

Infrastructure Dynamics of Urban Human Agglomeration in Nairobi, Kenya

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Abstract

Nairobi City has endured various challenges since its establishment in 1899 as an outpost for colonial railway workers to date. With a current metropolitan area population of close to ten million people, and being home to hundreds of world-class institutions, the city is continuously becoming more complex. Activities within old city space have become too compact forcing the city to expand over wider geographical bounds. Guided by general systems and concentric ring theories, this paper undertakes a descriptive examination of the city's expansion in the backdrop of its public infrastructure systems. Its major observation is that the city's laissez-faire type development poses a danger for its organized growth as envisioned in the Sustainable Development Goals (SDGs). Furthermore, inadequate government investment in road, water, drainage, sewerage and general hygiene, education and public health infrastructure to correspond with the mega growth of the city's population and economic activities is contributing to a general sense of untidiness and reduced liveability of the city with the subsequent rise in living costs and lag in the city's global ratings being evident. It hence recommends the adoption of a mix of public and public-private investment accompanied by defined and time bound tolling of users of these services in the interim to speed up their installation and access to alleviate the suffering being endured by the city's residents.

Key Words: Nairobi, Suburbia, Governance, Public Infrastructure, Public Private Partnership

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Background Information

According to Duranton and Puga (2014), cities generally tend to grow despite seeming stagnation in their population. Still, population growth is the major driver of urban sprawl (De Espindola *et al*, 2017). This sprawl results from increased consumerism as people seek to occupy more space (increasing home sizes), coupled with changing tastes which result in people changing their abodes from time to time. Such dynamics also characterize dwellers' use of basic amenities. As the population and wealth of a city grows, its residents will consume more water, generate more garbage, drive more, seek more medical services, get more education, eat more, and pollute more. Furthermore, technologies used in buildings also change with time. Some people, therefore, just relocate or redesign buildings and other urban infrastructure in response to this change. The reorganizations result in the evolution of cities and their infrastructure making them cover more space both on the earth's surface and in terms of their penetration of the skylines (Burgess, 1925).

The rapid expansion of cities by population and geographical spread is often a response to the changing socio-economic fortunes of cities and their dwellers. The availability of finances (capital) and opportunities in cities encourages rural to urban migration and the expansion of cities beyond their traditional boundaries (Vidal, 2018). As the financial inflows into cities increase, their population's demand for better services increases too. People find themselves more able to afford high end-urban conveniences. Similarly, the supply end will respond by gratifying this need for amenities and lifestyles. Such results in the social, economic, and physical evolution of cities into new shapes (Mwau *et al*, 2020; Ehrlich *et al*, 2019; Macagba, 2016;).

As a result of their exponential growth trajectory, cities worldwide are experiencing various sustainability challenges. These range from air pollution, uncontrolled and unplanned urban growth, poor urban transport, unsustainable urban fuels use and energy consumption, pollution, crowding, high cost of living including the high cost of housing, and degradation of the urban environment associated with the turning of cities into concrete jungles which lead to low carbon absorption capacities (De Espindola *et al*, 2017). Besides, cities face a distribution challenge affecting the spread of urban utilities across space. The state often tends to

overconcentrate resources in developing certain areas at the expense of others without considering urban expansion and urban stagnation or shrinkage dynamics in these areas (Ehrlich, Balk and Sliuzas, 2019).

Zheng *et al* (2015) opine that cities' tendency to have far much higher population concentration than rural areas tend to overwhelm the ordinary environmental population carrying capacity and ecological elasticity. In response, technologies such as tarmacked walk and driveways, concrete or tiled floors, parking spaces and games arena are used to make life easy and more friendly for humans but limit vegetation growth as well as the water absorption capacity of town surfaces. As a consequence, urban areas, which often have more cars than trees, generally tend to experience flooding than rural or naturally conserved locations with their equivalent topographical characteristics, hence forcing a reverse migration into suburbia (McDonald *et al*, 2018; Humphries, 2012). Similarly, poorly planned cities tend to have slums and chaotic streets characterized by untidiness and accumulation of waste (Vidal, 2018). These are issues that may quickly degrade such cities if left unchecked (Mwau, 2019). Nairobi is not spared from this trend.

Whereas traditional methods of data collection have concentrated on collecting and collating data for local and subnational consumption, emerging trends demand the availability of such data for making global comparison and peer learning. This data transcends demography, human settlements and socio-economic conditions of human dwellings. Its collection, compilation and distribution are the interest of both physical and social scientists, hence the need to establish the size and type of activities that take place within human settlements. This entails collecting data, especially from data-poor and most often less developed regions to establish a global database on human settlement patterns. It is expected that this study, which focuses on the urban growth dynamics of Nairobi, Kenya, is a step towards contributing to that global effort.

Methodology

The study adopts a descriptive approach to explain the observed phenomena. Its data was collected through observation and literature review. In particular, the study reviewed books, policy and legal documents, periodic reports from relevant bodies, journal articles, newspaper and magazine articles, and content from various online sources.

