Assessment of Urban Neighborhood Sustainability: A Case Study of Ngara Estate, Nairobi

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DECLARATION

This Research Project is my original piece of work and has not been presented for a degree in any other University

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DEDICATION

To my family.

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ABSTRACT

The study is an assessment of urban neighbourhood sustainability. The study argues that unmanaged urban growth has led to urban issues such as environmental problems, poor infrastructure and congestion, among others, thus affecting urban neighbourhood sustainability. Urbanization/urban growth has also led to increased demand of land for urban uses such as residential and commercial. The specific objectives of the study were: (a) Identify the types of land uses in Ngara estate (b) Examine the indicators of a sustainable urban neighbourhood in the area (c) Propose measures to improve the quality of the neighbourhood and review some of the best-case studies. The data was sourced through the administration of household questionnaires, interviews and observation. The qualitative data was analyzed using content analysis techniques, whereas quantitative data analysis was employed to summarize information and data through percentages. The findings of the study revealed that 53.3% of emerging developments were mainly high-rise residential apartments, 26.7% were in the form of high-rise residential apartments cum commercial, 13.3% purely commercial in the form of offices, retail and hotels and 6.7% were student hostels. Challenges associated with solid waste management include delay in the collection of waste (44%), the high fee charged (29%) for waste collection and lack of citizen responsibility and/or bad attitude (27%) towards the management of solid waste. About 39% of the respondents reported that they do not have access to NMT facilities such as the cycling paths and walkways. The major cause of water pollution in the neighbourhood are discharge of raw sewer (38%), oil spillage (34%) and solid waste (28%). Approximately 45% of the respondents also reported that the burning of waste is a major concern as it pollutes the air. 33% felt that burning of fossil fuel contributes to air pollution as well. Dusty roads also contribute to air pollution as reported by 22% of the respondents. Causes of land degradation include cutting down of trees (18%), disposal of non-biodegradable waste (67%) and light industrial waste (15%). Other issues are poor drainage (5%), poor hygiene (33%), inadequate facilities such as storage areas (5%) and theft (5%). A good number (82.7%) reported that the health facilities were adequate. Economic activities: Small-scale business accounts for 73% of economic activities whereas 27% were of medium scale. The study concludes that the existing and emerging land uses are of mixed-use in nature comprising uses such as residential and commercial uses. The key recommendations are preparation of land use plan or 'action plan' to guide developments in Ngara. Furthermore, detailed research on present capacity and future demand for infrastructure be done.

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ACRONYMS

CBD	Central Business District
GDP	Gross Domestic Product
GoK	Government of Kenya
Ha	Hectares
KENHA	Kenya National Highways Authority
KICD	Kenya Institute of Curriculum Development
KII	Key Informant Interview
KNBS	Kenya National Bureau of Statistics
KURA	Kenya Urban Roads Authority
NACOSTI	National Commission for Science, Technology and Innovation
NCC	Nairobi City County
NEMA	National Environmental Management Authority
NHC	National Housing Corporation
NIUPLAN	Nairobi Integrated Urban Development Plan
NMS	Nairobi Metropolitan Services
NMT	Non-Motorized Transport
NaMSIP	Nairobi Metropolitan Services Improvement Project
NWSC	Nairobi Water and Sewerage Company
SDGs	Sustainable Development Goals
SPSS	Statistical Package for the Social Sciences
ToD	Transport Oriented Development
UGT	Urban Green Transition

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

A sustainable city must always balance its social, economic as well as environmental needs. A successful city offers its residents physical infrastructure (water, energy, sanitation system, among others) and efficiency. A successful city also recognizes its people, natural assets and environment and build on such parameters to ensure the best returns (Cities Alliance, 2007). Present-day cities are part of the global environment, and their activities, whether positive or negative, are felt far beyond the city's borders. Global policymakers, therefore, have recognized that cities have a substantial impact on the state of the global environment. Managing environmental resources is essential to ecosystem health. The natural environment provides ecosystem services to cities, and they are fundamental to urban livability (Cities Alliance, 2007). Some of these include air, water and open spaces. Some of the benefits of the natural environment include:

- Clean air provides a healthy urban environment
- Rivers act as natural pollution filters and provides water for domestic and industrial use
- Forests serve as carbon sinks, leisure amenities, and watersheds
- Biodiversity is essential for food, medicine, materials to improve the quality of life.
- Wetlands filter waste and reduce flooding
- Coral reefs and mangroves protect coastal cities from storm surges, siltation and prevent erosion.
- Parks, buffers, and greenbelts act as carbon sinks and provide open spaces for residents.
- It also counteracts traffic noise and improves urban livability.

It is, therefore, essential that a functional and successful city must have a mutual relationship with the environment. Urban neighborhoods being the key units play a crucial role in cities formation and creating a sustainable urban neighborhood is a key step towards achieving sustainable cities, thus enhancing a mutual relationship between the city and its neighborhoods as well as with the natural environment (Gildroy, et al, 2012; Al-Hagla, 2008). According to Shirkhanloo (2018), sustainable urban neighborhood enhances positive interaction with the environment as follows.

- High density reduces the per capita demand for land, lowers the cost per capita for provision of infrastructure (roads, water, sewer system and waste collection) and public amenities.

- High proportion of multifamily dwellings reduces per capita consumption of building materials

It is worth noting that these environmental resources are regularly taken for granted in development as they are not integrated into cities' planning. Mismanagement of the urban environment often leads to dire consequences for the city residents, especially the urban poor (Shirkhanloo, 2018).

On the other hand, urban areas also offer its residents social and physiological needs, hence making it a key resource towards neighbourhood sustainability. Social Exhaustion Theory argues that a diverse group of people in an urban set up face different stressful social factors. Provision of social amenities that meets the need of different age groups such as schools, health facilities, active and passive recreational spaces, shopping centres, and entertainment joints plays a crucial role in transforming a neighborhood into a socially sustainable neighborhood. Social homogeneity also increases the residents' comfort and improves the quality of the neighbourhood in general (Habib, 2016).

Socio-economic factors also affect the livability of a neighbourhood. Access to employment opportunities, community safety and decent income determines how well neighbourhood residents live. These factors enable urban neighbourhood residents to afford medical care, quality housing and make healthy choices; for instance, employment provides income that determines the choices related to housing, food, or education, among others. Furthermore, economic factors theory deduces that a balance between social and economic is a prerequisite for a high-quality urban neighbourhood (Gadrey, 2005).

According to the United Nations World Cities Report of 2018, 54 % of the world's population live in cities and towns across the world, and it is anticipated to rise to 66% by 2050. Since Africa and Asia are some of the regions experiencing rapid urbanization, it is forecasted that 90% of the global cities' population will be concentrated in these regions (UN-world cities report, 2018).

For instance, in Nairobi city, the population grew from a paltry 119,000 at the onset of the 20th century to approximately 3.1 million people in the first decade of the 21st century. In 2020, the population is estimated to cross over the 5 million mark, and this trend is unexpected to slow down any time soon. According to the Kenya Housing Population Census of 2019, the population of Nairobi (excluding the Metro Region) is approximately 4.1 million (KNBS, 2019).

As Nairobi grew, it sprawled out, occupying land that is forested and productive in agriculture, thus degrading natural areas. The fast-growing population as far outstripped the city's ability to deliver essential services, for instance, sanitation, water, and waste management. It has also led to an increased number of vehicles, thus leading to increased traffic congestion and a high level of air pollution. In a nutshell, it has caused major environmental issues such as noise, air and water pollution, rapid urbanization, mushrooming of informal settlements, sanitation issues, water supply shortages, and inadequate solid waste management system. Furthermore, the encroachment of wetlands and riparian reserves leads to severe floods, inadequate waste disposal, and low-density development causes damage to urban biodiversity because of the urban sprawl (Mwathi, 2016).

Furthermore, the provision of social facilities has not been keeping up with the urban population's growth. Existing social amenities are either poorly stocked or dilapidated. There are also under the provision of social amenities such as community centres, rehabilitation centres, and fire stations among others. A study by Nairobi Metropolitan Services Improvement Project (2019) showed that health facilities in Nairobi Eastland's were inadequate. The average number of beds per 1000 people stands at 3. This is lower than the average of 74 in the city (NaMSIP, 2019). However, UN-Habitat advocates for the adoption of urban planning approaches, which integrate environmental aspects. Such approaches include creating sustainable urban neighborhoods (UN-Habitat, 2014).

1.2 Statement of the Research Problem

Nairobi is the capital and the major city in Kenya. It is also the most important economic, political, and transportation hub in East and Central Africa. In the past, the area constituting Nairobi city today was mainly a swamp until a supply depot of the Uganda Railway was constructed in 1896 that later became the railway's headquarters. In 1905, Nairobi replaced Mombasa as the capital city of the British protectorate; the city grew as an administration and tourism centre. However, after independence, the city grew rapidly, thus putting much pressure on the city's social and physical infrastructure.

Ngara neighbourhood is within the fringes of the Nairobi CBD. Since independence, Ngara has grown as a planned and sustainable neighborhood that used to accommodate middle- and high-income people. The neighbourhood was known for its good housing, public facilities, economic vibrancy, ample green spaces, adequate and excellent infrastructure (roads, sewer, and drainage), and free of environmental challenges. According to Kyalo (2012), however,

increased demand for land for residential and commercial developments has put the neighbourhood in constant land use transformation. Increasing the number of learning institutions within the neighborhood and CBD has also led to a high demand for hostel developments. The constant growth of the neighbourhood has led to unmanaged urban growth that distorted the neighbourhood's urban fabric. Uncontrolled urban growth has led to urban issues such as environmental problems, poor infrastructure, and congestion, thus affecting the neighborhood's sustainability.

According to the Kenya Housing and Population Census (2019), Ngara area recorded a population of over 31, 000. Increased population in the area has also led to increased pressure on social amenities. Challenges facing amenities such as healthcare include unequipped facilities, poor maintenance, and understaffed. Deficit in terms of provision of social amenities also exists and is projected to increase, according to NaMSIP (2019). Furthermore, recreational spaces have also been grabbed.

Similar studies done before by Kyalo (2012) and Mweru (2012) majorly focused on spatial transformation and development challenges. However, no studies have been done on assessing the sustainability of the neighbourhood. This is a research gap that exists, which this study aims to fill. The research mainly examines the sustainable neighbourhood indicators in the Ngara area (social, physical, economic, and environmental).

1.3 Research Questions

1.3.1 General Question

Does Ngara exhibit the general indicators of a sustainable neighbourhood?

1.3.2 Specific questions

1) What are the types of land uses in Ngara estate?
2) What are the indicators of a sustainable urban neighborhood in Ngara?
3) What approaches and best-case studies can be adopted to improve the sustainability of the neighbourhood?

1.4 Research Objectives

1.4.1 General Objective

The general objective of this study was to assess the general sustainability of the neighborhood (social, physical, economic and environmental). The specific research objectives are as outlined below;

1.4.2 Specific Research Objectives

1) Identify the types of land uses in Ngara estate.
2) Examine the indicators of a sustainable urban neighbourhood in the area.
3) Propose measures to improve the quality of the neighbourhood and review some of the best-case studies.

1.4 Research Hypothesis

The study was meant to test the relationship between neighbourhood housing and services and residents' perception of the quality of these parameters, which are key in a sustainable neighbourhood. Expressed as a null hypothesis;

H_0: There is no relationship between the neighbourhood's quality of housing and services and residents' perception on the quality of these elements.

As a research hypothesis;

H_1: There is a relationship between the neighborhood's quality of housing and services and residents' perception on the quality of these elements.

1.5 Justification of the Study

Ngara being one of the Nairobi city neighborhoods plays a significant role in the formation of the city. As noted earlier, Ngara was planned as a middle-class neighborhood, and was a functional, livable neighborhood with ample public open spaces, adequate infrastructure, good housing, among others. The emergence of haphazard and unplanned developments, however, has degenerated the once functional neighborhood.

The urban fabric of Ngara estate has developed into an urban neighborhood of isolated enclaves of residential developments, commercial centres, and informal activities such as food kiosks, garages, and available open spaces invaded by vendors. This is because of poor urban planning, as well as a lack of urban governance and management.

These urban issues have posed significant challenges to Nairobi and delayed the city's transition to a modern and globally competitive city; however, Nairobi city's recent development strategy has shifted towards creating compact development nodes that are livable, green, efficient, competitive and inclusive. Before shifting to outer neighbourhoods, there is a need to address key urban issues affecting the core neighbourhoods surrounding the Nairobi CBD, including Ngara. This study focuses on assessing the sustainability of the neighbourhood. The study findings will form a basis for reviewing development guidelines applicable within the area and adjacent neighbourhoods such as Pangani, Parklands, and Eastleigh. Lastly, my interest in the topic draws upon my background in the built environment.

1.6 Scope and Limitation of the Study

The focus of the study was on the sustainability aspect of Ngara neighborhood. The scope covers physical, social, economic, and environmental. Ngara Neighborhood is situated to the North East of Nairobi CBD; it is approximately 2km from the CBD. Ngara estate is one of the neighborhoods surrounding the CBD that has seen dramatic urban decay in some of its areas, and the Estate comprises of Ngara East and Ngara West. Ngara west is bordered to the North, Southwest, and East by Forest road, Kipande road, and Muranga road respectively, whereas Ngara East is bordered to the East, West, and South by Muranga road, Dr. Griffin road, and Nairobi downtown respectively.

In the present day, sustainable development in cities is one of the most important goals spearheaded by international organizations such as the UN-Habitat and city managers worldwide. Urban neighborhoods, which are the smallest units of spatial organization, affect the sustainability of cities. Therefore, it is critical to emphasize the sustainability of urban neighborhoods as a vital approach to achieving cities' sustainability.

Therefore, the objective of this study was limited to assessing the status of Ngara estate based on the sustainable urban neighborhood indicators. The study is constrained to both Ngara East and Ngara West. Although Ngara East has seen the emergence of few developments, Ngara west has seen a resurgence in contemporary developments. There is an emergency need of modern-day apartments and offices as single storey buildings have been demolished in favor of high-rise apartments. On the other hand, hawkers have invaded the streets and the infrastructure is poor. Therefore, it was important to dwell on both neighborhoods. It would have been ideal for the researcher to visit some of the sustainable neighborhoods around the

world. However, financial constraint and travel restriction due to the COVID-19 pandemic was a hindrance for the researcher to explore and visit some of the sustainable neighborhoods.

1.7 Operational Definitions

Urban fabric: Refers to the physical form of an urban set up (both towns and cities). These aspects include architectural scale, form, materials, density, and elements.

Urban morphology: It is the study of urban form, which focuses on the formation and transformation of cities over a given period.

Sustainable urban neighborhood: It is a neighborhood with value as a place to live, work, and play over many generations.

Urban sprawl: Spreading of urban development on undeveloped land (countryside) within the urban fringes.

Urban regeneration: Program of reversing urban decay by improving the physical structure and redeveloping of a given place.

Urban decay: Deterioration of a city, or part of it, which used to be functional. Deterioration could be in the form of physical, environmental, or social aspects.

Urban form: It's the physical characteristics of an urban setup. These physical characteristics could be in the form of size, shape, density, and set up of buildings (Liptay, 2009).

CHAPTER TWO: LITERATURE REVIEW

This chapter mainly focuses on the literature review related to the subject under study. The topic has been divided into five major sub-sections covering urbanization, land use and land use cover, sustainable neighborhood, case studies of sustainable neighbourhood, theoretical and conceptual framework.

2.1 Global Urbanization

In the year 1960, the worldwide urban population was approximately 34% of the entire population; however, by the year 2014 the global urban population accounted for about 54% of the total and it keeps on growing. It is projected that the urban population throughout the world will be 67% by the year 2050 (approximately 5.3 billion people). This occurs as a result of people moving from rural to urban areas. These changes eventually lead to land use changes, economic activity as well as culture. Urbanization also has cons caused by unplanned growth thus leading to poor infrastructure and inadequate housing, water and sanitation. Urbanization is one of the key global change processes. As the people continue to move and the footprint of urban areas continues to grow locally and globally, it is important to understand resulting land use pattern, its interlinkage with natural resources and environmental change. Over the next couple of decades, urbanization will continue to grow especially in Asia and Africa (Horvat et.al, 2018).

On the other hand, physical expansion has also been faster suggesting reduction in urban densities. Studies have also shown that decline in household sizes have been decreasing in developed countries. Furthermore, cities in developed nations have been facing rise in per capita living space thus influencing spatial growth of cities. Urbanization affects settlements regardless of its size. Villages transform into a small town, small town transform into larger towns, and large towns becomes cities. This pattern has resulted into growth of mega cities around the world (UN-Habitat, 2014a).

A mega city is an urban centre with catchment population of approximately 10 million. In the year 1970s there were only three megacities, and by the year 2000 there were 17 and it's projected to increase by 24 megacities by the year 2030. The global perception of urban areas has shifted. Over the years, urban areas are viewed as places where societal issues were manifested in space in terms of health risks, congestion, pollution among others. Urban areas

are now described as centres where concentration of socio-economic activities is perceived as a strength for transformational change (Horvat et.al, 2018).

2.2 Urbanization Trend in Kenya

Urban population in Kenya is projected to rise significantly in the next years. Kenya's urban population was estimated to be 27% of the country's population, which translates to approximately 13.8 million Kenyans living in urban centres. It is projected that the urban population will stand at 22.4 million (33.4%) and 44 million (46%) in 2030 and 2050 respectively. The annual urban growth rate is 4.23%. This statistic is according to the World Urbanization Prospects (2018). According to World Bank Review (2016), urbanization levels tend to vary across the counties in Kenya. Analysis of the 2019 Kenya population housing census, most counties have small to medium size towns hence the level of urbanization in these counties are relatively low. Most of these towns lack land use development plans that guide and control development thus spatial development occurs without planning in these towns (KNBS, 2019).

