical housing developments where it can be removed or reconstructed in another way in case it is needed.
3. Economical and moderate high raised building or building storey for low income earners is another recommendation for sustainability in construction sector.
4. Use of local material wisely and in the way, it is not affecting environment for future generations use.

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Appendix

Figure A: Vertical development in the city center (Kigali City)

Figure B: 2000 Hotel in the city center and in vertical buildings in Kigali city