Theoretical Perspectives

This study is based on two theories of human settlement, and aggregation. According to the theory of human settlement, human societies and human settlements evolve. This evolution is not only based on the material characteristics of these settlements. Instead, settlements, through their material depictions, reflect the evolved capacities of their occupiers to create, learn and communicate ideas, cultures, languages, myths, and social institutions (Bowen and Gleeson, 2019). According to the authors, this is in line with the general systems theory thinking that the culture and experience of a people define their understanding and shaping of systems. Furthermore, due to their unique abilities, and guided by their created laws, human beings possess the capacity to communicate and create complex organizations, including cities (Bowen and Gleeson, 2019; Wilkiens, 2007).

Whereas it is possible to decompartmentalize various aspects of a system such as a city to know how they individually function, it is also true that the individual parts of systems (including cities) work in cooperation with, in response to, and in harmony with each other to bring forth the interactive-functional whole as perceived by Darwinist Structural Functionalism as well (Walonick, 1993). By and large, cities are an expression by their owners of their ability to organize, accumulate their efforts, and structure their lives in a way that gives meaning and fulfilment. They speak of man's ability to pursue his cognitive and linguistic abilities to solve problems and structure his society (Bowen and Gleeson, 2019).

The interactions of components do not follow any linearity. Similarly, their outcomes are most often random, though with some basic guiding principles as would apply to constitutions and city bylaws which give skeletal direction on the projected development of a city. Walonick(1993) reports that systems such as cities can either be controlled (cybernetic) as applies in authoritarian administrations or uncontrolled (Wilkiens, 2007). Nairobi tends to operate in the middle. Here, whereas the invisible hand, though corruptible (Mwau *et al*,2020), sets foundational frameworks, a lot of the development is determined by market forces (Mwau, 2019). The general rules set by the government are meant to influence the role of each unique unit (a piece of infrastructure) in establishing generalized patterns, but,high prevalence of corruption among stakeholders often results in these being ignored.

Another theory underpinning this paper, viewed as very key in explaining Nairobi's growth trajectory, is the Concentric Ring theory which postulates and describes a hypothetical ring-like land use pattern. The theory, developed by Ernest, W. Burgess in 1925, views the growth of cities to follow a certain pattern that divides the city into seven concentric cycles (Rodrigue,2020). These seven cycles divide the city into seven concentric zones with the CBD being at the core followed by an industrial zone and transport terminals, low-cost housing- largely slum dwellings for factory workers. A residential zone for the working class, and higher quality housing zone with longer and costly commute. The rich on the other hand live in flashy suburbia located at the periphery, and where life is largely comfortable but expensive (Burgess, 1925).

The cost of land ordinarily reduces as one moves from the city's core. This offers motivation for people to buy land and settle further (Macagba, 2016). Other than in the well-planned suburbia which attaches estate construction to installation of basic supporting infrastructure, the theory predicts that suburbanization of formerly farming villages as people move further from the core of the city, generally reduces accessibility, rent and population densities therein. Concerning rent, the figures can reduce to zero on occasions when residents build or acquire their own homes. And whereas this explains the limited availability of infrastructure, others suggest that governments should prepare for and respond fast to the land expansive urban growth and put these amenities in place to not only improve residents' quality of life but also instill citizen satisfaction and political cooperation (Addie, 2016; Hamel & Keil, 2016).

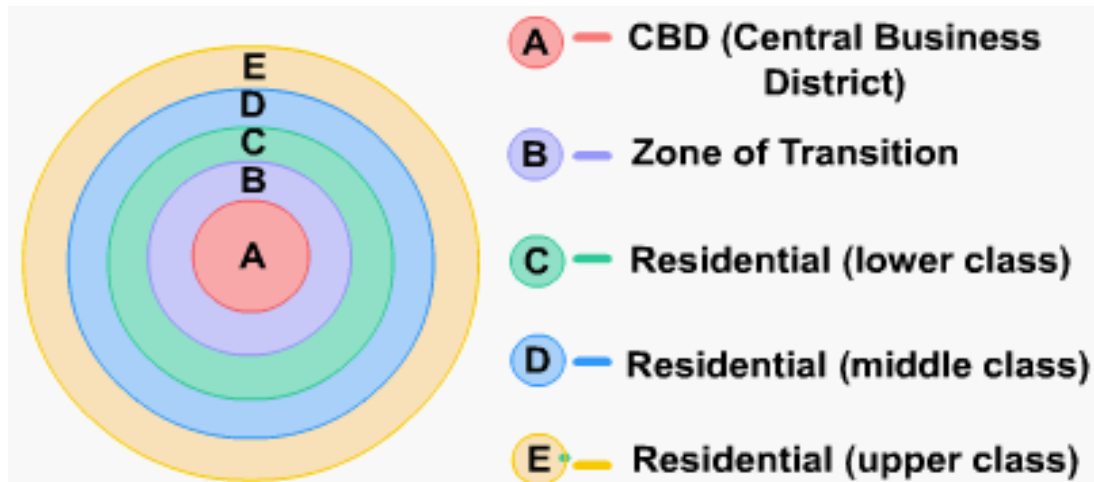


Figure 2: Burgess' 1923 Concentric Zone Theory Urban Land Use Model. Source: Thompson, M. (2014). *Original Theories of Urban Growth*. Link: <https://mt744.wordpress.com/2014/04/12/original-theories-of-urban-growth/>.