Due to population and economic pressure, urban populations are residing in areas that are vulnerable to natural disasters thus posing serious economic and social risks. There is a link between a country's wealth and cities for example, the world largest cities such as London, Los Angeles, Sydney, and Toronto are in the World's biggest economies. However, cities in Kenya have not realized their maximum potential towards poverty reduction and economic growth contribution (UN-Habitat, 2018).

Rapid urbanization has stressed the capacity of cities and towns in Kenya to provide requisite infrastructure and basic services, which are necessary to stimulate growth. Recent UN estimate projects that urban population in Kenya will increase to over 35 million by the year 2030. This accounts over 65% of the country's population. As per this estimates, majority of Kenyans will be living in urban areas in the next couple of years. Therefore, this will further pose socio-economic, institutional challenges as well as environmental issues for Kenyan cities (UN-Habitat, 2018).

2.3 Land Use

2.3.1 Land Use Changes and Patterns

Land use pattern is largely dependent on relationship between mankind and environment and there are several factors that influences land use pattern. Among factors that defines land use

patterns include land use of properties abutting, public interest, social norms and human values among others. Conversion of land use tend to occur across the world. As reported by Conway (2015) urban development in coastal New Jersey was predicted to occur in forest and barren land. The table 2.1 is a prediction of land use pattern in the coastal city of New Jersey.

Table 2.1: Land Use Changes in Coastal City of New Jersey, USA

Class	1995	2000	2005	2010	2015	2020
		Percent of Total Area				
Urban	15.4	16.6	17.8	19.0	20.1	21.3
Forest	47.2	46.5	45.5	44.7	43.8	43.1
Agriculture	4.3	4.1	4.0	3.9	3.7	3.6
Barren Land	1.7	1.5	1.4	1.3	1.2	1.1
Wetlands	31.3	31.3	31.3	31.2	31.1	30.9

Source: Conway, 2015

Karanja (2018) undertook a research on implication of conversation of conversion of agriculture land use in Ruiru. The study reported that Ruiru originally was dominated by agricultural land use and largely undeveloped land. However, the growth of Ruiru town has increased built-up areas hence consuming large pieces of land. The study revealed that the predominant land uses in Ruiru neighbourhood are residential (62%), commercial (21%) and agricultural use (17%). Acreages of most of these properties (53%) are sixteenth, a quarter of an acre (28%) and an eighth (11%) while 8% were properties above an acre (Karanja, 2018).

Karanja (2018) argued that the causes of land use conversion are as a result of dwindling profit for agricultural activities and increased returns in land use conversion and selling. This has led people to subdivide and put up their properties for sale. Riparian land has also been encroached and these include rivers and wetlands. Karanja (2018) also argued that Ruiru's close proximity to Nairobi led to conversion of agricultural land to meet the housing demand for people living in the Metropolitan area. Kageni (2018) also reported that increased population is another factor that contributes to land use change. Increased population has put pressure on land thus driving subdivision of land into small pieces. The study also reported that the quest to own a land led to encroachment of protected areas such as wildlife corridors (Kageni, 2018).

Haque et.al (2008) study on land use change in Sylhet recorded gradual land use change. According to the study, the land uses in the city in 1970 were 645.33 Ha dominated by marshy land, 430.88 Ha as vacant and 336.17% was a land for cultivation. By the year 1988, residential land use had increased to about 39.11% of the total area of the study. Most of the residents were also engaged in commercial activities. In 2007, however, the area recorded a radical shift in land use changes with 58.71% of the study area being residential land use. The other land use distributions are as follows: agriculture (12.06%), commercial (16.66%) and public purpose (0.5%). In a nutshell, housing construction increased from 12.97% to approximately 38.19% (Haque et.al, 2008).

2.3.2 Land Use and Land Cover Changes in Nairobi

A study by Oyugi et. al (2017) on land use and land cover changes in Nairobi revealed that Nairobi has seen built up areas increase from approximately 73.08 km^2 in the year 1988 to about 228km^2 in the year 2015. The major land use that have been affected is the forest. In the year 1995, the forest cover in the city was approximately 122.41 km^2 but in a span of five years, the forest cover was reduced by 50%. This reduction was attributed to clearance of forest land to pave way for urban development. On the other hand, land under rangeland and shrub vegetation covered 453.99 km^2 in the year 1988 but again it has been reduced to 200.30 km^2 as record in the year 2015. The decline in land under forest and vegetation cover in favor of urban development in the city has had immense effect in terms of pollution and environmental quality features. It is worth noting that the spatial urban expansion has not taken all directions in the city. The growth pattern and direction has mostly been witnessed along Thika, Mombasa, Kangundo and Ngong road. In most cases, developments along above-mentioned directions have been ad hoc in terms of planning thus necessitating revision of zoning regulations by the authorities (Oyugi et.al, 2017).

The urban agriculture in the city can be categorized as small-scale crop gardening and peri-urban agriculture. Small scale agriculture is practiced along the roadsides and high-density residential neighborhoods whereas peri-urban agriculture is mainly practiced where there is relatively large piece of land to allow for cultivation and livestock rearing. Urban agriculture in Nairobi has also seen a decline. According to the study by Oyugi et.al (2017), decrease in agricultural land can be attributed to the population growth. Figure 2.1 shows the land use and land cover change trends in Nairobi between the years 1988 and 2015.

Figure 2.1: Land Use and Land Cover Changes in Nairobi Between 1988 and 2015
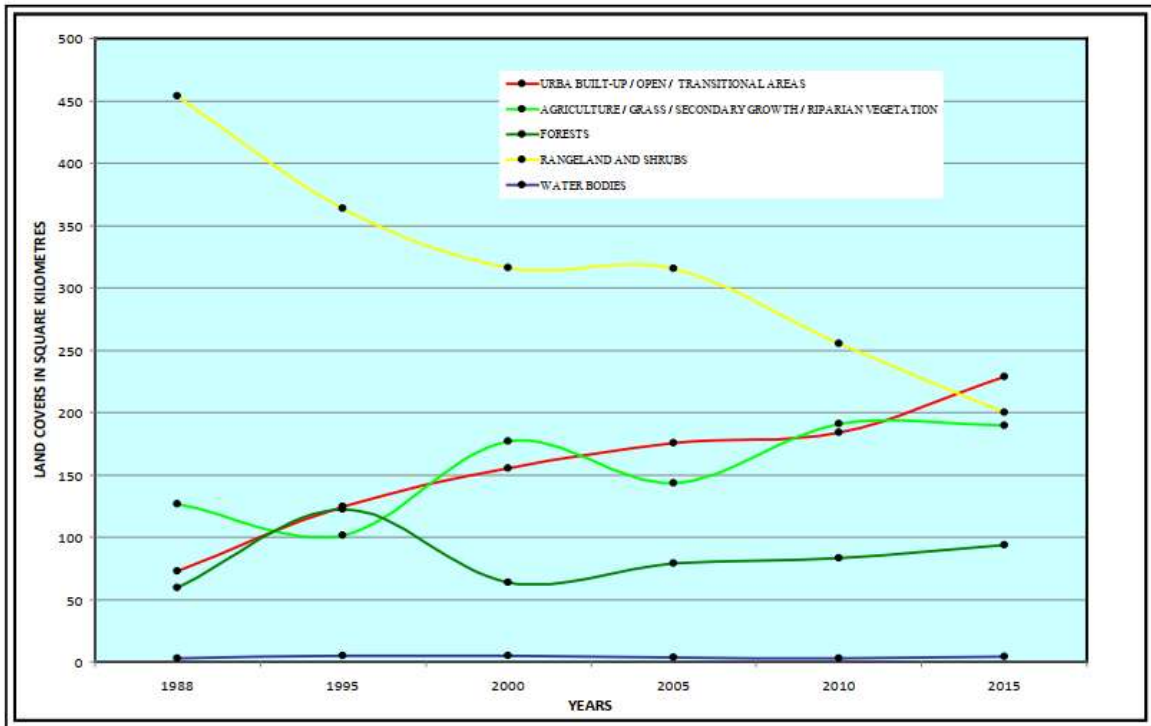
Source: Oyugi et.al, 2017

Similar studies by Odera (2016) revealed similar trend was observed in Kiambu County between the years 1984 and 2013. Odera (2016) noted that there has been a shift in land use from agricultural to residential and commercial uses. A sharp decrease of grassland, wetland and forest was recorded in the same period. On the other hand, the land for urban use in Kiambu county increased from 1.9% in 1984 to 34% by the year 2013. Over time, demand for land for urban development is predicted to increase (Odera, 2016). The figures 2.1 and 2.2 shows the decline in agricultural land between 1984 and 2013 in Kiambu.

Figure 2.2: Land Use Cover for Kiambu County in the Year 1984
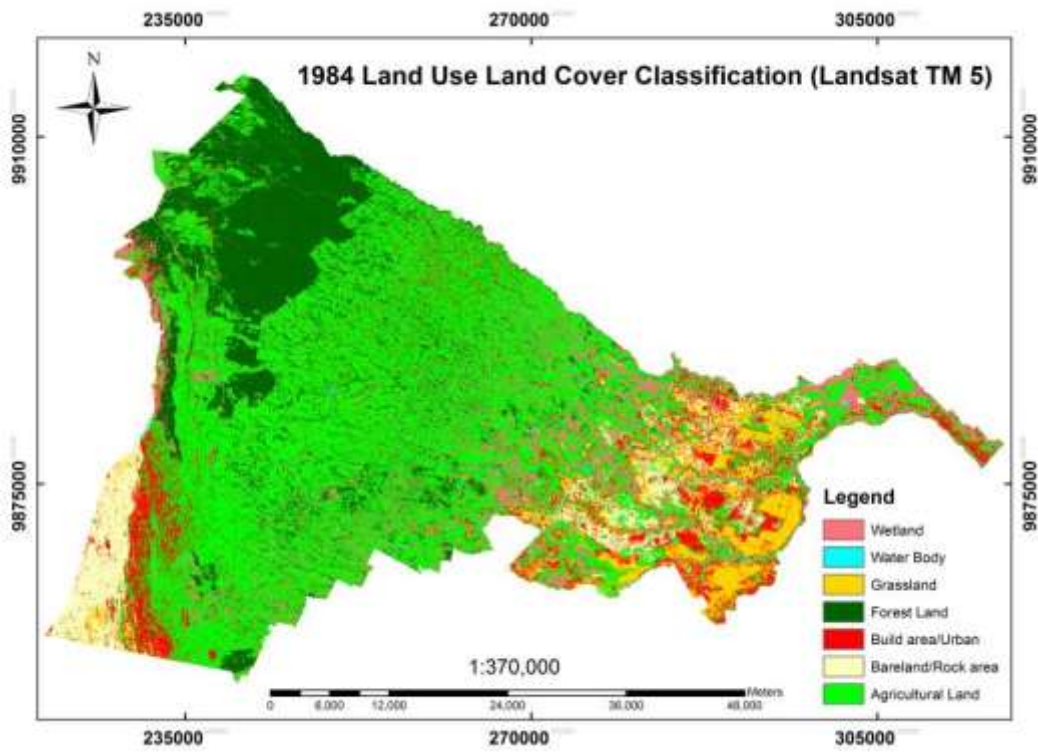
Source: Odera, 2016

Figure 2.3: Land Use Cover for Kiambu in the Year 2013
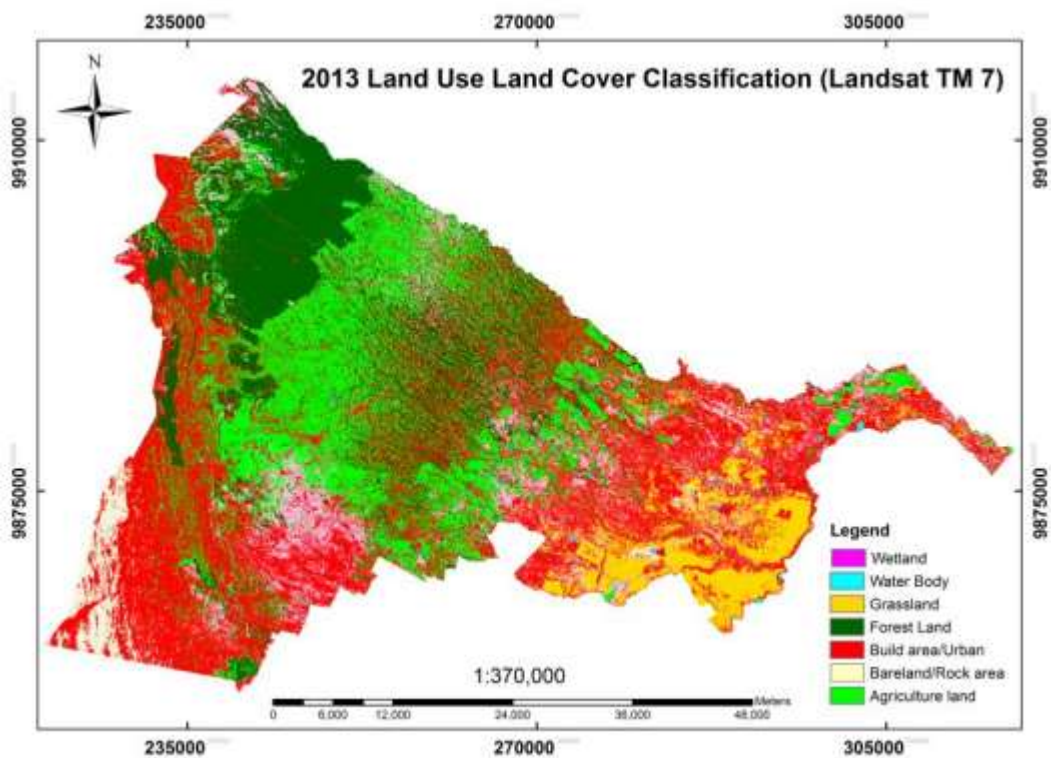
Source: Odera, 2016

2.4 Factors Influencing Land Use and Land Cover Changes in Nairobi

Land use changes in Nairobi is precipitated by factors such as physiographic, socio-economic and demographic, and key among them is the rate of urbanization. According to the UN-Habitat report (2017), the rate of urbanization in Nairobi averaged about 4.7% per annum. Factors such as economic growth and migration have acted in concert to drive the urbanization rate. These factors are as discussed below.

2.4.1 Economic Growth

The rapid economic growth in the country and particularly Nairobi has increased the rate of urbanization in the city. The Gross Domestic Product (GDP) recorded in the year 1985 was KES 25 billion, 110 billion in 1995 and 1.4 trillion in 2015. The economy on the other hand has been characterized by mixed gains for instance in the year between 1963-1973, the economy grew by 6.6% annually. It however, declined to 5% per annum between the year 1980 and 1990 and 4% between 1990-1997. Since the start of the 21st century, the economy has been oscillating at 5% per annum. In 2019, the economy grew at a rate of 5.3%. Economic growth has led to increased industries as well as expansion of city as real estate developments boomed. This has therefore led to expansion of built up areas. Increased development can be correlated to growth in GDP (GoK, 2019).

2.4.2 High Population Growth Rate

In the third decade of the 21st century, slightly over half of the world populations, approximately 4 billion, are living in urban areas. In the last few centuries, and for the most part in recent decades, the world urban population shifted dramatically as more and more people moved from rural to urban areas (Roser, 2019). Throughout the world, urban populations are projected to rise in the coming decades. By 2050, it is anticipated that 68% of the global population will be residing in urban areas up from 54% as reported in 2016. Africa and Asia will be among the continents with the fastest growing urban population in the same period (UN-Habitat, 2018).

Nairobi's population in 1969 was at 509,286. Between the year 1979 and 1999, the population grew from 827,775 to 2,143,254. In 2009, Nairobi's population was at 3,138,369. Currently Nairobi's population is over 4 million. When compared to its population in 1969, there is an increase in Nairobi's population eight times the one recorded in 1969 (GoK, 2019). Urbanization in Nairobi has been accelerated by high population rates and increased rural to

urban migration. On the other hand, increase in urbanization has led to increased pressure in land due to high demand for housing, industries, institutions and businesses. The rapid urbanization has overwhelmed the county's capability to sustain basic housing services. Nairobi County resorted to an ad hoc paradigm of planning in an attempt to sustain the rapidly growing population. This attempt did not succeed as it further worsened the county's economic, social, physical, economic and environmental factors (Oyugi, 2017).

2.4.3 Physiographic Features

As reported by Oyugi et.al. (2017), there has been no rapid expansion to the western and northern parts of the city. This is due to lack of convenient topography and high land prices, which has restricted constructions. The slow growth in these areas is also associated with policies regarding flight safety and wildlife. This is because these areas border airports and national reserves. Growth to the north eastern, eastern and southern frontiers was hindered due by poor transport network but has since greatly improved since 2003. In addition, these areas are characterized by rocks that provide fine finish to constructed buildings. The availability of these rocks has been an added advantage to realtors thus promoting urban expansion in these areas.

2.5 Environmental Implication of Land Use Dynamics

Mwathi (2016) argued that land use changes are linked to environmental challenges. The study reported that land degradation was a major problem caused by land use changes. Mwathi (2016) also argued that unsustainable use of land such as clearing of trees and overgrazing are some of the factors that contribute to land degradation.