Legal and Administrative Framework for Urban Planning in Nairobi City County

Mativo (2015) reports that urban planning laws in Africa, Asia and Latin America have largely failed to work. This results in the construction of unapproved infrastructure, slum and squatter settlements, and general disregard for formal process in day-to-day urban governance. Among the factors contributing to this menace include complex and inflexible legal and regulatory regimes that do not acknowledge the socio-economic realities in these countries, and corruption. Kenyan urban spaces, for instance, are notorious for haphazard growth and spontaneous development without conscious adherence to urban planning principles, legal and policy dictates, processes and capacities (Kitur, 2019). This is independent of the existence of robust legal and institutional frameworks in the country dating from the colonial error town planning Act and The Crown Lands Act instituted by the British government in 1902, the Town Planning Act of 1937, The Nairobi Master Plan of 1948, Sessional Paper Number 10 of 1965, the Human settlement Strategy of 1978, various mid to long term national economic plans including Kenya's Vision 2030 launched in July 2008 and several such laws (Kitur, 2019).

Today, land use in Kenya is governed by the Land Act No.6 of 2012 and its later amendments in 2019 which categorises land tenure into public (government), community and private ownership. These pieces of land can be acquired through purchase, leasehold or inheritance overseen by state land registries. The Act categorically spells out processes for transfer of land, land use regimes and sanctions for violation of laws (NCLR, 2012a). In addition to the Land Act 2012, two other pieces of legislation (Land Registration Act 2012 and The National Land Commission Act 2012) were passed by parliament to provide a holistic legal foundation on land governance and use. These work in tandem with Sessional Paper No. 1 of 2017 On National Land Use Policy (Ministry of Lands and Physical Planning, 2017) which spell out a clear-cut policy and legal framework on land use governance and physical plans for the city. Whether these rafts of policies and laws are implemented in letter and spirit has historically been disputed (Mativo, 2015; Kalua, 2020).

In addition to land governance laws, Kenya's urban planning is also guided by the Physical and Land Use Planning Act of 2019. The Act establishes physical and land use consultative forums at the national and county levels. In addition, it sets up a directorate of physical and land use planning headed by a director general. Housed within the ministry of lands and overseen by the National Land Commission, the directorate has well spelt out roles and responsibilities at national and county levels. It also calls on the need to have stakeholders within the sector cooperate nationally and locally to ensure effective land use planning, including through the incorporation of technology in supporting this effort (Republic of Kenya, 2019). The Act calls on the need to

develop physical and land use plans that ensure equitable, sustainable and economically sound plans in adherence to national values set out in Kenya's 2010 Constitution.

Furthermore, Kenya has an Urban Areas and Cities Act 2011 and its 2019 amendment which provides rationale for classification and establishment of urban areas and cities, as well as governance and management of urban areas and cities. It lays down criteria for upgrading of settlements into towns and cities, and establishes board to oversee these urban agglomerations with organisational structures, financing and accountability mechanisms that meet the economic, social and environmental needs of the country in line with its global commitments and ambitions (NCLR, 2012c). This set of laws is supported with others in the construction sector which include: Architects and Quantity Surveyors Act, CAP 525 of 1978 and revised in 2010; the National Building Regulations of 2015 aimed at delivering safer, attractive and well-planned built environment (Building Authority of Kenya, 2015).

Additionally, Nairobi City County has over time developed policies to guide its development. Such include the 1973 Nairobi Metropolitan Growth Strategy, the 1979 Land Use Rationalization Policies and the 2013 Nairobi Integrated Urban Development Masterplan which identifies key development and conservation areas for sustainable socio-economic revitalization of the city. Among the areas covered in the 2013 policy include improvement and modernization of the transport, housing, power, water, sewer, storm water, and telecommunication infrastructure, protecting the environment and strengthening the institutions mandated with governing the city based on key underlying principles (Muema, 2016). Complementary legislation that guides urban planning and infrastructure development in Kenya and in Nairobi City County consistent with this masterplan include:

- i. Road sector Laws such as the Kenya Roads Act No. 2 of 2007. The Act created institutions mandated with construction, maintenance and oversight of various categories of roads. These institutions include Kenya National Highways Authority, Kenya Rural Roads Authority and the Kenya Urban Roads Authority. The act stipulates the administrative structure of the authorities and delineates responsibilities for each, although this has often resulted in conflicts and confusion over road infrastructure management. It also provides finances for the authorities (Republic of Kenya, 2007). Through it, the authorities work through collaborative ad cooperation frameworks to deliver on their mandates, albeit with some conflicts (KENHA,2018). Additional legislation in this sector includes Kenya Roads Board Act No.7 of 1999, Kenya Ports Authority Act of 2012 and Kenya Railways Corporation Act of 2012.
- ii. Article 43 of the Kenyan 2010 Constitution declares access to water a human right. The Water Act of 2012 is the mother law guiding ownership, control and ownership of water resources in Kenya. The law also establishes water boards at national and local levels to authorise, regulate and oversee the extraction and use of water resources y individuals and organizations (NCLR, 2012e).The Act, in addition to the National Sustainable Waste Management Policy guide the waste management regime in the country (Republic of Kenya, 2018; Akosua, Schwartz and Zwartveen, 2019).
- iii. The Constitution declares mandatory free basic education a right to every child in 53 (1) (b). Article 55 (a) of this constitution mandates the state with taking appropriate measures to ensure every child accesses these rights. In addition, Kenya has an Education Act of 2011 which operationalizes and institutionalises these constitutional dictates (NCLR, 2012f). Due to this robust policy and administrative framework, the country has invested massively in education which accounts for 5.3% of the GDP in 2018 (World Bank,2020c).
- iv. Like education and transport, healthcare is another public good that supports sustainable (decent) living and which is guaranteed in Article 43 (1) (a) of the Kenyan 2010 Constitution. The country has The Health Act No. 21 of 2017 as which sets rights and duties, establishes public health facilities, and puts in place a governance structure for the country's healthcare, public health and reproductive health infrastructure (Republic of Kenya, 2017). In addition, the country developed a Kenya Health Policy 2014-2020 aimed towards attaining the highest standard of health for the country (Republic of Kenya, 2014).

Kenya has several other global, regional, national and local policy and legal commitments that guide these affairs. These cut across sectors and have resulted in her having vibrant emerging urban centres across the country. The policies and laws have also sustained Nairobi to date despite her immense challenges. Similarly, Nairobi, being an independent county with a complete government including a legislative assembly, and an executive, has come up with prudential guidelines that are locally customized to give relevant life to the national laws. The county government has relevant local units and officers in charge of these concerns in line with the principle of devolved governance espoused in Kenya's constitution.

Nairobi was created in 1899 by British Authorities in British East Africa during the construction of the East African (Uganda) railway (Otiso, 2012; Greenway & Monsma, 1989). It existed as a province and city managed by a provisional commission and a city council until 2010 when it was changed into one of the 47 counties created under devolved governance by Kenya's 2010 Constitution. The city, which is also Kenya's capital has, grown beyond bounds to becoming a flourishing commercial and industrial hub for the Horn of Africa Region. It hosts several multi-state agencies including being the Headquarters for United Nations Environmental Programme (UNEP) and The United Nations Office in Nairobi (UNON); the African Continental Headquarters of the UN, and only one of UN's four such offices across the globe (Ministry of Foreign Affairs-MFA, 2018).

Although the initial forces that resulted in its creation were largely colonial interest, the evolution of the city has been influenced by its emerging economic, infrastructural and demographic character over the decades since its inception. Initially, its population was centered at the city's core due to the clustering of industries, commercial establishments, and human settlements close to each other resulting in a city with a very busy and highly polluted core. This characteristic is not unique to Nairobi's history but characterizes the history of most of the world's cities including London, New York, Beijing, Mumbai, and Lagos (Kitur, 2019).

As wealth and inconveniences of the city increase, the demand for better living and working conditions have constantly resulted in a continuous mass migration of a sort. This is facilitated by expanding infrastructure opening accessibility and liveability of initially remote city neighbourhoods. This brings forth suburbia, new industrial zones, and new trading complexes which also get swallowed up in chaos with time as is characteristic of formerly wealthy suburbs such as Kilimani, Kileleshwa, Woodley, Milimani, Buruburu, South C and South B (Muau, 2019; Muema, 2016). Makena (2020) reports that land in these areas has become too expensive making it unviable to accommodate single-family houses per unit of land. Such are being replaced by high-rise residential and office buildings that can accommodate more activities and increase income to property owners due to their proximity to the CBD (Muiruri, 2016). These trends are understandable though. Cities such as Nairobi often get compartmentalized into specialized geographical, economic, and social zones with occupants of such clusters determined by their financial and other forms of capital (Addie, 2016; Macagba, 2016).

Today, Nairobi City County has a population of 4,398,073 spread across an area of 696 km² (269 square miles). However, the larger Nairobi Metropolitan Area has a population of 9,354,580, more than double that of the city-county itself (Kenya National Bureau of Statistics-KNBS, 2019). This is indicative of how far the city's population has sprawled outside its administrative boundaries. It also demonstrates how the city county has integrated closely with her neighbouring counties making them interdependent. Nairobi's population and in effect urban planning challenges have been transferred to her largely rural neighbouring counties of Machakos, Kiambu, and Kajiado without a reciprocal increase in funding to establish urban infrastructure therein, even as the old neighbourhoods in the inner city suffer state neglect in maintaining and upgrading such facilities (Makena, 2020). This explains the general infrastructure challenges that the metropolitan area is bedevilled with (Mutanu, 2020; Mwau et al, 2020; Mansour et al, 2017; Wanzala, 2016; Agence France Presse- AFP, 2014; UNDP, 2011).

As an independent state-funded administrative unit, Nairobi is governed by a politically elected county governor who works closely with a county executive board and the county assembly which is the legislative arm of the county government. These units further have departments and senior administrators who oversee their affairs. To coordinate planning and administration, the county works closely with similar administrative units in other counties that make up the agglomerated metropolitan area. This collaboration also ropes in the National government through various ministries, and the newly created Nairobi Metropolitan Services which, overseen by the presidency of Kenya, is expected to fast track infrastructure development and service delivery in selected sectors for the city (Otieno, 2020).