The study also marked encroachment and degradation of protected or gazetted areas for instance forest. This has led to reduction in forest cover. Encroachment has also affected supply of water, wildlife and environmental quality in the city. Furthermore, encroachments to natural ecosystems has led to fragmentation and isolation of natural ecosystems. For example, the migration corridor for wildlife towards Kitengela has been encroached by built-areas. These encroachments are as a result of ineffective environmental protection and ineffective development control in the city (Mwathi, 2016).

As affirmed by the studies undertaken by Oyugi et.al (2017) and Odera (2016), there is no doubt that urban sprawling has also led to cities consuming more of agricultural space in favor of urban development thus leading to less dense and inefficient land use pattern. Land pressure

also led to increased prices and occupation of marginal areas by slums. Eventually, the living conditions have been deteriorating and low density, which has occurred because of urban sprawl, has made the provision of services and infrastructure more costly (UN-Habitat, 2014). Because of increased rate of urban population, urban growth and the need for social, economic, and physical development, sustainable development concept arose as will be discussed later. In urban context, new approaches were adopted in order to achieve cities' sustainable development (UN-Habitat, 2018).

2.6 Land Use Planning and Development Control in Kenya

The Kenya Constitution of Kenya 2010 introduced a devolved system of government through which planning roles are shared across national and county governments. The constitution also led to formation of the National Land Commission mandated to oversight over land use planning in the country. Planning in the country and counties rely on various laws including County Government Act (2012), Urban Areas and Cities Act (2019) and Physical and Land Use Planning Act No. 3 of 2019. Land use plans prepared by the counties include Local Physical Development Plans, Integrated Strategic Urban Development Plan, and Zoning Plans among others. Development control in Kenya is mainly undertaken by the County Governments. Development control mainly entails processing and issuance of approvals for building plans, extension of use, change of use, subdivision and amalgamation applications. Other activities related to development control include processing of leases, occupation certificates and carrying out of inspections (GoK, 2019).

2.7 The Concept of Sustainable Development

Sustainable development is a concept that was first highlighted in the UN Conference on the Human Environment, which was held in 1972 in Stockholm, Sweden. In the United Nations Conference on Environment and Development that took place in Rio de Janeiro in 1992, the concept of sustainable was the basis of the conference. The conference, which was attended by over 100 Heads of States and 178 representatives from government, marked the beginning of development of action plans and strategies for moving towards sustainable pattern of development. In the 1987 report, "Our Common Future" by Brundtland Commission, sustainable development was the solution to environmental challenges. Environmental concerns therefore were the foundation for sustainable development (Shirkhanloo, 2018). The report credited for popularizing the concept defines sustainable development as, *"Development*

which meets the needs of the present population without compromising the ability of the future generations to meet their own needs (Onyenechere, 2011)*."*

The Brundtland Report investigated the concerns, which had been raised that human activities were causing grievous damage on earth, and that growth and development damage could be unsustainable in the end if the human activities were unchecked. Some of these concerns had initially been raised in Garret Hardin's Tragedy of the Commons (1968), Silent Spring (1962), and the Blueprint for Survival among others (Keeble, 1988).

In the year 2002, the World Summit on Sustainable Development, which was attended by 191 head of governments, multilateral financial institutions, UN agencies and other major groups, was held in Johannesburg. The Summit paved way for commitments such as sustainable consumptions and production as well as water and energy.

Ever since, the concept of sustainable development has developed, and the international community has come to acknowledge the fact that development and the environment could be mutually managed in a beneficial way. Sustainable development has also increased its connectivity to social and economic elements of development. It is now the interface between the social, economic and environmental sustainability. Working towards a sustainable development is a multi-stakeholders and multidisciplinary process, which includes actors at various levels of governments (Shirkhanloo, 2018).

2.8 The Idea of a Neighborhood

A neighborhood is an area within physical boundaries where people identify as home and they live and organize their private lives (Rahman, 2012). It is a planned and integrated urban community related to the larger city, which is part of it. A typical neighborhood comprises of a mix of residential, social facilities, open spaces, infrastructure and supporting amenities. Within a neighborhood, at least 10% of the area should always be dedicated for public open spaces. It should also be supported by libraries, shopping facilities among others (Meenakshi, 2011).

According to UN-Habitat Report (2017), cities need to build wide variety of urban structures where city life can thrive and issues of urbanization addressed. Neighborhoods are therefore crucial in shaping urban structure component. Neighborhood is about physical, social and economic sector, which constitutes the sense of place and attachment (Poortinga, 2017). An

ideal neighborhood is therefore based upon the ideas that can encourage the concept of live-play-work. Urban neighborhoods have a robust physical reality within the cities with distinct social, economic and physical features. They are the key units of cities that play critical roles in cities formation. Neighborhoods are also place where individuals live and play. Urban neighborhoods must therefore meet the needs of the residents and consider the needs for future generation. Cities cannot be sustainable if its components such as the neighborhood do not meet sustainability criteria. Accordingly, sustainable urban neighborhood as an important social and geographic unit plays a critical function in developing sustainable cities, and planning of sustainable neighborhoods should always be the first step towards achieving sustainable development in cities (Shirkhanloo, 2018).

As above mentioned, neighborhoods are the locations, which connects various factors such as the socio-economic, physical, as well as environmental aspects. Because of this interlinkage with various factors, the term neighborhood is defined from different contexts such as physical, social, political, and psychological among others (Liptay, 2009). These different perspectives present its own definition of the term neighborhood. There are a wide variety of approaches to applying the concept of sustainable development to neighborhood.

2.9 Sustainability Indicators in an Urban Neighborhood

2.9.1 Physical Indicators

KS Code Planning and Building regulation of 2019 stipulates that residents require adequate spaces, and service areas as well as proper siting of structures with ventilation and non-obstructed views. The building code further stipulates that buildings should be highly accessible. Building by-laws require that residents should also have access to clean water for potable use (Njonjo, 2013). Poor housing is a threat to the quality of life of residents as it affects their mental health, physical and self-development.

Furthermore, buildings which forms part of the physical environment, being a human basic necessity as it provides shelter, a sustainable neighborhood is envisaged to provide a wide variety of housing for all income groups. Provision of wide choice of housing eventually promote long term value as well as create a balanced community over a period of time (Arwari, 2016). Besides catering for different income groups, housing provision should also cover different age groups.

Additionally, the physical characteristics of housing in a sustainable neighborhood should provide for kitchen, bedrooms, bathrooms, dining area and space for laundry and living area. All this provision should be adequate. Other aspects to be taken into consideration includes safety, ventilation and garbage disposal (Nyaboe, 2016). Proper house ventilation ensures dilution and removal of pollutants. Ventilation is also required for free air flow. Exposure to pollutants resulting from poor air circulation is highly likely to cause health risks such as cancer. Making provision of the above directly correlates to the satisfaction of residents in a given neighborhood (Arwari, 2016).

As far as infrastructure is concerned, provision of sufficient water supply to meet the needs for the residents, businesses and institution in a neighborhood is key. KS Code Planning and Building regulation of 2019 requires that buildings should be retrofitted with wholesome water supply system. Different sectors of a neighborhood such as industrial, commercial and institutions require water for production, drinking and waste dilution. Furthermore, water is also needed in crop production and energy production. Therefore, provision of adequate water supply is of essence. As urban population keep on increasing, improvement and upgrade of existing water infrastructure is of paramount (Arwari, 2016). Drainage is also a critical component in a city or even neighborhood. A good drainage system prevents flooding and emergence of waterborne diseases. Njoya (2018) noted that Nairobi City faces drainage issues as the drainage system within is not functional holistically. An overhaul of the drainage system in the city is therefore required so as to address the flooding menace witnessed across the city when it rains.

A sustainable neighborhood should also have a proper connection of sewer line. Neighborhoods should be able to drain liquid waste from their neighborhoods without issues such as clogging and/or blocking. However, this is not the case with Nairobi city and many neighborhoods as their sewer line is rusty and blocked thus rendering it unfunctional in most areas. These poor system causes health hazards thus exposing residents to water borne diseases (Njoya, 2018). Appropriate waste water management also enhances a quality of neighborhood as waste management practices help in water removal from ablution blocks and reuse of waste water in a way that is beneficial to the environment. Residents can use waste water in non-potable uses such as irrigation of landscape areas and flashing of toilets (Arwari, 2016).

2.9.2 Road Networks and Public Transportation

Sustainable neighborhood concept should always be based on accessibility. Meaning that people needs are easily accessible and within a walking distance. Walkability affects livability, and health income of a neighborhood and city in general. Walkability is not just about a walk but it should also include attractiveness, safety, convenience, and connectivity. A good neighborhood transport system should always minimize the use of cars by the residents. Transport system should also maximize the opportunities for public transport and reduce the level of pollution. It should encourage walking, cycling and carpooling. Furthermore, it should also enhance land use mix, connectivity and sufficiently serve the high-density residential development (Deddington Neighborhood Plan, 2017).

Supporting facilities for instance, public stops or termini should also support modes of transport with little or no disruption on the flow of traffic. In order to achieve maximum internal connectedness within a sustainable neighborhood, entire road networks should be provided with sidewalks and cycling facilities (Non-motorized transport facilities). The road networks should also be in a good condition (Deddington Neighborhood Plan, 2017).

2.9.3 Environmental Indicators

Environmental quality, cleanliness and housing stock in a neighborhood impacts positively on neighborhood satisfaction. Litter, trash, street noise, abandoned houses, smoke, odor, encroachment on wetlands and riparian areas as well as deforestation among others lower the environmental standards of a neighborhood. Care must therefore be taken to protect the environmental quality of a neighborhood.

Natural open spaces provide environmental related benefits. A network of green open spaces, which includes wetlands, ecological reserves, and forest among others are crucial to providing habitats for plants and wildlife as well as humans. Furthermore, parks also assist in creation of cities that can help in slowing global warming. Every tree helps in fighting global warming by minimizing the greenhouse gases in the atmosphere and help in cooling of cities (Liptay, 2009).

Access to public open spaces and parks provide numerous health benefits. Access to areas that are vegetated for instance playgrounds, parks, and open spaces has been associated with excellent general health, reduced level of stress levels and depression. On the other hand, a sustainable urban neighborhood should also conserve, protect, and integrate natural resources into the community development. Care must be taken to integrate the natural resources as an

integral part of a development, rather than treating these areas as islands of undevelopable land. Interpretive signage, seating area and public art can be incorporated in public open spaces (Liptay, 2009).

2.9.4 Social Indicators

The indicators of social qualities in a neighborhood include socio-economic, security, social inclusion, social cohesion and empowerment. Accessible and safe environments also influence neighborhoods security. They enhance sense of well-being as it provides opportunities for social interaction and engagement. Such safe environment include access to green open spaces such as playgrounds, recreational facilities and parks. People with access to safe green open spaces are highly likely to be physically active and less likely to be overweight as compared to people with less or without access to such facilities (Wallace, 2011).

Integration of outdoor playing areas, safety and crime level, community participation involvement, access to health care facilities, educational facilities, places of worship, entertainment and community centers among others greatly determine the social sustainability of a neighborhood. The characteristics of individuals and households determine as well the quality of the overall neighborhood sustainability. Permentier (2011) argued that young people tend to be less satisfied with their neighborhood as compared to elderly people. Households with children put more value in safe and spacious living environment. Furthermore, children's presence impact positively on the social interaction in the neighborhood. It is of importance that quality of social amenities such as green spaces and accessibility of social facilities for instance, schools and health facilities should be emphasized so as to contribute to the social needs of the residents in any neighborhood (Permentier, 2011).

2.9.5 Economic Indicators

The advantages of an economically sustainable neighborhood are that residents are able to work and invest in their place of residence without having to travel too far. Planned and sustainable neighborhoods lead to increased economic activities as a result of created residential, commercial and industrial parks thus leading to increased economic activities. Living in vibrant and economically strong neighborhoods lead to higher level of neighborhood satisfaction that relates to a higher wellbeing of the residents as compared to living in poor areas. It is therefore important that a neighborhood has to be economically vibrant and provide business opportunities to its residents (Permentier, 2011).

2.10 Key Principles of a Sustainable Neighborhood

UN-Habitat, the United Nations body mandated to advocate for development of socially and environmental cities, promotes five main principles as discussed below.

2.10.1 Adequate Space for Streets and Efficient Streets Network

The main aim of this principle is to develop an appropriate and efficient street networks that enhance movement for motorized, non-motorized transport system, which includes vehicular, and cycling, and pedestrians respectively. Streets also plays a critical role in formation and shaping spatial structure of a neighborhood by defining the pattern of development blocks, public open spaces, and buildings among others (UN-Habitat, 2020). This principle, therefore, provides for development of a sustainable neighborhood. The following characteristics are considered in street design for a neighborhood:

- Walkable and cyclist friendly streets.
- Interconnected street hierarchy.
- Ample parking space.
- Accessible public transport.

2.10.2 High Density Development

Recently, rapid world urbanization and population explosion has been witnessed around the world. In order to achieve sustainable development, high density residential development is of paramount. High density concentrates people and activities as well as brings forth socio-economic benefits and environmental benefits and it's the central pillar in sustainable urban planning (UN-Habitat, 2020). High density offers the following benefits:

- Efficient utilization of land.
- Reduced cost of provision of public utilities and facilities
- Enhanced social equity.
- Mixed land use.
- Increased energy efficiency and decreased pollution.

2.10.3 Mixed Land Uses

This principle is centered on developing a wide range of compatible land use activities within appropriate location. Mixed land use provides a planned community which is focused on the concept of live-work-play thus providing a comprehensive wide range of land uses to cater for

residents and visitors need. It includes retail, residential, recreation, commercial, and social amenities. These land uses when provided in a neighborhood need to be compatible and well balanced (UN-Habitat, 2020).

2.10.4 Social Mix

Social mix principle objectives promote social cohesion and neighbourhood interaction among a wide variety of social groups and provide access to urban opportunities. Social mix is the basis for hale and hearty social networks. It is worth noting that mixed uses and social mix support each other (Sebnem, 2014). The benefits are as discussed below;

- Increasing social cohesion and promoting social interaction
- Creating job opportunities
- Attracting a wide variety of services to the neighborhoods

2.10.5 Limited Land Use Specialization

As mentioned earlier, cities around the world are facing serious challenges for example, traffic congestion, pollution, inadequate housing, and services. These challenges are caused by development strategy adopted in most cities and individual application of land use specialization (Sebnem, 2014). Therefore, this principle encourages mixed land use strategies in satellite nodes. In summary, these five principles are interconnected and interlinked. High-density provides requisite activities and residents, which are the foundation for sustainable neighborhood. The principles also create a balanced neighborhood, growth of population and sustainable development. The mixed land uses provide condition for urban residents to live, work, and play. Achieving sustainable neighborhood promotes high-density development thus curbing urban sprawl and maximizes utilization of land. It also encourages pedestrianization and reduces car dependency and offer interconnected network of streets that provides safety and supports cycling, and walking (UN-Habitat, 2020).

2.11 Achieving Urban Neighborhood Sustainability

The above-mentioned principles encourage livability and foster sustainable urban neighborhoods. The urban neighborhood sustainability can be achieved through the key features discussed as follows:

2.11.1 Walkability

Provision of non-motorized transport facilities encourages people to make use of public open spaces. The pedestrian movement network also forms part of the overall public open space

system. Walkability reduces congestion and improve connectivity. It also reduces air pollution and contributes to vibrant neighborhood (Liptay, 2009). All public open spaces may also be used for pedestrian movement except for freeways and with serious restrictions within natural open spaces. Pedestrian movement does not necessarily require substantial infrastructure as vehicular movement does and it is not subject to complex spatial and technical requirements, but it has to be given an appropriate consideration as this is the primary way in which urban environments are moved through and experienced by their users (UN-Habitat, 2020).

2.11.2 A Vibrant Street Life

Different urban activities promote and encourage street life; in this regard, high density and mixed-use development play a significant role in enhancing lively street life. High population generated by high-density development produces service and space demand. Therefore, prosperous street life within neighborhoods satisfies residents' needs and offers a safe as well as vibrant neighborhood life (UN-Habitat, 2020).

2.11.3 Affordability

Affordability should be supported in transaction activities, services, economic as well as housing by encouraging declining costs and services. Applying the above-mentioned principles contribute to decreased consumption resources and time. An affordable neighborhood is the core element of a sustainable neighbourhood.

2.11.4 Safety

Safety is a consideration in a sustainable urban neighborhood. Safety goes beyond measures such as crosswalks, it also includes traffic measures within street networks such as roundabouts, landscaped medians, and sidewalks among others (Liptay, 2009). Traffic calming should always be on major arterials, collector streets, commercial areas, near schools, and pedestrian crossings among others.

2.11.5 Connectivity

Linkage should be provided within the neighborhood and other places through pedestrian networks. Connectivity networks should minimize the number of dead-end roads in order to avoid circuitous routes. Doing so make trips as short as possible and allows pedestrians and cyclist to move without inconvenience. In addition, it provides alternate neighborhood distributor roads. The neighborhood roads should also enhance emergency response access to the residences. The pedestrian access should be clear and direct to arterial/collector streets through street or block designs. They should also accommodate cycling paths, on-street

parking, streetscape elements as well as transit. Streets should be wide enough, a range between 18-28 m in width (Liptay, 2009).

2.12 Case Studies of the Best Sustainable Neighborhoods

Two case studies, which are the best example of sustainable neighborhoods were reviewed. The two neighborhoods are in Malmo, Sweden. These two neighborhoods are EkostadenAugustenborg and VastraHamnen in Malmo City, Sweden.