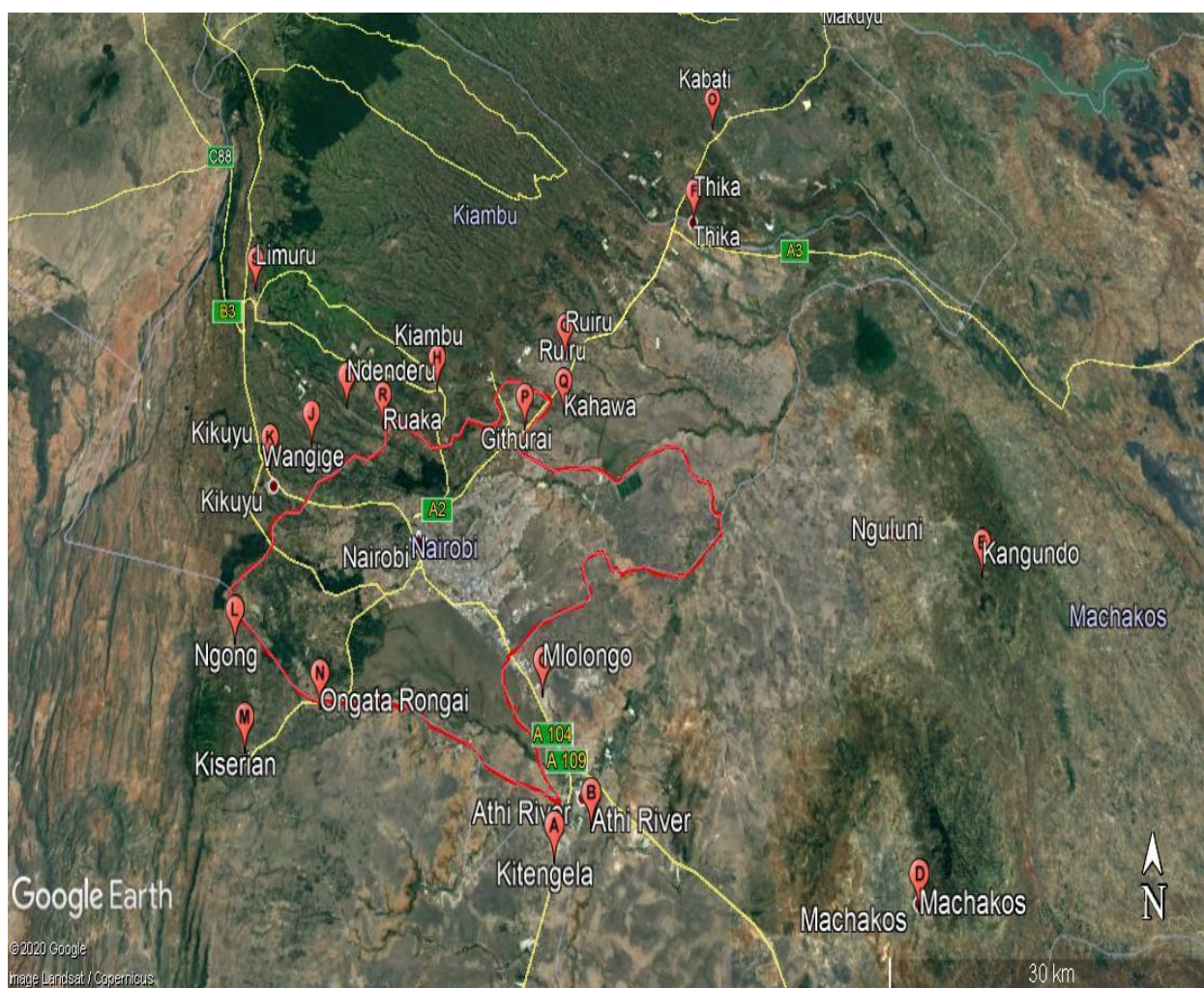


Figure 1: A map showing the aggressive growth of Nairobi's Metropolitan Area from its original size (with georeferenced boundaries in red) as it captures smaller towns. Its westward growth is limited by the Great Rift Valley whose walls border Ngong Town.

Nairobi's Urban Planning and Governance Bottlenecks

Perhaps the most glaring challenge facing the city's core (within the 10km radius from the CBD) is congestion. Describing this chaos that characterises vast parts of estates such as Pipeline, Umoja, Fedha, Imara Daima, Kayole, Mukuru, Githurai, Kahawa, Kagemi, Kitengela, Ongata Rongai, Kibera, Kariobangi, and several similar classes of residential areas housing the bulk of the city dwellers, Mwau (2020) writes:

‘‘On a hot and hazy Sunday afternoon, Nairobi’s concrete tenements loom over the city’s shacks (or ‘slums’). Men and women hang clothes on rooftops and balconies – making the buildings appear as a patchwork of fabric mosaics. The streets below buzz with activity: hawkers, stallholders, water vendors, and pedestrians’ bustle among shops, betting joints, cafes, and bars. People stream in and out of the tenement’s ground floor gates. Children play. On the balconies, some tenants pass time in the only place where the building opens up to the air outside. This is something of a luxury – many tenants have inward-facing balconies or live on floors with only artificial lighting. Neither sunlight nor fresh air finds its way through here. Meanwhile, water starts to run again from the only tap on the floor (sometimes the only one in the building) and queues are building up. The building caretaker scales the floors letting tenants know the vital service is on again. Back outside, as the evening closes in, pedestrians pour to, and from the matatu pick-up point. Matatu is Nairobi’s informal public transport, including buses, minibuses, and vans.’’