2.12.1 VastraHamnen, Malmo Sweden

Malmo is the third largest city in Sweden with a population of approximately 250,000. In the 1970s, the ship building industry in Malmo faced economic decline that led to docklands and industries being abandoned. However, a plan was drawn to stimulate the economic growth of the city. One of such plans was to develop a new inner city within the City of Malmo, therefore funds were channeled to the improvement and renovation of VastraHamnen area to uplift its status as a modern urban neighborhood (Barton, 2016).

The first stage was renovation and construction of Bo01 Housing Estate. The project aimed to provide space to live, work and study for about 3,000 inhabitants within the area. The key focus was creation of sustainable and environmentally friendly neighbourhood. As a whole, the vision for the neighbourhood was to provide a globally leading example of dense built up areas with environmental adaptation. Besides, reprocessing of resources and increased biodiversity, waste, households' energy needs were met by great deal of renewable sources of energy. Non-motorized transport including pedestrians and cyclist have been given priority across the neighbourhood. Public transportation in form of Bus Rapid Transport has also been provided and it provides linage from the neighbourhood to Malmo city centre (Barton, 2016).

Neighbourhood diversity has been enhanced through provision of nesting boxes and bee flower beds as well as expansion of water bodies. Local renewable energy is sources from aquifers exploitation, solar thermal collectors and wind turbines. The local residents are capable of monitoring their consumptions of electricity and water through state-of-the-art technology systems that have been installed in their homes so as to minimize wastage of resources. Furthermore, all sorts of solid waste are sorted, organized and recycled through separation units in every household unit (Sebnem, 2014).

Another key aspect of the Bo01 neighbourhood is design and buildings condition. The design accurately defined the architectural quality of the neighbourhood as well as public open spaces.

The housing was designed with a range of options including rental, freehold and shared ownership. Public facilities such as shops, creches and offices were integrated within the estate. Austin (2013) study also reported that people and their interactions are also another essential factors that were put into consideration in the neighbourhood. Public open spaces such as the green areas, meeting places and parks were provided to encourage interaction among the residents of Bo01. Each apartment has also been provided with small and well-designed green space (Austin, 2013).

2.12.2 EkostadenAugustenborg, Malmo, Sweden

Augustenborg is a neighbourhood that was built in the year 1948 by Malmo City Housing Limited. The area was developed as a planned neighbourhood with well-designed built environment. A long the way, a new construction program was formulated and implemented in the neighbourhood hence made the neighbourhood lose its glory and became degenerated. In the 1980s to 1990s the area saw increased demand in housing as a result of migration to Malmo city. As a result of immigration, the area witnessed social issues brought about by diversity in social and cultural norms. This forced authorities to develop program that improved the neighbourhood and led to three pillars of sustainability (Austin, 2013). In the year 1998, urban development programme for EkostadenAugustenborg was developed. The programme's intention was to demonstrate and justify solutions to urban renewal. New measures were adopted that included management of waste, traffic management, development of the state-of-the-art systems for rainwater management, increased biodiversity and services. In fact, the urban development program for EkostadenAugustenborg was described as farthest-reaching ecological program in Europe (Wallstrom, 2010).

Austin (2013) argued that the urban development program integrated the sustainable development principles through the following means: Cycling and pedestrian networks were improved in local transport system. Residents were also encouraged to start carpooling with electric and environmental-friendly cars. Reuse and recycling of waste such as paper, metal, batteries and carton among others was highly encouraged among the residents. Green roofing adopted also boosted diversity in the neighbourhood. Furthermore, the neighbourhood supports a wide variety of social and cultural population who migrated to Malmo, Sweden. Community integration was also enhanced in EkostadenAugustenborg through provision of social clubs, diverse cultural events, indoor and outdoor activities. Social amenities were also provided and this include primary schools, local shops and elderly homes among others (Barton, 2016).

2.13 Summary of Selected Literature Reviewed and Gaps Identified

Table 2.1 Summary of Literature Review and Gaps Identified

Author	Title of Study	Key Findings	Gaps Identified
Kyaka J. Kyalo (2012)	Study of Transformations of Built Forms in Ngara Area, Nairobi.	Focused on morphological, spatial and built forms (typological) transformations taking place Ngara area of Nairobi.	The study does not explain how sustainable these transformations are and its implication to the neighborhood.
Christopher Matere Khaoya (2009)	Challenges to Inner City Redevelopment in Nairobi: The Case of Ngara.	Focused on various land uses, infrastructure found in Ngara and cost of construction.	The researcher mostly dwelled on challenges from an economical perspective but did not looked at challenges from a spatial/Physical, social, and environmental point of view.
Deirdre M. Liptay (2009)	Creating Healthy Communities Through Urban Form	The researcher reinforces the connection between public health planning, built form and provides future direction for urban form policy	The study does not outline clear planning mechanism and response to the challenges identified in the study.
Margaret N. Ngayu (2011)	Sustainable Urban Communities: Challenges and Opportunities in Kenya's Urban Sector.	The author describes the key issues that are faced by the local authorities, governments, and civil organizations in urbanization dynamics.	The researcher did not look at the sustainability of the urban communities in Kenya and no clear intervention framework.

2.14 Theoretical Framework

Smart growth model advocates for a change in growth of cities and the theory is attributed to a team of environmentalist led by Benfield K. Raimi. The Smart Growth development model integrates land use and transportation. It advocates for development of compact mixed-use development within urban areas, which already exists and discourages dispersed development within the urban fringes. For urban development to be sustainable, it must be compact and diverse as well as have defined boundaries. Density and mixed-use is at the heart of Smart Growth strategy. All these factors reduce size of land put for urban uses, lower cost of infrastructure investments, increase walkability and help in preservation of the environment (Alexander, 2005).

Land use practices are the major contributing factors leading to growth problems in urban neighborhoods. Smart growth strategy leads to development of urban communities, which are highly accessible and livable. The strategy acknowledges that spatial and economic growth is good, however, it attempts to redirect urban growth in such a way that jobs created and revenues generated is not undermined by hidden costs such as lost time in traffic and health issues due to pollution among others. The model provides a livable and stronger sense of neighborhood cohesion (Lin Ye, 2005). Smart growth theory suggests that the ideal approach to urban development is to reduce urban sprawl and maximize utilization of spaces in existing urban development through urban infill, compact mixed-uses as well as other projects, which support densification. This include transit-oriented development (ToD) where accessible transit points link urban residents to city center. The pros for Smart Growth model include.

- Reduced traffic congestion.
- Reduced pollution.
- Stronger sense of neighborhood and good connectivity; and
- Aesthetically urban neighborhoods.

This study also adopts the Urban Green Transition (UGT) as the theoretical framework. Cities are inevitably on a growth trajectory and therefore it is important to evaluate how human beings relate with the society and nature. Core issues that will be affecting cities will be more about interrelations between factors such as air, water, energy shortage, congestion, and endangered species. The UGT framework has two-three order matrix: economic, social and environmental dimensions and spatial distribution, capital, and technology (Jinpeng Fu, 2016). UGT was

coined from the awareness of deviating from modes that are unsustainable with social and environmental parameters taken into immense consideration. UGT underscores the importance of stakeholder involvement to the urban transition process to comprehend the urban transformation process and defend realization of urban development (Jinpeng Fu, 2016). Based on the sustainable development principles, UGT develops interlinkage and collaborative urban development from economic, social, and environmental perspectives. It also enhances city's benefit in its lifecycle.

2.15 Conceptual Framework

Environmental Indicators

- Ecologically sensitive areas
- Urban flora and fauna
- Parks, buffers, and greenbelts

Physical Indicators

- Physical Environment
- Supply of Services
- Transportation

Sustainable Urban Neighborhood

- Healthy urban environment
- Secure and livable community
- Functional infrastructure

Social Indicators

- Social amenities
- Affordability
- Livability
- Security
- Social cohesion

Economic Indicators

- Economic vibrance
- Ease of doing business
- Employment opportunities

Table 2.3: Conceptual Framework

Source: Author, 2020

Sustainable neighborhood should holistically reflect key elements, which includes social, physical, economic and environmental qualities. Physical features of a neighborhood cover mainly housing, infrastructure and transportation. A sustainable housing should offer a wide variety of housing targeting a wide variety of income groups. These housings envisaged in a sustainable neighborhood should be in good condition in terms of aesthetics and design character. Besides the aesthetics, the housing should offer comfort and habitable. It can be deduced that Ngara neighborhood offers housing for a wide variety of income group, however, more needs to be done especially on the lower income groups as the housing is poor and poses a risk to the quality of life for the residents.

A sustainable neighborhood should also meet the demand of its residents in terms of water supply, sewer, drainage, energy and road networks. The neighborhood should also be well connected to a functional sewer. Drainage system of the neighborhood should also be in good condition to address issues such as flooding as well. A neighborhood should also embrace green sources of energy and movements networks should be good and accommodate motorized and non-motorized road users (Barton, 2016). Based on the study findings, Ngara neighborhood lags behind in terms of the physical aspects as discussed in the findings and results section. Social and environmental aspect also informs the sustainability of a neighborhood. Indicators include availability of adequate social amenities, security and social cohesion among others. Provision and ease of accessibility of social amenities such as schools, police stations, religious facilities, health centers, libraries and community centers are integral part of a sustainable neighborhood. Provision of networks of green spaces and recreational grounds also plays a critical role as it provides opportunities for social interaction and outdoor activities.

On the other hand, quality of the environment in terms of clean air, water and serene environment free of litters and waste also contributes towards social, environmental needs of the neighborhood residents. Ecologically sensitive areas such as dams, forest, wetlands and rivers within any neighborhood should also be protected and in most cases be integrated into the wider neighborhood rather than being treated as 'islands' that are isolated (Austin, 2013). Lastly, sustainable neighborhood should provide areas for business activities to serve people from within and outside the neighborhood. It should also provide opportunities for wide variety of economic activities and ease of doing business. The neighborhood business district should also be vibrant. Ease of doing business in a community is not only determined by the neighborhood parameters but also supported by the concerned authorities.

CHAPTER THREE: RESEARCH METHODOLOGY

This chapter outlines the research methodology that was adopted by the study. The chapter outlines target population, sampling design, sources of data as well as methods of data collection. It also provides a brief background of the study area.

3.1 Study Area Locational Context

The study area is situated within the fringes of the Nairobi CBD. It is one of the neighborhoods, which borders the Nairobi's CBD and it is approximately less than 1 kilometer from the CBD. The study area lies on the path of the regional road network, being bound by Northern Corridor (A2) to the South West and Thika Road to the North East. These road networks make the study area highly accessible and provides connectivity to the wider Nairobi Metropolitan Region and beyond. Ngara neighborhood is divided into two: Ngara East and Ngara West. Some of the estates within the area include Old Ngara, New Ngara, Bachelor estate, Desai among others. The neighborhood is situated along Muranga road.

Figure 3.4: Location Plan for Ngara

Source: (Kyalo, 2012)

3.2 Land Ownership

Ngara covers approximately 250 hectares (Ha) of land with about 900 plots averaging approximately 0.04 Ha (NIUPLAN, 2015). The two predominant land tenures in Ngara are: Public and private land ownership. Private land ownership is fragmented, which characterizes the single dwelling and multi-dwelling residential as well as business premises in the area. Furthermore, public institutions namely Kenya Railways Corporation, State Department of Housing and Urban Development and Nairobi City County Government own large pieces of land within Ngara. Other public institutions with large pieces of land are Nairobi city primary school, Jamhuri High School, and Kenya Institute of Curriculum Development (KICD).

3.3 Population Snapshot

The following data has been sourced from the Kenya National Bureau of Statistics (KNBS) 2019 Census of Population and Housing for Ngara area. The data provides a snapshot of the population within the study area.

Table 3.4: Number of Households and Population for Ngara

Area	Households	Female	Male	Total
Ngara	12,311	15,211	15,918	31,132
Ngara East	8,276	9,871	10,677	20,550
Ngara West	4,055	5,340	5,241	10,582

Source: KNBS, 2019

3.4 Physiographic Features

3.4.1 Soil, Topography and Drainage

The study area is covered by black cotton soil. In relation to topography, Nairobi city is generally located at an altitude of 1600m to 1850m above the sea level. The topography on the western side of Nairobi tends to be on higher ground while the Eastern side is generally low and flat in nature, and within the study area the topography is relatively flat with a graduating slope towards the north and south respectively.

3.4.2 Climatic Condition

The climatic conditions experienced within the study area are similar to the climatic character of the city. Nairobi's climate is always dry and cold between the months of July and August but very hot between November and February.

On average, Nairobi receives an annual rainfall of about 900mm and the first peak, heavy rains, are experienced during the months of March, April, and May while the second light rains peak are in the month of September, October, and November. The daily maximum mean temperatures range between 22 and 28 degrees Celsius while minimum ranges between 12 and 14 degree Celsius.

3.5 Study Design

A study design is a framework in which the research is being undertaken; simply, it is a medium or a road map for data collection, measurement, and analysis. The study adopted was a case study research design as it involves integrating both qualitative and quantitative data in the study area. According to Mugenda & Mugenda (2003) a case study is considered an in-depth study of a given situation rather than sweeping statistical survey. The case study also provides in-depth state of affairs as it naturally happens hence informing a better understanding of the research problem. Furthermore, it helps narrow down a field of research that is quite broad into one that is easily researchable.

3.6 Study Population

The key target population in the area was household units. The total number of households in the neighbourhood are 12,311. On the other hand, business operators and property owners were also included in the study as they provided data related to business activities and land uses respectively. The sample size was about 138, which was arrived using the Cochran formular.

3.6.1 Sample size and sampling technique
    i.   **Sample Size**

Units of sampling analysis was households and property owners/developer in Ngara. The sample size was computed using the Cochran formular (Cochran, 1953).

$$n = \frac{t^2 \times p\,(1-p)}{m_2}$$

 n - Sample size

 t - Confidence level, 95% confidence level, whose standard score is 1.96 m- Tolerable Margin of error (5%)

 p – Estimated population

$$n = \frac{1.96^2 \times 0.9\,(1-0.9)}{0.05^2} = 138$$

The calculation give rise to a sample size of 138 residents.

    ii.   **Key Informant**

The key informants were officers from the Nairobi City County. Officers from the urban development and management, environment, policies and planning implementation and

development control sections participated in the interview. Officers from these departments were chosen as they are in charge of urban activities and aware of the challenges within the city neighborhoods.

3.6.2 Sampling Technique

In the study, random sampling was adopted. About 138 questionnaires were randomly administered to the households and business operators identified. A total number of 81 questionnaires were administered to households. Household interviews were mainly conducted on Friday, Saturday and Sunday because these days were considered to be the best to get hold of household heads. Business interviews (42 questionnaires) were administered during the week. Lastly, 37 questionnaires were administered to the developers.

3.7 Sources of data

Primary and secondary data was used in the study. Secondary data was gathered through review of books, journal articles, articles in a periodical, past research, credible internet sources, and publications. Secondary data collected included land use changes, policies, sustainability and data about the study area among others.

On the other hand, primary data was obtained through administration of questionnaires, interviews and observation. Types of data obtained through these sources included development densities, housing conditions, level of pollution on land, availability of open spaces, encroachment of riparian reserves, informal activities, condition of infrastructure such as the roads and availability of the pedestrian networks among others.

3.8 Methods of Data Collection

Data types collected include qualitative data. Qualitative research according to (Denzin, 2005) is an activity that locates the observer in the world; it enables qualitative researchers to make sense of phenomenon in terms of the meanings, which people bring to them. It aims at determining facts, testing theories, and validating relationships between variables.

Equally, quantitative research is an approach that was also employed in the study. This approach explains a phenomenon through collection of numerical data, which are analyzed by use of mathematically based methods. Some of the techniques used in this type of research include random selection of participants from the study population. The researcher in quantitative research is considered as being external to the actual study and the research

outcomes are always expected to be replicable no matter who carries out the research (Muijs, 2004). Furthermore, quantitative approach was employed in cases where there was need of giving numerical answers in the study area. The methods for data collection are as discussed below:

i. **Questionnaires Administration**

Questions were structured so as to gather information from the sampled households and businesses. Structured questions were used in preparing both closed questions and open-ended questions for the study. Open-ended and unstructured questions were used to interview the households for more qualitative data. Questionnaires were used to collect data such as respondents' profile, social amenities (adequacy of public facilities, conditions etc.), economic (types of businesses and challenges) and environmental aspects (noise, solid waste, water resources, littering among others).

ii. **Interviews**

Open-ended interviews were undertaken with the key informants. The key informants were selected based on their knowledge and involvement in the area. Mostly, officials from the department of planning, housing, and environment in Nairobi City County participated in the key informant interview.

iii. **Observation and Photography**

Observation was key in gathering information on physical aspects such as pedestrians' networks, informal activities, state of housing, pollution, and other features. Other units of measurement include existing and upcoming developments. Observation was also complemented with photographing. Photographs included those of buildings, and roads among others.

3.9 Validity Test

Content validity was carried out by administering pilot test. The questionnaires were first administered to people with knowledge of the study to respond to the questions. Recommendations were useful in unpacking complex and repeated questions. A total of 12 respondents were also subjected to a pilot study to enhance reliability of the findings. Furthermore, the questionnaires from the field were also counterchecked for any inconsistencies and reliability.

3.10 Method of Data Analysis

a)   Analysis of Qualitative Data

The qualitative data was analyzed using content analysis technique. Content analysis has been used in the study while presenting the qualitative research findings. The purpose of this method is to create statements that produce for the readers the feeling that they have experienced the events described in the study (Lincoln, 1985). Using content analysis provides much detailed information as well. The findings and results were organized in a logical way and written in a descriptive manner. The key themes discussed are background characteristics of the respondents, land use patterns in Ngara, sustainability of the neighborhood based on the sustainable indicators and approaches that can be adopted to address and improve the sustainability of the neighborhood.

b)   Analysis of Quantitative Data

Quantitative data analysis was employed to summarize information and data through percentages. Data collected from the structured questionnaires were first proof read, cleaned and coded to enable empirical analysis using the Statistical Package for Social Science (SPSS) version 22. The use of SPSS enabled analysis of descriptive statistics such percentages and frequencies. The analysis was presented in form of graphs, tables, and figures. Data obtained through key informant interviews was analyzed using the content analysis. The data was integrated into categories and direct quotations were used for presentation. The table 3.5 shows the various variables and how they were measured:

Table 3.5: Variables under Study and Units of Measurement

Background Characteristics	
Key Variables	**Measurements**
Residence characteristics	● Number of years lived in the area
Income	● Income method ● Amount of money earned monthly
Types of Land Use in Ngara	
Densities	● Number of floors of building and built area in terms of coverage ● Intensity of developments ● Acreages of properties
Land uses	● Categories of land uses

Indicators of the Sustainable Neighbourhood	
Physical Housing & Service (roads, sewer, water, solid waste management)	● State of housing and typologies ● Size and condition of the road reserves ● Sources and number of residents with accessibility to water and energy ● Number of public stops and time taken to public stops. ● Level of management and littering
Social (social amenities, security etc.)	● Number of social amenities ● Distance and time taken to access social amenities ● Reported insecurities ● Frequency of residents undertaking physical activities
Economic (types of businesses, business environment)	● Types and number of business ● Income levels
Environment (water resources, air, noise, littering etc.)	● State of the environment ● Usage of private cars ● Level of pollution

Source: Author, 2020

3.11 Ethical Issues

Research ethics is critical in research activities and require that researchers should shield their subjects' dignity and publish well the information researched. Ethical research values were observed in every stage while carrying out this research. Respondents were informed about the study and notified that their participation was voluntary. A license from the National Commission for Science, Technology and Innovation (NACOSTI) was also obtained to legitimize the study undertaken.

CHAPTER FOUR: RESULTS AND DISCUSSION

This chapter presents the findings of the study. The discussion is based on the research objectives that include the respondents' background characteristics, types of land uses, examining the indicators of the sustainable neighbourhoods, and approaches recommended to improve the neighborhood's sustainability.

4.1 Background Characteristics of the Respondents

The background characteristics of the respondents are as described below:

4.1.1 Gender Distribution

Among the household respondents, 54% were female, whereas 46% were male respondents. This shows that there was a balanced gender representation in the study population. The age distribution of the household respondents is summarized in table 4.6.

Table 4.6: Age Distribution of the Respondents

Age Distribution		
Age	**Frequency**	**Percentage (%)**
21-30	23	28.7%
31-40	28	35.0%
41-50	18	22.5%
51-60	12	13.8%
Total	**81**	**100%**

Source: Field data, 2020

4.1.2 Education Level

Majority (86.4%) of the respondents had formal education up to tertiary level. About 48.1% had university-level education, 38.3% college, 8.6% secondary, and 4.9% had primary level education or never went to school. Looking at the level of employment, as shown in figure 4.2, it can be deduced that 79% of the respondents are employed because of their high level of education.

4.1.3 Employment Status

Majority (79%) of those interviewed stated that they were either formally self-employed or formally employed. This comprised 44% informal employment and 35% informal self-employment. Others (14%) reported that they were informally-self-employed. The informal self-employed are mostly those who operate an unlicensed business such as food kiosks. The formally self-employed group are those running business with licenses from the authorities,

whereas formally employed are those in white-collar jobs. Only 7% reported that they were unemployed. As mentioned above, over 70% are educated up to tertiary level. This group can either run their own businesses or secure formal employment (refer to figure 4.5).

Figure 4.5: Level of Employment among the Respondents
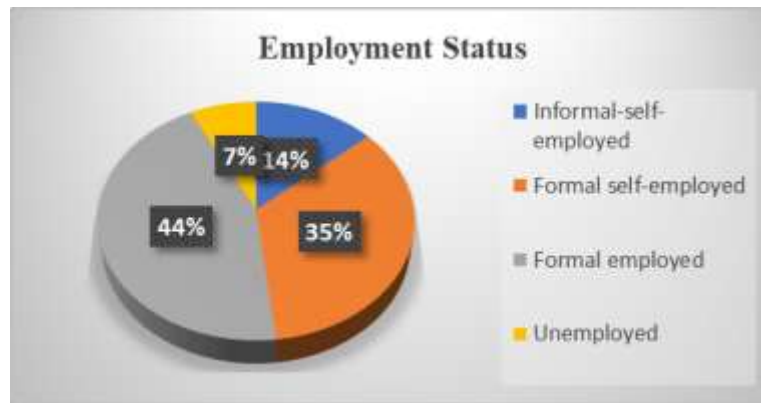
Source: Field data, 2020

4.1.4 Average Personal Income

Figure 4.6: Average Monthly Income of the Households
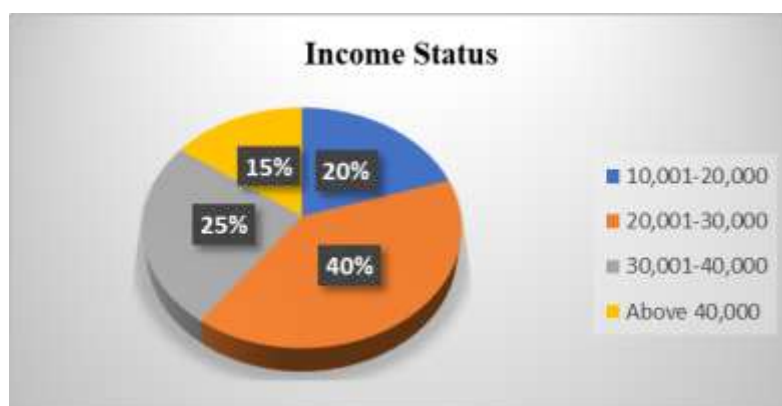
Source: Field data, 2020

About 41% of the respondents reported that they earn a monthly income above KES 40,000, whereas 24% and 13% noted that they earn a monthly income ranging between KES 30,001-40,000 and 20,001-30,000, respectively. Those earning below KES 20,000 comprised 21% of those interviewed. Additionally, 25% of those interviewed also reported to have an alternative source of income.

4.1.5 Residence Characteristics

Figure 4.4 summarizes the number of years the respondents have been living in Ngara estate. The findings showed that 44% have been living within the estate for less than 10 years, while

6% have been residing in Ngara estate for over 40 years. About 55.6% reported to have lived in Ngara for more than 10 years. Findings also showed that residents living in public housing have lived in Ngara for over 10 years. Some of these residents have already retired from public service.

Figure 4.7: Number of Years of Residency in the Neighborhood
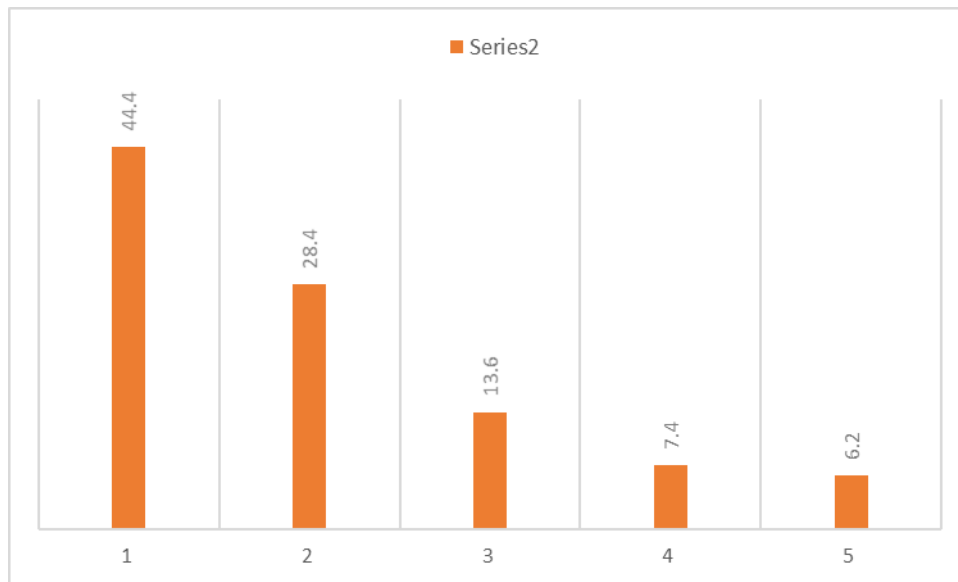
Source: Field data, 2020

In the last 10 years, the findings showed that 69% of the respondents moved to Ngara from other neighborhoods within Nairobi city county, whereas 21% originated from areas outside Nairobi city county. Further, the research engaged the respondents to understand their reasons for choosing Ngara as their preferred neighborhood for either setting up business or living. The pulling factors include job-related reasons (29%), cheap housing and proximity to Nairobi CBD (22%), business opportunities (13%), and availability of learning institutions (5%).

4.2 The Type of Land Uses Emerging in the Neighbourhood

A study on the type of land uses in Ngara focused on the existing and emerging developments. The study also sought to establish the densities of emerging developments. Presentation is in the form of a detailed description of the land uses photographs and land use plan representation. It is worth noting that the land use survey was limited to interviews with property owners and observation from the street level. Survey on the land uses focused mostly on the emerging developments.

4.2.1 Land Tenure and Sizes

The neighbourhood has been set on approximately 617 acres of land with about 900 plots. According to NIUPLAN (2015), land tenure in the area is predominantly public and private ownership. Private land ownership is majorly fragmented and characterized by single dwelling and multi-dwelling residential units. The study surveyed buildings that were either under construction or those that were most recently constructed. Findings showed that the acreages of the sampled properties are: sixteenth of an acre (26.7%), 0.025-0.05 Ha (6.7%), 46.7% ranged between 0.05-0.1 (a quarter of an acre), and 20% of the properties had plot sizes above 0.2 Ha (half an acre).

Key informant 1 noted that *"the Nairobi City County allows a minimum size of approximately 0.05 Ha (an eighth of an acre) within the neighborhood."* It can be concluded that a significant number of properties (26.7%) are below the recommended plot sizes in Ngara. UN-Habitat (2018) recommends a reasonable plot size that will provide adequate space for facilities such as parking and playing spaces for children.

4.2.2 Types of Land Uses in Ngara

Change of use is the planning process of converting the land use of a property from one particular use to another. The study revealed that 73% of the developers had undertaken a change of use from one particular land use to another, whereas 27% have never done a change of use before. A study done by Kyalo (2012) indicated that 23% of the properties in Ngara had transformed from one particular land use to another through a change of use process. A decade down the line, findings showed that more and more properties are being transformed for different land uses.

Findings showed that 57% of the land uses were single dwelling residentials before a change of use. This shows that most of the old single-dwellings observed within the neighborhood are being demolished to pave the way for high-density developments. Furthermore, 24% of the respondents reported that before undertaking a change of use, the initial land use was commercial, and 19% noted that the original land uses were hostels (refer to plate 4.2-some of the single dwelling residential developments targeted for demolition).

a) Residential

About 53.3% of the sampled properties were residential development in the form of contemporary and multi-dwelling apartments. Findings further showed that residential cum

commercial developments comprised 26.7% of the surveyed buildings. The commercial uses attached to residential developments were mainly low-scale retail outlets, pharmacies, boutiques, and banking halls. These commercial uses are located on the ground and first floor of these developments (refer to plate 4.2).

Plate 4.1: Examples of the Single Dwelling Residentials in the Neighborhood

Source: Field survey, 2020

Plate 4.2: Examples of Emerging Residential cum Commercial Developments in the Neighborhood

Source: Field survey, 2020

b) Commercial

On the other hand, about 13.3% were predominantly for commercial uses, which are small-scale businesses, offices, and serviced apartments. Commercial developments are mainly located along Muranga, Park, and Ngara road. These commercial buildings accommodate retail, banks, and hotels, among others. It was also observed that there are informal structures put up by informal business operators. The emergence of these illegal structures can be attributed to the Nairobi city county government's poor management of Ngara market and failure to enforce development control measures.

c) Light Industrial

It was observed that there are limited light industrial activities in the neighbourhood. Light industrial uses were observed mainly along the major road networks namely Muranga and Thika road. *As noted by key informant 2, Ngara neighborhood is also characterized by light industrial activities limited to petrol stations, showrooms and logistics.*

d) Public Purpose

Furthermore, it was also found that hostels (6.7%) are among the neighborhood's existing and emerging developments. It can be presumed that developers are interested in developing hostels in Ngara because of higher learning institutions in the neighborhood. Ngara is also near the Nairobi CBD, thus making it an ideal location for hostels' development as students learning in universities and colleges in the CBD can walk to Ngara.

Other public purpose that already exist includes educational facilities, health facilities, and places of worship. Some of the educational facilities are public institutions within the wider neighbourhood, most notably: Kenyatta University (Law campus), University of Nairobi (Parklands law campus), Mount Kenya University, among others. Others include Ngara Girls Secondary, Nairobi River Primary School, Arya Girls Secondary, Muranga Primary School, Pioneer University, Jamhuri High School, and Nairobi City Primary School. Health facilities include Guru Nanak Hospital and Ngara Healthcare Centre. Some of the places of worship are churches, mosques, and temples.

4.2.3 Development Densities

Key informant 1 reported that the development densities permitted are: *"Ground coverage of 70% whereas the plot ratio allowed is approximately 300%."* Initially, the maximum number of storeys allowed was approximately 4 levels, and this was observed in most of the old buildings within the neighborhood. However, the county's densities were revised to allow for higher densities as Ngara is close to the CBD, hence the need for revising the zoning guidelines to allow for high-density developments. Study findings revealed that 53% of the sampled developments had storeys ranging between 10 and 15 floors (ground coverages for most of these developments reported 80%). Furthermore, 40% and 7% of the emerging developments had storeys ranging between 5-10 and 0-5 floors, respectively. Developers interviewed reported that they were allowed to cover 70% of their plot areas.

A study by Njoroge (2015) showed that most of Eastleigh's emerging developments had ground coverage of about 90%. Eastleigh and Ngara are neighbourhoods within the same zone. As noted by the key informant, the ground coverage of 70% and a plot ratio of 300% ought to be applicable in Eastleigh as well, as it is in the same neighborhood as Ngara. However, the densities for these developments tend to differ. Njoroge (2015) further reported that the variation on-as-built drawings resulted from the client's request. However, a variation on development densities can be blamed on the failure of the Nairobi city county to enforce development control measures, including carrying out regular inspections on developments that are still under construction. The key informant revealed that *the county faced challenges in enforcement due to inadequate personnel.*
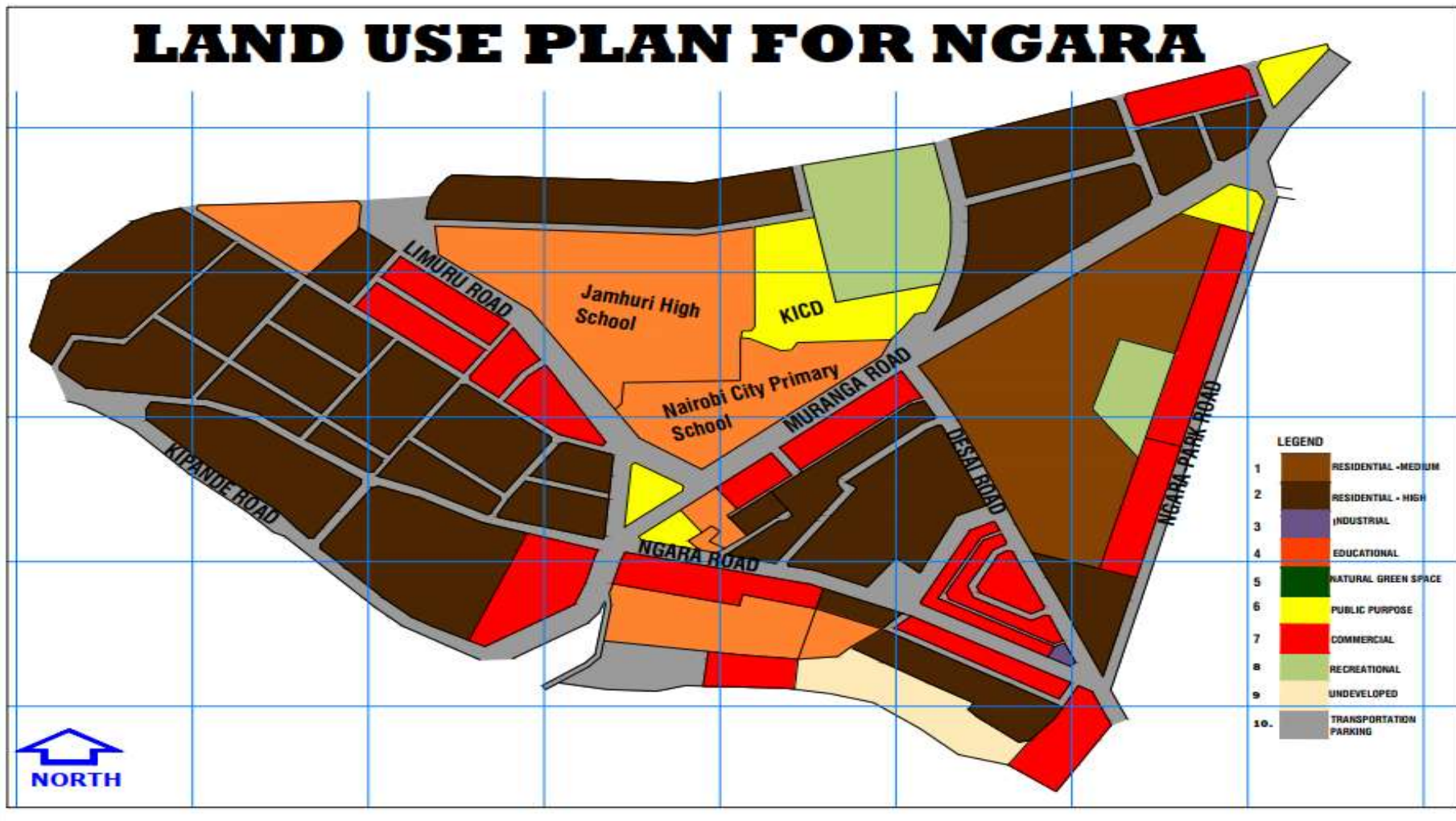
Source: Modified (Nairobi City County, 2020)

4.3 Examining Indicators of Sustainable Urban Neighborhood in Ngara

This section covers four themes: Physical, social, economic, and environmental indicators of the neighborhood. These themes are discussed below.