In many estates, including the Kibera, Kayole, Soweto, Lunga Lunga, Mukuru, and Kariobangi slums, male members of the family and their children are accustomed to spending as much time outside the house as possible to avoid crowding in their single-room dwellings. For neighbourhoods that also lack designated sporting grounds and formal markets, men tend to pass their time in illegal brew sheds imbibing cheap contaminated alcohol, bars, betting shops, and in pay TV rooms watching English Premier League and movies. Children on

the other hand try to make the most of any available free space (often yet to be developed plots) playing, as women and other shoppers buy from stalls that line up in front of houses and atop storm water runoff channels along roads. These conditions contribute immensely to sexual depravity, drug abuse, diseases as well as gang and criminal activities among both adults and children (Vidija, 2018).

Whereas human settlement is often influenced by infrastructure expansion and deliberate government opening up of initially remote areas, this is not the case for Nairobi. The expansion of the city is largely stimulated by inconveniences at the city's core such as crowding, poor quality of housing, high crime rates, high cost of land and housing, and lack of environmental sanity (Mwau, 2019) which pushes the middle class to seek alternatives at the peripheries. It is, furthermore, a product of an aggressive private investment environment particularly in sale of land and houses, public transport, and private water supply, private education, and healthcare. The assumed serenity and cleanliness, in addition to the lure of having necessities such as water supply (albeit salty borehole water), electricity, some private academy, and proximity to a tarmacked road (from 0-10 kilometres to a tarmacked road or one that is earmarked for tarmacking in years to come) are often attractants used to bait people into buying property and relocating into suburban neighbourhoods, often with the assumption of saving on rent. Unbeknown to them, this is a trade-off with high transport and living costs at the periphery (Mwau et al, 2020).

The government's supply of these basic public infrastructure services is often greatly delayed, sometimes by over a decade (Mwau, 2019; Wanzala, 2016). Most early 2000s suburbs are yet to be connected to clean tapped water, public schools and health services, and bitumen or macadamised roads. The new conurbations largely depend on expensive private academies and hospitals charging exorbitant fees due to lack of competition and government regulation of fees, and tagging of these neighbourhoods by market forces as affluent. A great chunk of Nairobi's metropolitan area is not covered by government piped water supply, city's sewer system, or tarmacked city road network. Secondly, the city also lacks transport infrastructure and alternatives like roads, walkways, cycling paths, and railways. It characteristically manifests heavy traffic jams during peak hours, water shortage and hawking, long queues in hospitals and water points, and unhygienic fresh food kiosks established atop drainages (Wanzala, 2016; Mwau, 2019; Mwau et al, 2020).

The World Bank (2020b) reports that a good chunk of Nairobi's burgeoning population has been pushed into informal and low-income formal settlements where access to water and sanitation services is limited. Work is however underway to improve the water supply and sewerage services through the installation of new pipelines and catchment areas for these services. The impact of these upgrades however remains uncertain. It is also unlikely that they will reach all the suburbia where residents consume commercialised services with prohibitive pricing and unreliable quality (Mwau et al, 2020; Wanzala, 2016; K'Akumu & Apidda, 2006). The cost of living here is increased by spending on bottled drinking water and privately procured exhaust services for domestic toilet waste disposal (Mwau et al, 2020; Mansour et al, 2017; UNDP, 2011).

Liaros (2018) states that cities are shaped by the prevailing economic, governance, social, political, and technological narratives with their ecosystem. All contributions by these aspects of society will work for the good or the bad of the systems within which they exist. Consequently, a city like Nairobi, in its development, is also shaped by these forces which portray the ideals of the society within which it exists. And, true to his assertion, this is the trend in the entire country in which government public infrastructure service delivery tends to come late after human settlement (Mwau et al, 2020). Maintenance of such facilities is also often delayed and inconsistent resulting in extensive damages, vandalism, and hefty restoration costs (Maake, 2015; Oronje, Rambo and Odundo, 2014). Some milestones are however being reported due to devolved governance and improving state planning and financing under Kenya's Vision 2030, and the drafting of new laws to establish legal, institutional and financing frameworks for sustainable development in counties, towns and cities alike (World Bank, 2018).

The public investment challenges and the seeming haphazard mushrooming of suburbs do not necessarily connote a lack of planning. To a great extent, the expansion and growth trajectory of cities such as Nairobi happen in response to government policies and plans, some of which have been highlighted in this document. The Kenyan government for instance came up with devolved governance in 2013 as demanded for in the 2010 constitution. This opened up initially dying towns as headquarters of regional governments. The initially sleeping shopping centres and small towns, upon being accorded these statuses in the shaping the development of their regions, started expanding into major urban nodes with Nairobi being one such (Splinter and Leynseele, 2019). It is experiencing a rapid rate of urbanization of between 5-7.5% (Makena, 2020; Mwau et al, 2020; Makworoa and Mireri, 2011).

Land tenure system in Kenya's in towns such as Nairobi limits land ownership to 99 years leasehold (National Land Commission, 2017). This makes potential homeowners reluctant to purchase land within city bounds. It is particularly so because land in the neighbouring counties of Machakos, Kiambu, and Kajiado located a few kilometres away, which also form part of the greater Nairobi metropolitan area, can be purchased on freehold title deeds with unlimited tenure (Wanzala, 2016; The Land Act, 2012). The three counties are generally within a radius of 15-20 kilometres from Nairobi's CBD. Their affordable and freehold

land attracts millions of potential homeowners. Consequently, their used-to-be farmlands that border Nairobi City County have with time been converted into suburbia where homeowners build on an eighth or a quarter of an acre. The areas largely consist of second-generation immigrants seeking a new identity off town, and the lucky newcomers (Makena, 2020; Rodrigue, 2020; Mwau *et al.*, 2019; Wanzala, 2016).

Nairobi's aggressive expansion has overcome administrative barriers, a national park, and forest reserves that initially marked the end of the city. Some sections of the Nairobi National Park and forests such as Ngong, Ololua, Karen, and Karura have been encroached by these expansion activities to make way for infrastructures such as roads and railway lines, factories, warehouses, and human settlements (Mutanu, 2020). Courtesy of these activities, wildlife migration corridors have been swept away resulting in a reduction in their numbers (Agence France Presse- AFP, 2014). Furthermore, tree cover in forests that act as water towers and carbon sinks; and hence a lung and an ecological lifeline for the sprawling city has reduced significantly. Even the remaining patches of these forests have been invaded by recreational activities, theft (of seedling, wood, red soil for gardening and other rare forest resources), dumping of earth excavated from construction sites and are also used as shortcuts to other parts of the city by pedestrians. These activities threaten their regeneration, and the trends are, perhaps, an indication of this society's anthropocentric attitudes towards natural resources and their dominance and use by human (Koech, 2019; Perry, 2019; Onyango, 2015).

Justifying Determinants of Socio-Economic Character of the City's Neighbourhoods

Burgess (1925) and Rodrigue (2020) consider urban growth as a process of conversion and expansion of land use. Macagba (2016) describes it as a process of invasion through which urban development overcomes administrative divisions to develop a new urban form with its own unique urban spatial structure. It is also accompanied by succession whereby new social groups and land use patterns gradually emerge to replace the former. This occurs both in the city's core, the suburbia, and rural areas where residences and farms are replaced by industrial-commercial hubs and residential estates (Macagba, 2016). Also accompanying this, according to the author, is a process of segregation where the city's population is grouped according to preferences which are further informed by capabilities and prejudices. In effect, the wealthy leave the congested and slum-like urban core to the poor and the working class as they seek a quieter life in the periphery.

As individuals hop through the economic classes, they will relocate and get accepted in the unique environment characterized by their newly acquired socio-economic identity through the process of assimilation and accommodation. The individuals go through a process of filtering which determines their belongingness in a certain urban community, and unique socio-economic cocoons within these geographical locations. Administrative areas in cities will also go through a similar process that individuals go through depending on the changes in their land use, and types of occupants. This process would see former slums become high-end estates or industrial complexes and vice versa. The undercurrents also determine the value of and the general cost of living in the emerging socio-economic neighbourhoods. This is analogous to the Darwinian survival for the fittest principle (Macagba, 2016) which also discriminates land (geography) by its economic worth, usually, based on the environmental services it offers, but also on people's attitude towards its utility.

On this basis, therefore, the mass migration of Nairobi's middle-class residents to the city's outskirts is not only understandable but necessary. Whereas the involvement of private investors in this by providing amenities whose supply is otherwise a preserve of the government would be excusable in the short term due to the rapidly increasing demand for the same, the state's persistent laxity in quickly filling the emerging gap cannot be justified. Coupled with poor regulation of the service providers, the situation results in the supply of low quality yet expensive basic amenities such as public transport, water, drainage, sewerage, education, and health services; and the poor state of roads. This lowers the quality of life for *Nairobians* as well as stifles the development a city commonly referred to as the gateway to the East and Horn of Africa region. This position is admired and greatly contended for by other fast emerging cities such as Addis Ababa, Kigali, and Dar Es Salaam (African Development Bank, 2019; Mwangi and Kibe, 2014).

There is hope that ongoing projects, including the introduction of affordable national housing by the national government, will offset the challenges (CAHF, 2019). That Kenya is experiencing these challenges can be attributed to the lack of a stable democratic government in the country between 1978 and 2002 (Goldsmith, 2020; Akech, 2014). The subsequent governments have tried to put in place policies and capital investments to restore the country and Nairobi city on their path to sustainable development as demanded by the Sustainable Development Goals (2015-2030) and their precursor Millennium Development Goals (2000-2015) (SDGs Kenya Forum, 2019). Forces such as underinvestment and corruption still limit the gains made in expanding access to basic infrastructure not only in Nairobi but across the country. Still, improved awareness and agitation by the citizen are bearing some fruit (TI-Kenya, 2017). It is highly expected that the current and future governments will pump more resources into developing all parts of the city which is playing catch up against its contemporaries across the globe.

Conclusion and Recommendations

Reviewed literature indicates that Nairobi's population is growing very fast. Thesprawl, although reduced by devolved governance which has taken a bit of the population pressure resulting from rural to urban migration, is expected to continue. Through its rather uncontrolled expansion, the city is also absorbing more initially rural land into suburbia even as it merges with other smaller towns within its neighbourhood to form the Nairobi Metropolitan conurbation. This growth in Nairobi's population and geography is putting pressure on basic public infrastructure services which need to be rapidly expanded in line with Nairobi's emerging urban dynamics.