4.3.1 Social Indicators

Wallace (2011) reported that social facilities integrated with other developments create a sustainable community that is condensed, convenient and vibrant. Social facilities also help to build synergy between different land uses. The study sought the respondents' views on the availability, accessibility, and conditions of the neighborhood's key social amenities. The findings are summarized in table 4.7.

Table 4.7: Response on Adequacy, Convenience, Condition, and Challenges Associated with the Social Amenities in the Neighbourhood

Social Facility	Adequacy	Convenience	Condition	Challenges
Schools	Adequate (100%)	Within walking distance (86.4%) Not within walking distance (13.6%)	Good (92.6%) Fair (7.4%)	None reported
Markets	Adequate (96.3%) Inadequate (3.7%)	Within walking distance (75.3%) Not within walking distance (24.7%)	Good (28.4%) Fair (69.1%) Poor (2.5%)	Overcrowded (52%) Poor drainage (5%) Poor hygiene (33%) Inadequate facilities (5%)

				Theft (5%)
Health centres	Adequate (82.7%) Inadequate (17.3%)	Within walking distance (65. 3%) Not within walking distance (34.7%)	Good (86.4%) Fair (12.3%) Poor (1.2%)	Expensive (43%) Inadequate facilities (15%) Inadequate personnel (28%) No medicine (14%)
Open spaces	Adequate (48%) Inadequate (52%)	Within walking distance (98%) Not within walking distance (2%)	Good (52%) Fair (29%) Poor (19%)	Dusty (14%) Flooding (29%) Invasion by informal business activities (24%) Litter (24%) Poor maintenance (9%)

Source: Field data, 2020

a. **Educational Facilities**

As discussed earlier, the resident population of Ngara is approximately 30,000. As observed during the field survey, there are about 11 education facilities in the neighbourhood. Physical Planning Handbook recommends that one primary and one secondary school must be provided

to serve a catchment population of 4,000 and 8,000, respectively. Schools in the area include Ngara Girls Secondary, Nairobi River Primary School, Arya Girls, Muranga Road Primary School, Jamhuri High School, and Nairobi City Primary School, among others. Others are Kenyatta University (law campus), Pioneer University, University of Nairobi (Parklands law campus), and Mount Kenya University. The majority (86.4%) revealed that the schools are within a walkable distance and 92.6% reported to be satisfied with the schools' conditions.

b. **Social Amenities**

Social amenities include places of worship, health facilities, markets, and shopping centres, among others. The residents interviewed reported that the challenges they face with health facilities are: lack of medicine (14%), inadequate personnel (28%), high cost (43%), and inadequate facilities (15%). As noted earlier, 27% of the developments in the area are residential cum commercial. These commercials are the ones serving the residents. Ngara grocery market is located along Kienjeku road. It is the main grocery market serving the neighborhood. The second market is located along Jodongo road, which mainly deals with hardware items, welding, fabrication and clothing. Challenges associated with the markets as reported by the respondents include overcrowded (52%), poor hygiene (33%), inadequate facilities (5%) and poor drainage (5%).

c. **Security**

Neighborhood security is critical. Neighborhood's security positively impacts people's safety and how they feel living and working in a given place. One key factor that stands out in Ngara is security. The majority (97.5%) reported that they feel safe living in the neighborhood. On the other hand, 2.5% felt the place is not secure enough. The study sought to understand what were some of the security issues of concern. The respondents were only concerned about petty thefts and break-ins. The key factors that contribute to security in the area include proximity to a police station (29%), availability of security guards (43%), gated estates (15%), and security systems (13%).

d. **Social Cohesion**

Wallace (2011) argued that social cohesion aids in building communities that enable its residents to interact and mix freely. Things that bring people together include communal activities and public spaces such as playgrounds, gyms, community centers, and religious places. However, during the field survey, 84% of the respondents noted that they were not keen

on activities that bring the community together. The study engaged the respondents to find out why they were not keen on embracing activities that encourage social cohesion. Diverse responses were noted: 15% reported that they were not keen on physical activities as they did not have time, lack of recreational spaces (12%), poorly maintained grounds (13%), invasion by cars and matatus (12.2%), and lack of facilities (47%).

4.3.2 Economic Indicators

As far as economic indicators are concerned, the study focused on economic activities, employment levels and business environment within the neighborhood. These are discussed as follows;

a. **Types of Economic Activities**

Economic activities in Ngara can be divided into two categories: small and medium businesses. Small-scale business accounts for 73% of economic activities in the neighborhood. Small-scale business is the dominant economic activity in the area. These small-scale businesses include retail shops (14%), hair salons and boutiques (22%), electronics and automobiles (10%), vegetables and fruits vendors (20%), automobiles and hardware (8%), garages and car wash business (16%). These businesses are spread across the neighborhood.

Medium-scale businesses account for 27% of the economic activities in the neighborhood. Medium-scale businesses include supermarkets and wholesale shops (2%), petrol stations (1%), hotels, and micro-finance institutions (7%). Some of the microfinance in the neighborhood include (STIMA Sacco and Kenya Police Sacco). The study findings revealed that the business people prefer Ngara as a place to set up a business because of the following reasons: close proximity to the Nairobi CBD (35%), high number of customers (40%), and cheap rent (25%)

b. **Employment Level**

As noted earlier, approximately 43% of the residents are informal self-employment, 36% informal employment and informal self-employment (15%). Most of the self-employed are engaged in tertiary services such as small and medium enterprises and the jua kali sector. The majority (43%) of those in self-employment are running retail outlets, boutiques, hair salons, barbershops, grocery shops and electronic dealers. Respondents reported that Ngara offers a wide range of business opportunities and attracts customers as it is close to the Nairobi CBD. Furthermore, Ngara rental prices are affordable as compared to CBD. It was noted that Nairobi City County mainly owns the market facilities in the neighborhood. The monthly rental fees

paid by 50% of the traders are below KES 5,000 per month. Furthermore, 36.7% pay a rental fee ranging between KES 5,001 and 10,000. The remaining 13.3% of the traders pay rental fees above KES 10,000. It is also worth noting that employment in Ngara reflects two components: In-neighborhood employment and labor services exported to Nairobi CBD, industrial area and other areas within the city.

c. **Business Challenges**

The business community in the neighborhood reported a myriad of challenges, and they were of the view that the issues create an unconducive business environment. The issues reported by the respondents include: Inadequate sanitation facilities (10%), congestion within the market (30%), high taxes and delay in waste collection (20%), harassments by the County Government officials (13.3%), lack of storage facilities (20%) and inadequate water supply (6.7%). The study engaged the business respondents to find out their opinion on what can be done to address business challenges in the area. Table 4.8 summarizes the respondents' views.

Table 4.8: Respondents' Opinion on how to Address Business Issues

Opinion	Frequency	Percentage (%)
Increase sanitary facilities	6	14.3 %
Protect the riparian land	4	9.5 %
Reduce permit charges and taxes	13	31.0 %
Relocate business that pollute the environment	3	7.2 %
Renovate and expand market facilities	9	21.4 %
Repair roads and streetlights	2	4.8%
Stop harassment by council officials	5	11.9%
Total	**42**	**100%**

Source: Field data, 2020

It is worth noting that the Nairobi City County ought to create a conducive business environment as economic activities are one of the pillars of a sustainable neighborhood. This could be achieved by addressing the challenges reported by the respondents.

4.3.3 Physical Indicators

The variables discussed under the physical environment are housing conditions and mix, and supply of services (road networks, sewerage, drainage, telecommunication, water, electricity and public transportation).

a. **Housing Condition and Mix**

The KS Code Planning and Building Regulation (2019) and the Constitution of Kenya (2010) state that housing is a basic need and every citizen has a right to decent housing. On this note, the researcher sought to understand the residents' views about the building aesthetics and conditions within the neighborhood. Table 4.9 shows the summary of the responses.

Table 4.9: Respondents' Opinion on Housing Condition within the Neighborhood

Response	Frequency	Percentage (%)
Good	50	61.7%
Fair	9	11.1%
Poor	22	27.2%
Total	81	100%

Source: Field data, 2020

About 61.7% of the respondents reported that housings in the neighborhood are in good condition. A quick scan through the neighborhood confirms the responses as most contemporary buildings are in good condition. Most of these are multi-family residential structures and commercial buildings in the form of offices and hotels. Precisely, these buildings are located in Ngara west.

On the other hand, 11.1% and 27.2% of the respondents stated that the housings are in fair and poor conditions, respectively. Most of these buildings are old and dilapidated residential structures. Some public housing (Kenya Railways Corporation and Nairobi City Council-defunct) is part of these poor housings, confirming a study by Matindi (2008), which reported that public housing in Kenya has not changed much and continues to deteriorate. There are also commercial buildings in poor states, especially around the business district in Ngara East. Poor housing conditions affected the aesthetics of the neighborhood and devalued the emerging contemporary developments. Plate 4.3 depicts some of the residential structures in poor condition.

Key informant 2 acknowledged that the neighborhood's housing conditions were not appealing, and some were not even suitable for human habitation. The officer noted that most of the housings were old residential buildings with old sewer lines that do not function properly. The drainages were also blocked, thus leading to flooding during the rainy season. The officer also reported that playgrounds, open spaces, and parking areas had been set aside in large estates owned by government institutions but were invaded by informal business owners such as vegetable vendors and mechanics. This confirms what the respondents reported about the invasion by informal business activities.

The study sought to find out a solution to the poor housing conditions. Key informant 2 reported that Nairobi City County is the owner of three estates in the neighborhood. The estates include Bachelor/Jevanjee, Old Ngara, and New Ngara Estate. Rental in these estates range between KES 6,000 and 12,000 for one- and three-bedrooms units, respectively. Key informant 2 reported that the Nairobi city county has plans underway to demolish some of the old houses in favor of high-rise apartments. Others will be refurbished. The author also sought the officer's views about other privately owned buildings in the neighborhood that are old and dilapidated. Key informant 2 noted that the County might compel the owners to refurbish their structures.

Arguably, housing seems to be a big issue in Kenya, especially within urban centres. As noted earlier, 38.3% of the respondents were unsatisfied with the housing conditions. As Onsabwa (2019) noted on housing study and environmental conditions in Bondeni, Nakuru, 70.3% of the respondents felt that their housings were poor. Generally, this shows that poor housing in Kenya's urban centres is a deep-rooted problem that necessitates a concerted effort between the private and public sectors.

Furthermore, the researcher sought the residents' views on what can be done to improve the housing conditions and general aesthetics of the neighborhood. Among those interviewed, 74.4% were of the view that the housings should be renovated and repainted, whereas 25.6% opined that they needed to be demolished.

b. **Supply of Services**

The variables discussed herein include road networks, water, sewerage, energy, drainage, and solid waste management. The findings of the study are as discussed below;

i. **Road Networks**

The key informant reported that "*the road reserves in the neighborhood range between 18m and 60m wide.*" UN-Habitat's (2020) report states that a neighbourhood should have adequate and efficient networks that accommodate motorized and non-motorized transport systems as good connectivity provides easy access to pedestrians' places of interest and seeks to discourage car usage. It also makes local trips easier and more pleasant by foot rather than a car. Local road networks are to provide a level of connectivity. Therefore, the road reserves, as reported, are wide enough to accommodate all the road users. About the road conditions, table 4.3 summarizes the responses on road conditions in the neighborhood.

Table 4.10: Response on Road Condition

Response	Frequency	Percentage (%)
Good	39	48.1%
Fair	25	30.9%
Bad	17	21%
Total	**81**	**100%**

Source: Field data, 2020

It was observed that Ngara neighborhood has a number of short blocks which provide direct route systems. This is mostly in Ngara west, and they provide moderate direct connectivity for pedestrians to places of interest such as schools, markets, and shopping centers. In Ngara East, however, there are a few short blocks that provide low direct connectivity for pedestrians. Low direct connectivity forces pedestrians to embrace other means of transport rather than embracing the transport's NMT mode. It is, therefore, paramount to have a neighborhood that encourages healthier and active living. This can be achieved by having shorter and direct routes because such convenient links do not prolong walking distance.

Key informant 1 noted that the road system in Ngara area is a sort of typical grid system. As classified by KURA roads, the key collector are: Muranga, Ngara-Park, and Limuru road. The informant reported that roads in and around Nairobi metropolitan region have not kept pace with people's transportation demands and have resulted in heavy traffic congestion during the morning and afternoon peak hours.

It was also reported that the neighbourhood's road reserves are wide enough to accommodate both carriageways and pedestrian networks. The road reserves range between 18m and 30m wide, enough to accommodate both the carriage and non-motorized transport (NMT). Muranga road is a dual carriage, whereas both Limuru and Ngara-Park roads are single-carriage. The informant noted that some of the neighborhood roads fall under the jurisdiction of KURA and KeNHA. Only a few local roads are under the jurisdiction of the County Government. On the road conditions, the officer reported that funding projects such as road maintenance are a challenge and some of the roads are not within their docket.

ii. Public Transportation

Deddington Neighborhood Plan (2017) noted that a good and sustainable neighborhood should minimize private cars' use. Respondents were gauged about the effects of using private cars and the majority (93%) seemed to be aware of the negative effects brought about by many

private cars on the roads. Figure 4.8 summarizes the responses to the level of awareness on the use of private cars.

Figure 4.8: Level of Awareness on the Use of Private Cars
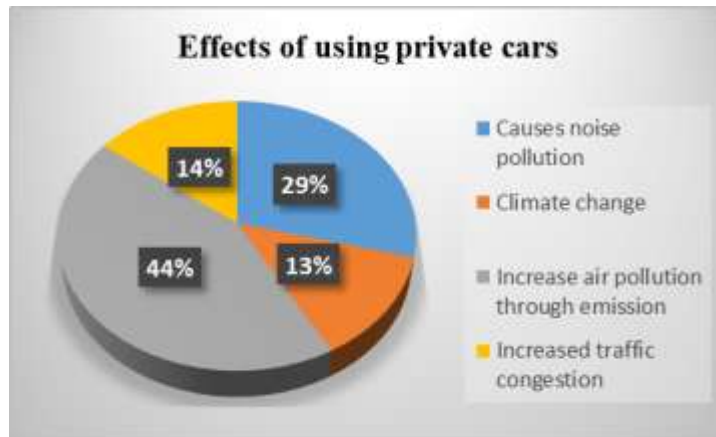
Source: Field data, 2020

About 95.1% of the respondents have access to public transportation, while 4.9% do not have good public transportation access. Muranga, Limuru, and Ngara-Park road are the major public transportation routes to Ngara and the Nairobi CBD. A total of four public stops have been provided along Ngara-Park road and Muranga road. Even though a good number of people have good access to public transportation, 83% of the respondents reported they were not satisfied with the level of service in the public transport sector. Challenges reported include theft (17%), high and fluctuating fare (25%), harassment by matatu crew (41%), assaults (5%), and unroadworthy matatus (12%). The study sought to understand their views on what can be done to improve and encourage public transport use. Table 4.11 summarizes the respondents' opinions.

Table 4.11: Ways on how to Improve the Public Transportation

Response	Frequency	Percentage (%)
Companies to provide transport to their staff	10	12.3%
Improve quality of public transport	22	27.2%
Increase fuel cost for private car users	13	16%
Matatu Saccos to train their crew to work professionally	7	8.6%
Subsidize transport cost	17	21%
Unsure	12	14.8%
Total	**81**	**100%**

Source: Field data, 2020

iii. Non-Motorized Network

UN-Habitat (2019) report emphasizes on walking or cycling as a sustainable means of transport. The majority (61%) of the respondents reported that they have access to NMT facilities, whereas 39% reported that they do not have access to NMT facilities. It was observed that some of the regional and local road networks have NMT facilities, whereas others do not have any form of NMT facilities. NMT facilities include cycling paths, walking pathways, and trails.

It is worth noting that where these NMTs have been provided, it was observed that matatu operators and informal business operators were invaded by matatu operators such as food vendors, on-street shops, and hawkers. About 67% of the respondents also reported that they did not feel safe using the NMT facilities. As reported by the respondents, the key challenge includes bad road behavior by boda-boda riders and matatus (52.1%). Presently, the Nairobi Metropolitan Services (NMS) are constructing footpaths on Ngara-Park road. This should be replicated across major and minor roads in the neighborhood.

c. Sanitation System

Table 4.12: Methods of Disposal of Liquid Waste

Sanitation System	Frequency	Percentage (%)
Connection to sewer line	61	75.3%
Pit latrines	7	8.6%
Septic	13	16%
Total	**81**	**100 %**

Source: Field data, 2020

Findings showed that 75% of the respondents were connected to sewer lines, 16.3% utilized septic tanks, and 8.6% are neither connected to sewer or septic tanks for disposal of liquid waste. These respondents depend on pit latrines for sanitation.