Nairobi's growth pattern seems to adopt a ring model consistent with Burgess' Concentric Rings theory (Rodrigue, 2020). Its land use pattern appears to have a concentric cycle spectre expanding from the CBD (downtown) to the suburbs. In it, the quality of housing and lifestyles generally gets better as one moves further from the CBD. However, this comes at a cost as houses become more expensive, and commodity prices shoot due to social tagging of residents as 'rich'. For a city with one Central Core which also hosts most of the jobs, those living in suburbia generally spend more time and money on their commute to access their workplaces. In Nairobi- Kenya, as already stated, the quality of life in the suburbia is also affected by endemic unavailability of public amenities namely hospitals, schools, water, roads, sewer system, and sometimes, electricity (Matata, 2004; World Bank, 2020a). With time, the neighbourhoods also attract slums due to lack of affordable housing in their proximity to house low-income people who work within them. Such can force further outward migration turning the city into an unending jungle of unplanned, chaotic communities and structures. These are major pillars of sustainable urban and community development envisioned within the SDGs. They are also important in poverty eradication. A country with a poor city population will definitely have more poverty in its rural communities.

Considering, for instance, the dire needs created by lack of basic sanitation and transport infrastructure, this paper recommends continuous modelling, mapping, planning, financing, and development of basic infrastructure in emerging urban constellations. Among the forces to be employed includes provisional privatization of the installation of amenities such as storage and piping of clean water and drainage to the areas where they are urgently needed. The same can apply for schools, health centres, community roads and proximate low host housing. This can be accompanied by the tolling of water services to recuperate investments followed by a handing over of the facilities to line government authorities once investments and feasible profits have been generated. The approach has already been adopted for road use in various cities with Nairobi's first toll road (Mombasa Road) currently being under construction.

Tolled water and sewerage service access can be connected to the mainstay city network and billed for a certain duration by investors before being reverted to the government on a cost recovery and profit-sharing framework. Such undertakings will see private finances and operational (machines and oversight) instruments deployed in efficient and cost-effective delivery of services (through a public-private partnership) which if left to the government bureaucracies to undertake, may take another decade or more before being realized. Doing this reduces delayed access to basic fundamental rights by the people; a direct acknowledgment of the utility of these amenities in improving city dwellers' access to high-quality basic public infrastructure, and in effect, better and affordable living standards. More importantly, streamlining these sectors will weed out cartels that have been blamed for deliberate vandalism of city infrastructure such as hospitals, water, schools, and sewerage pipelines to privately provide these services to city dwellers and profiteer from them. Cases exist where public servants mandated with providing these services deliberately hamper their availability, then set up competing alternatives to generate incomes for themselves.

For instance, due to limited investment by the state in laying down the water supply and sewerage infrastructure, water supply and sewer exhaust services, in many urban neighbourhoods, are operated by informal private service providers in a cartel like arrangement which constricts municipal service provision so as to fill the gap through privately owned bowsers, pipelines and tankers at exorbitant prices and hence make themselves billions from poor Kenyan urban dwellers (Akosua, Schwartz and Zwartveen, 2019).

In addition, in the wake of the geographical expansion of the city, more stringent zoning and systemwide planning and control of neighbourhood houses and other infrastructure layout and designs should be put in place. This will ensure that the city acquires a standard form (identity) and beauty as opposed to careless mix and match approaches which turn city neighbourhoods into a chaotic mishmash (cocktail) of all types of structures and land use types. This requires vigilant planning and monitoring of land use, as well as the use of natural resources (including forests, heritage sites, public amusement parks, and national conservation areas such as the Nairobi National Park) which should be coupled with stringent measures to curb corruption by cartels at the land registries and by urban planning officials who approve land use and spare illegal structures from demolition without strict adherence to set regulations (Alushula, 2019; Angote, 2018; TI- Kenya, 2017; Theuri, 2020; Kariuki and Ng'etich, 2016; NCLR, 2012b; Southall, 2005; NCLR, 2012d).

As the city evolves and continues to grow, its planning should be continuously researched and improved. This entails the employment of spatiotemporal analysis which entails an examination of the relationship between space and time. There is a need to continuously establish how fast the city grows or degrades, how this compares with trends in other cities, and which lessons can be derived from these growth dynamics and their impacts on people and the environment to better model the urban living-working-visit experience for those who interact with Nairobi's urban environment. This is in recognition of the fact that for a long time, built environments such as Nairobi and mother nature have generally been looked at with an anthropocentric lens.

The development of built environments is largely viewed as aiming at bettering human interactions with such environments. Unfortunately, as anthropocentric as space development is, it more often than not results in calamitous impacts on the man whom it is meant to serve with Nairobi not being an exception. The anthropocentric approach has caused or exacerbated environmental and man-made disasters due to limited environmental considerations of the effects of human settlements (Copnina *et al*, 2018). Government planning and investment offset these excesses to ensure the sustainability of urban growth and development for cities such as Nairobi whose experiences with flooding, building collapse, disease outbreaks, fire incidences, high instances of crime, pollution, poor waste management, and substandard water and sanitation services (Mwau, 2019, Mwau *et al*, 2020) attest to this necessity. This is in recognition of the fact that urban ecosystems work as an ecological whole. A failure in any aspect of its planning and governance will ultimately poison the whole system and derail the sustainable development of Nairobi and other cities and towns within the region.

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