Njoya (2018) reported that a sustainable neighborhood should have a proper and functional sewer system. However, 37.5% of the respondents noted that they face challenges with the sanitation facilities system. The respondents reported that they face blocked and leaked sewers (82%) and filled latrines issues (12%). Blocked and leaked sewers end up causing air pollution, water contamination, and illnesses. NWSC, which runs and manages the sewerage system, should carry out regular maintenance of the sewerage system as this is the main cause of the sewer blockage and leakages as reported by the residents.

Traders (72.9%) reported that the markets do not have adequate sanitation facilities as they are not connected to the sewer line. Market operators reported only 2 pit latrines, thus inadequate to serve the market operators and their clients.

i. Water Supply

About 92.6% of the households and business premises rely on piped water supply from the NWSC for potable uses, whereas 6.2% rely on borehole water. Only 1.2% of the respondents reported that they source water from service deliveries; most of these are business establishments that rely on water vendors in case of water shortages. Study findings also showed that 76.7% of households with water connection from NWSC experienced water shortages at least once or twice per week; however, this phenomenon was witnessed across the city as Nairobi experienced water shortages.

It is worth noting that none of those interviewed reported to practice rainwater harvesting, which is a viable alternative as a source of water for non-potable uses and also a good environmental practice. In a study done by Wanjiru (2019) on Environmental sustainability, respondents reported water management practices such as rain water harvesting. The Nairobi county government ought to encourage property owners to practice rainwater harvesting as this will go a long way in supplementing potable water supplied by the NWSC. Rainwater harvested could be utilized for non-potable uses, such as flushing toilets and landscaping, among others.

ii. Drainage Network

Approximately 43.2% of the respondents reported that they face flooding issues (56%) and a pool of stagnant water (44%) when it rains heavily. It was observed that the drainage issue resulted from an inadequate drainage system in the wider neighborhood. It was further observed that the drainage networks were clogged because of solid waste.

iii. Solid Waste Management

The County Government Act (2012) mandates County Governments to provide services to their residents, including management and disposal of solid waste. However, it seems that the County Governments have failed to discharge their mandate. Findings from a study by Kamweru (2019) revealed that 37.2% of solid waste was collected by the County Government of Nakuru, whereas 62.4% carried out by private waste collectors. More or less the same, this study's findings revealed that most of the residents (68%) rely on the services of private waste collectors and 32% on Nairobi City County for the provision of solid waste management services. This shows the sorry state of solid waste management in counties, especially within the urban setups.

On efficiency, the residents reported overall inefficiency in the management of solid waste. The respondents reported that the challenges in solid waste management include delay in collection of waste (44%), high fee charged (29%), lack of civic responsibility (26%), and lack of dustbin facilities (1%). Figure 4.7 summarizes the causes of poor solid waste management. Some of the challenges caused by poor solid waste management include blockage of drainage networks (17%), untidy living surroundings (29%), a breeding ground for pests and diseases (11%), and polluting the environment (43%) (land and water). From the above, there is a need for undertaking awareness for sustainable management of waste. As reported by Barton (2016), strategies such as the 3Rs (Reduce, Re-use and Recycle) worked perfectly in EkostadenAugustenborg, Malmo as residents were encouraged to practice sorting, recycling, and segregating of waste at the source.

Figure 4.9: Factors Contributing to Poor Solid Waste Management in the Neighborhood
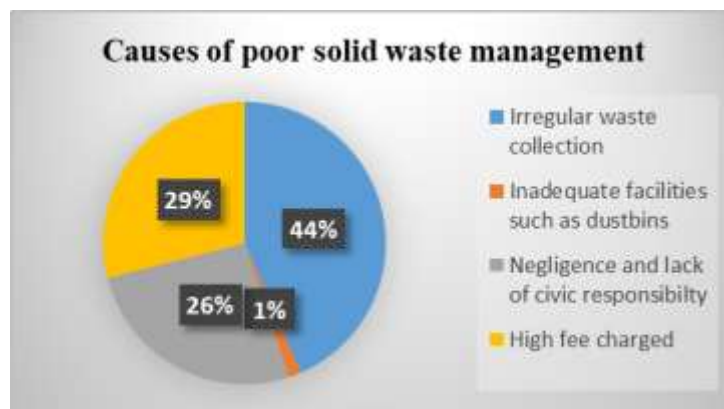
Source: Field data, 2020

Some of the challenges caused by poor solid waste management include blockage of drainage networks (17%), untidy living surroundings (29%), a breeding ground for pests and diseases (11%), and polluting the environment (43%) (land and water). From the above, there is a need for undertaking awareness for sustainable management of waste. As reported by Barton (2016), strategies such as the 3Rs (Reduce, Re-use and Recycle) worked perfectly in EkostadenAugustenborg, Malmo as residents were encouraged to practice sorting, recycling, and segregating of waste at the source.

iv. Energy Supply

Findings showed that 100% of the residential, commercial, and public purpose premises are connected to electricity. Concerning cooking, a small number of residents (22.2%) rely on electricity for cooking. The majority of them (65.5%) rely on gas as the main source of energy for cooking, while the remaining 12.3% rely on charcoal for cooking as well.

Table 4.13: Sources of Energy for Cooking among the Households

Power source	Frequency	Percentage (%)
Electricity	18	22.2%
Gas	63	77.8%
Total	**81**	**100.0%**

Source: Field data, 2020

A limited number of emerging developments (19%) have installed solar panels to harness solar energy. These premises mostly utilize solar energy in the showers and kitchen. Some places also have installed standby generators. However, there is a need to aggressively promote the use of renewable energy among developers as development with green mechanisms is the cornerstone of sustainability. Barton (2016) revealed that the entire neighborhood of EkostadenAugustenborg largely relied on renewable sources of energy.

4.3.4 Environmental Indicators

In addressing the environmental aspect, the study focused on the environment as a key element of a sustainable neighborhood. The study sought to understand the level of protection on water resources, level of air, noise pollution control, and protection of ecologically sensitive areas. The findings are as discussed below;

i. **Water Resources**

Findings showed that three key anthropogenic factors contribute to water pollution in the neighborhood. The causes of water pollution are raw sewer (38%), oil spillage (34%), and solid waste (28%). Raw sewer discharged to the river originates from the residential and commercial buildings. Oil spillage comes from garages that are lined up along the Nairobi River.

The study sought the views of the respondents on measures that can be adopted to reduce water pollution. The majority (47%) believed that the sewerage system needs to be repaired and regularly maintained, and 39% reported that releasing harmful substances to the water bodies should be banned. Activities they suggested include relocating garages from the Nairobi river and enforcing the regulation that governs the protection and management of water resources by the relevant authorities. Further, 14% were of the opinion that public sensitization on environmental protection should be carried out.

ii. **Control of Air Pollution**

Air pollution is also a major environmental issue in Ngara. Burning of waste (45%) is the major source of air pollution. The respondents reported that the major culprits are the mechanics burning worn-out tires. A quick walk in the area reveals garages domiciled in the residential

areas. Garages are light industrial uses and not compatible with residential. Burning solid waste also contributes to air pollution, as reported by the households and the business community. About 33% reported that fossil fuel (fumes from motor vehicles) is another source of air pollution.

Dusty roads (22%) also contribute to air pollution. The respondents noted that roads in a bad state cause air pollution, especially during the dry season because of dust. The respondents' views on the management of air pollution were: proper disposal and management of solid waste (41%), encourage the use of public transport (39%), undertaking road maintenance (18%), and creating public awareness (2%).

iii. Land Management Issues

The anthropogenic activities that cause degradation of land as reported by the respondents include cutting down of trees (18%), disposal of non-biodegradable waste (67%), and light industrial waste (15%). Respondents reported that trees are being brought down to pave the way for construction and erecting billboards, whereas non-biodegradable waste results from poor solid waste management. These non-biodegradable wastes include glasses, plastic products, and metals.

Figure 4.10: Factors Causing Land Degradation in the Neighborhood
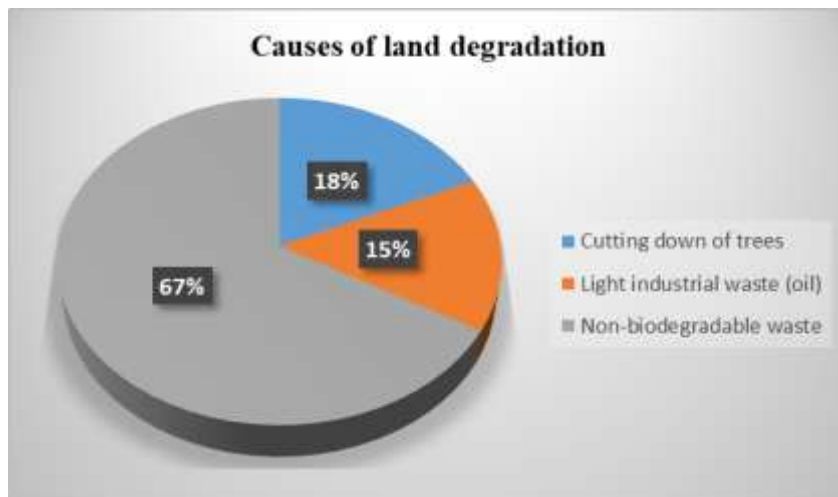
Source: Field data, 2020

iv. Noise Pollution Control

The Environmental Management and Coordination Act (2015), Noise and Excessive Vibration Pollution (Control) Regulations 2009 define noise as any undesirable sound or uncontrolled noise that is objectionable or may affect human health or damage to the environment. A study by Kogutu (2018) revealed that the average noise levels in decibels in Ngara bus station is

93.63, 85.45, and 92.31 between 6:00 a.m. to 8:00 a.m., 12:00 p.m. to 2:00 p.m., and 6:00 p.m. to 8:00 p.m. respectively. This statistic was reaffirmed by this study's findings as 73.4% of the respondents reported that the bus termini and public transport, in general, contributed to noise pollution in the neighborhood.

On the other hand, 26.9% of the household respondents complained about noise pollution from construction sites due to moving machines and incoming vehicles delivering construction materials. Also, 43.2% reported that they face noise challenges because of the garages and jua kali activities. This is because garages and jua kali are in the midst of close to the residential buildings. Locating garages within residential precincts causes incompatibility issues and should not be sited within the residential areas.

In summary, noise pollution from these sources is a nuisance to the residents. Therefore, there is a need to ensure that incompatible land uses should not be sited close to residential premises. Furthermore, construction worksites should ensure that administrative controls are put in place to cut noise pollution in construction areas.

v.   Littering

Littering is a problem that can negatively affect a community. Apart from reducing the residents' pride, littering on parks, streets and/or any other open space may impact business and tourism in any community, city or region. It is on this basis that the study sought to find out the residents' opinions about littering in the neighborhood. Among those sampled, 40.9% reported that there were littering issues in the neighborhood. Figure 4.11 shows the nature of litter in the neighborhood.

Figure 4:11: Nature of Litters in the Neighborhood
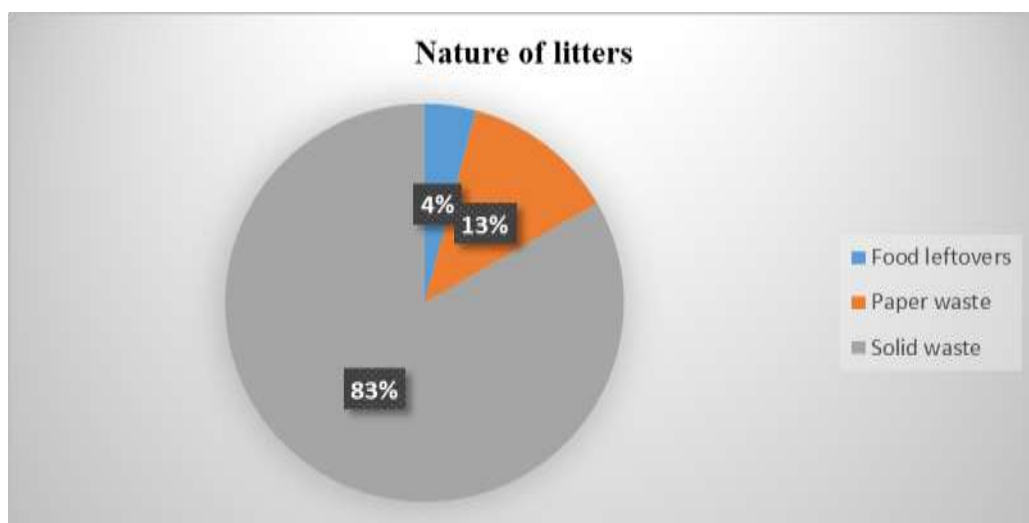
Source: Field data, 2020

As reported by the respondents, the main factors that contribute to littering include irresponsible behavior and/or bad attitude (29%). Most people are not concerned about litter and pollution of the environment. Furthermore, 48% reported that there were no dustbins in public spaces such as streets; hence people, especially within business districts, end up disposing of waste anyhow. The mushrooming of informal business activities such as food kiosks, hawkers, vendors, and garages also contribute to littering, as reported by 23% of the respondents.

Disposal of vehicles spare parts anyhow in the area is also a concern among the residents. Such waste can cause long-term effects on the environment, especially plastics, as they are non-biodegradable. They choke water bodies, blockage of the drainage network, among others. Even the biodegradable waste pollutes the environment as they decompose and release methane gas that contributes to global warming. Possible solutions to the littering issues as suggested by the sampled residents are as summarized in figure 4.12

Figure 4.12: Proposed Solution to Address Littering Issues
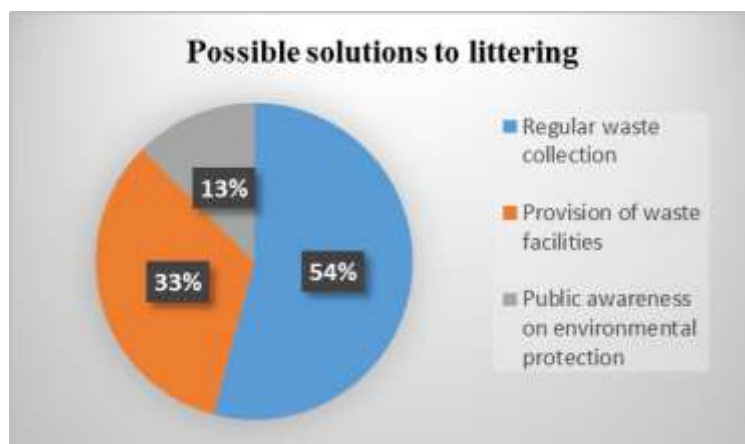
Source: Field data, 2020

Therefore, a concerted effort is of the essence to protect the neighborhood's environment. The authorities should play a role in ensuring the efficient management of solid waste generated. Waste handling facilities such as waste bins should also be provided, especially around the business district and public open spaces. Skips for holding waste temporarily should be provided as well and should regularly be picked from the sources.

vi.   **Ecologically Sensitive Areas**

Mbuta (2013) reported increased encroachment and/or invasion of riparian and wetlands because of the high rate of urbanization; agricultural lands are also cleared to pave the way for urban development because of urbanization. The study sought to determine if there were an

invasion of public open spaces, and 63.7% of the respondents reported that the invasion of public open spaces is mainly because of informal business activities. Factors that contribute to encroachment include a low level of awareness in environmental policies and enforcement of development control guidelines, as reported by 56% of the respondents. *The study's findings were confirmed by the key informant that they face challenges in enforcing development control measures because of inadequate personnel, among others.*

Ecologically sensitive areas are part of public open spaces. It is worth noting that ecologically sensitive areas, which form part of the neighborhood's open spaces, are largely restricted along the Nairobi river, which borders the study area on the southern side. As such, it has a huge impact on the study area. It performs critical ecological functions.

They moderate impacts from flooding, control erosion, and provide habitat for aquatic life. To verify the residents' responses, a field tour within the Nairobi river stretch was undertaken. It was noted that this ecologically sensitive area had been encroached by land uses such as garages and the Ngara market. The mandatory riparian reserve of at least 15m has not been observed. This has to be enforced by the relevant authority, the National Environmental Management Authority (NEMA), and the County Government of Nairobi. Care must be taken to integrate this natural open space system as an integral part of the study area's development as it provides immense opportunities and value from an ecological, identity, attractiveness, and property value perspective.

The Nairobi river stretch along Kipande road was rehabilitated and converted into a park (Michuki Park) by the NMS in coordination with the National Government. The same should be replicated across the Ngara area. Planting trees and observing the riparian reserve will go a long way in rehabilitating these ecologically sensitive areas. Information on tree cover was limited to observation, and it was noted that the tree cover in Ngara is quite limited, especially Ngara East. However, there is a need to encourage developers to plant trees within their premises, and the NCC should focus on planting trees in public spaces.

4.4 Approaches Recommended to Improve the Neighborhood Sustainability Based on Case Studies Reviewed

The best approach recommended for adoption in addressing issues identified and improving the neighborhood's sustainability is urban renewal. Urban renewal is a strategy of land development of a degenerated place such as a residential neighborhood. Urban renewal involves the demolition of structures, relocation of businesses, people, and the use of compulsory acquisition of private property to allow for government-initiated public

developments. Some of the urban renewal program principles include environmental conservation, redevelopment, social-economic inclusivity, economic revitalization, and enhancing access to affordable housing (Maculan, 2020).

A case study adopted is the Augustenborg neighborhood in Malmo, Sweden. Augustenborg is a residential neighborhood that has undergone an urban renewal program and is one of the benchmarks for urban renewal programs worldwide. Augustenborg is a sustainable neighborhood to be emulated. Augustenborg was developed in the early 1950s; however, the neighbourhood dramatically degenerated in the 1970s to a point where the residents fled, and the area was turned into a ghost neighbourhood.

However, the City of Malmo partnered with a social housing company in 1998 to regenerate Augustenborg as an eco-city that is socially, ecologically, and economically sustainable. The study, therefore, recommends two key approaches: redevelopment and environmental conservation (Austin, 2013).

4.4.1 Environmental Conservation

Study findings revealed raw sewer (38%), oil spillage (34%), and solid waste (28%) are the major sources of water pollution in the neighbourhood. Factors causing air pollution include burning of waste (45%), burning of fossil fuel (33%), and dusty roads (22%). Furthermore, the anthropogenic activities that cause degradation of land include cutting down trees (18%), disposal of non-biodegradable waste (67%), and light industrial waste (15%). The respondents also reported issues related to drainage and blockage of the sewer system. On the other hand, the respondents reported the degradation of ecologically sensitive areas such as the rivers.

Therefore, on this basis, the study recommends restoration and conservation of the natural environment in Ngara estate. The key area of address is the restoration and conservation of degraded areas such as the rivers. Infrastructural networks such as the drainage and sanitation system should also be looked into. NMT should also be provided across the neighborhood to create a sustainable community where the residents adopt an eco-friendly mode of transport (walking and cycling) to address air pollution issues.

A case study reviewed and adopted is Augustenborg. Augustenborg neighbourhood historically was vulnerable to floods. The infrastructure for storm water and sewer in the area was a combined sewer system. The system was overloaded during the rainy season, occasioning floods and sewer leakage in water courses. In general, flooding was increasingly viewed as one

of the key environmental challenges in the neighborhood. However, the urban renewal effort in the neighbourhood focused on enhancing green and blue infrastructure for managing storm water and waste to reduce flood risks and enhance biodiversity and improve transportation and waste management (Barton, 2016).

The environmental conservation outcomes in the neighborhood included the construction of an open drainage system to handle storm water from green roofs, lawns, and parking lots. Heavy flows could be held in ponds and directed through swales and ditches to natural water courses. The drainage system could handle 90% of stormwater in the neighborhood. Biodiversity also increased by 50%, and waste generation and carbon emission decreased by 20% (Barton, 2016).

4.4.2 Redevelopment Approach

The study also recommends the possibility of redeveloping Ngara Estate. This option includes structural repairs, painting, and demolishing of buildings where necessary. Western Harbor is one of the successful redevelopment projects. The redevelopment project of the Western Harbor neighbourhood focused on increasing parking capacity, increasing development density, energy consumption, and achieving modest buildings (Barton, 2016).

The study's findings obtained through observation and discussions with the residents showed that there are quite a number of illegal structures for food kiosk, business, and garages set on the road reserves, open spaces, and riparian areas. First and foremost, the garages and other informal businesses should be relocated from the residential areas as they cause noise pollution.

Furthermore, the majority of the buildings in Ngara East are old and dilapidated. Some not even good for human habitation, 74.4% of the respondents opined that these structures should be renovated and repainted, whereas 25.6% opined that they needed to be demolished. Secondly, the Nairobi city county government should modernize the existing markets in the area to accommodate a large number of traders to reduce the illegal business structures witnessed in the area. Old residential buildings should be renovated or demolished as well to enhance the neighborhood's aesthetics.

The pros of the redevelopment include controlled housing development and use of land for public amenities. It also provides an opportunity for public participation. On the other hand, some of the redevelopment cons include a short-term reduction of housing stock. It also has negative impacts on social and community ties and cost (Maculan, 2020).

4.5 Hypothesis Testing

The researcher sought to test the hypothesis, which was meant to test the relationship between the quality of the neighborhood's housing and services and resident's perception. Furthermore, the Chi-square test was used in the hypothesis testing. A confidence level of 95% or a significance level of 0.05 was also considered suitable.

Table 4.14: Hypothesis Testing

Physical Indicators	(Based on respondents' assessment of physical indicators mainly housing and neighbourhood services)		Total
	Favorable	Unfavorable	
Perception of physical indicators (Existing)	34	9	**43**
Perception of Physical Indicators (Initial)	16	22	**38**
Total	**50**	**31**	**81**

Calculation:

Observed frequencies	Calculations	Expected Frequencies
34	50*43/81	26.54
16	50*38/81	23.46
9	31*43/81	16.46
22	31*38/81	14.54

The values of (observed count – expected count)2 / expected count per cell are as follows;

Physical Indicators	(Based on respondents' assessment of physical indicators mainly housing and neighbourhood services)		Total
	Favorable	Unfavorable	
Perception of physical indicators (Existing)	$(34-26.54)^2/26.54$ (2.11)	$(9-16.46)^2/16.46$ (3.38)	**43**
Perception of Physical Indicators (Initial)	$(16-23.46)^2/23.46$ (2.37)	$(22-14.54)^2/14.54$ (3.83)	**38**

Source: Field data survey, 2020

The chi square sum = 2.11 + 2.37 + 3.38 + 3.83 = 11.69

Taking into consideration the chi-square table annexed as appendix 7, it is noted that with a significant level of 0.05 and degree of freedom of 1, the critical value is 0.004. It is also noted that the chi-square statistic is 11.69, which is higher than 0.004. Therefore, the null hypothesis, which states that there is no relationship between neighbourhood housing and services and resident's perception hence is rejected.

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

The study aimed at assessing the level of sustainability in Ngara estate. Therefore, this chapter provides a summary of the findings, conclusion, and recommendations as per the results of the three specific objectives: (a) Identify the type of land uses in Ngara estate (b) Examine the indicators of a sustainable urban neighborhood in Ngara (c) Propose approaches to improve the quality of the neighbourhood based on the best-case studies reviewed.

5.1 Summary of Findings

5.1.1 Types of Land Uses in Ngara

The first objective of this study was to identify the types of land uses in Ngara. The findings on this aspect revealed that 73% of the properties in Ngara had been converted from one particular land use to another. The study further revealed that 57% of the land-use conversion is from single dwelling residential while 24% and 19% of the land-use changes are from commercial and hostels to other uses, respectively.

Furthermore, the study found that 53.3% of the emerging developments were mainly high-rise residential apartments, 26.7% were in the form of high-rise residential apartments commercial, 13.3% were purely commercial uses in the form of offices, retail, and hotels, and 6.7% were student hostels.

In relation to development densities, 53% of the emerging developments had maximum storeys ranging between 10 and 15 floors, whereas 40% and 7% of the developments had storeys ranging between 5-10 and 0-5 floors. As far as acreages are concerned, 26.7% measured approximately 0.025 Ha, 6.7% ranged between 0.025 and 0.5 Ha, 46.7% ranged between 0.05-0.1% and 20% had plot sizes above 0.2 Ha.

5.1.2 Examine Indicators of Sustainable Neighbourhood in Ngara

Under objective two, the study sought to examine the indicators of a sustainable neighborhood in Ngara estate. The themes discussed are the physical, social, economic, and environmental aspects of the neighborhood.

Theme 1: Social Indicators

The study sought the views of the respondents on the key social amenities in the neighborhood availability. Generally, schools and markets were found to be sufficient and within walking

distance. However, markets were reported to face a myriad of challenges: overcrowded (52%); other issues are poor drainage (5%), poor hygiene (33%), inadequate facilities (5%), and theft (5%).

A good number (82.7%) reported that the health facilities were adequate. However, 65.3% felt that the health facilities were not within walking distance and some of the challenges reported are inadequate personnel, lack of medicine, inadequate facilities, and high cost. Open spaces such as recreational grounds, green open spaces, and parking areas were inadequate, as reported by 48% of the respondents. Where these facilities have been set aside, 48% reported that they were littered and have been invaded by informal business activities, flooded (29%), dusty (14%), and poorly maintained (9%).

The above issues are why most of the residents do not engage in communal activities or participate in activities that bring people together and foster social cohesion in the neighborhood. Lastly, 97.5% of Ngara residents felt that they were safe in the neighborhood. Key factors that contribute to security in the area are: close proximity to the police station (29%), availability of security guards (43%), gated estates (15%), and security systems (13%).

Theme 2: Economic Indicators

Economic activities in Ngara were found to be small and medium scale businesses. Small-scale business accounts for 73% of the economic activities, and 27% were medium scale businesses. The small-scale businesses include retail shops, butcheries, hair salons, grocery vendors, boutiques, electronics, vegetables, and fruits vendors, among others. Medium-scale businesses consisted of supermarkets, petrol stations, hotels, and micro-finance institutions.

It is worth noting that Ngara offers a wide range of business opportunities; however, some challenges, as reported by the residents, create an unconducive business environment in Ngara. Study findings found that these challenges include inadequate sanitation facilities and water supply (16.7%), congestion (30%), high taxes and delay in the waste collection (20%), harassments by the County Government officials (13.3%), and lack of storage facilities in the market (20%).

Theme 3: Physical Indicators

Under the third theme, the variables discussed include housing condition and mix, development density, and supply of services (public transportation, road networks, sewerage, drainage, water, and electricity). The study sought to gauge the respondents' views on the building aesthetics and conditions in the neighbourhood. Mixed reactions were noted, with 61.7% of the

respondents reporting that most of the housings are in good condition with 11.1% and 27.2% stating that the housing conditions are in the fair and poor state, respectively.

A study survey revealed that most of the buildings located in Ngara West are in good condition. However, the majority of the buildings in Ngara East are old and dilapidated. Some not even good for human habitation, 74.4% of the respondents opined that these structures should be renovated and repainted, whereas 25.6% opined that they needed to be demolished.

On infrastructure provision, 92.6% of the households and business premises rely on piped water supply from the Nairobi Water and Sewerage Company (NWSC) for potable use, whereas 6.2% rely on borehole water. Only 1.2% sourced their water from service deliveries. Most of these are business establishments that rely on water vendors in case of water shortages as 76.7% of the households and business premises reported water shortages during the week.

In relation to the sanitation system, 75% of the households and commercial establishments are connected to sewer lines, 16.3% utilized septic tanks, while 8.8% rely on pit latrines for sanitation. Reported challenges are blocked, rusty, leaked sewers, and filled latrines. The drainage system was reported to have issues such as clogged drainages and lack of drainage system in all the roads.

On solid waste management, 68% of the respondents rely on private waste collectors' services, whereas 32% depend on the Nairobi city county services. The respondents reported that the challenges associated with solid waste management include delay in the collection of waste (44%), the high fee charged (29%), and lack of citizen responsibility and/or bad attitude towards management of solid waste (27%). These challenges contribute to the blockage of drainages, untidy living surroundings, breeding grounds for pests and diseases, and land and water pollution.

Every household and business premises were found to have an electricity connection and mainly for lighting. However, variations were noted on cooking as (22.2%) rely on electricity, (65.5%) gas, and 12.3% charcoal. The road conditions in the neighborhood are generally fair. Public transportation is highly accessible, as well. However, 39% of the respondents reported that they do not have access to NMT facilities such as cycling paths and walkways. Parking areas were also inadequate as it was observed most of these spaces had been invaded by the informal business activities.

Theme 4: Environmental Indicators

Study findings revealed that the major causes of water pollution in the neighborhood are: raw sewer (38%), oil spillage (34%), and solid waste (28%). Oil sewage emanates from booming garage activities in the area, whereas the raw sewer originates from residential and commercial buildings.

Factors causing air pollution are burning of waste (45%), burning of fossil fuel (33%), dusty roads (22%). The respondents' views on ways of addressing air pollution were: proper disposal and management of solid waste (41%), encouraging the use of public transport (39%), undertaking road maintenance (18%), and carrying out public awareness (2%).

The anthropogenic activities that cause degradation of land as reported by the respondents include cutting down of trees (18%), disposal of non-biodegradable waste (67%), and light industrial waste (15%). In most cases, trees were being brought down to pave the way for construction, whereas non-biodegradable waste resulted from poor management of waste.

A study by Kogutu (2018) revealed that the average noise levels in decibels in Ngara bus station is 93.63, 85.45, and 92.31 between 6:00 a.m. to 8:00 a.m., 12:00 p.m. to 2:00 p.m., and 6:00 p.m. to 8:00 p.m. respectively. This information was reaffirmed by this study's findings as 73.4% of the respondents reported that the bus termini and public transport, in general, contributed to noise pollution in the neighborhood. Further, 6.9% also noted that noise level emanates from the construction sites, whereas 19.1% noted that garages and jua kali domiciled in the residential areas were a nuisance to the residents.

Finally, the study sought to determine if there was an invasion of ecologically sensitive areas and public open spaces. Ecologically sensitive areas, which form part of open spaces in the neighborhood, is largely restricted along the Nairobi river, and 63.7% of the respondents reported invasion of the Nairobi river stretch mainly by informal business activities such as garages.

5.2 Conclusion

The study concludes that Ngara area exhibits one key element of a sustainable neighborhood: mixed land uses. Existing and emerging land uses are mixed-use in nature and consist of land uses such as residential and commercial uses. It is worth noting that Ngara offers an opportunity to provide a wide variety of housing as private developers mostly supply housing for the middle and high-income end.

Observation and informal discussion with some of the respondents and key informants revealed that government institutions own large chunks of unutilized land. Presently, the National Government is developing low-income housing in the area, and Nairobi city county has the same plans for developing its properties. Implementation of these plans will go a long way in addressing issues of poor housing.

Addressing challenges such as the invasion of open spaces will also increase the number of open spaces in the neighborhood. The area that requires urgent intervention, however, is the provision of adequate and functional infrastructure. Provision and regular maintenance of drainage networks, sewerage systems, road networks, and proper management of solid waste will have a positive environmental and economic as it will directly address issues such as air, water, and noise pollution.

5.3 Recommendation for Policy Makers and County Government of Nairobi

The study recommends that all public open spaces be reclaimed, reintegrated, and/or rehabilitated where necessary. A case study is the recent rehabilitation of Michuki Memorial Park, the same can be done along the Nairobi river stretch and other public open spaces within the neighborhood. Nairobi City County Government should also consider demolishing the existing Ngara market and put up modern structures that will accommodate many traders.

All massive developments expected in the future should provide adequate open spaces for recreational and amenities such as creches and community centers. Such should be made accessible to the general public. Furthermore, the study recommends that a land use plan or 'action plan' should be prepared to guide spatial developments. Land use plans will address issues such as land use incompatibility. On the same note, the development control should be diligently enforced by the Nairobi city county to stop uncontrolled urban growth.

The study recommends that detailed research on present capacity and future demand for infrastructure, specifically in the neighborhood be done. Information on capacity and future demand will help provide and upgrade infrastructure not limited to road networks, drainage, and sewerage systems. It further recommends that mapping of public open spaces be done to determine the number of spaces available and the extent to which they have been grabbed or invaded.

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APPENDICES

Appendix 1: Household Questionnaires
Household Questionnaire
(1.0) DEMOGRAPHIC INFORMATION (Tick where appropriate)
1) Gender: Male [ ]   Female [ ]
2) Age: […………]
3) Marital status: [………………]
4) Education level: Primary [ ] Secondary [ ] College [ ] University [ ] None [ ]
5) How long have you been residing in Nairobi?
6) Have you been living here since you moved to Nairobi? [ ] Yes [ ] No
7) Where did you originate from before occupying this house? [ ] Rural area [ ] Estate within Nairobi [ ] Other specify
8) Why did you move here?..

(2.0) SOCIO-ECONOMIC (Tick where appropriate)

9) Type of employment: [ ] Informal-self-employed [ ] Formal self-employed [ ] Formal employment [ ] Unemployed
10) Do you have any other source of employment [ ] Yes [ ] No, If yes, what is the average house income…………………………………………………………………………………………
11) Total household income? [ ] 0-5,000 [ ] 5,001-10,000 [ ] 10,001-20,000 [ ] 20,001-30,000 [ ] 30,000-50,000 [ ] Above 50,000

(3.0) THEME: SOCIAL ASPECT (Tick where appropriate)
12) How can you rate the convenience and conditions of the following social infrastructures within Ngara?

Social Facility	Availability (specify the total number of the facilities where possible)?	Convenience (Is it within walking distance from your home)? Approximate (distance)	Condition and Level of Service (Briefly Describe)?	(Challenges if any)
Schools				
Health centre				
Shopping centre				
Market				
Community centre/social halls				
Bus stops				
Religious facilities				
Police station or police post				
Open spaces (recreational, green spaces etc.)				

13) Do you consider Ngara neighborhood to be secure? [ ] Yes [ ] No

a) If yes, what contributes to the security of the neighbourhood?...
....

b) If no, what kind of security concerns are there, please describe?...
....

c) What can be done to improve security in the neighbourhood?...
....

d) Any other security concern you may wish to talk about?
…………………………………………………………………………………………
…………………………………………………………………………………………

14) Are there streetlights in the neighborhood? [ ] Yes [ ] No
   a) If yes, how are the conditions? [ ] Good [ ] Fair [ ] Bad

(4.0) THEME: PHYSICAL ASPECT (Tick where appropriate)

15) Does Ngara provide a certain level of physical activities in any of the following activities?

Activity	*If Yes, please provide a brief description about the activity and conditions of the places for the activity*
Walking	
Jogging or running	
Cycling	
Gardening	
Soccer or basketball	
Organized sports	
Or no activity at all	

16) Are the following infrastructure available which provides safe walking environment for the residents? (1.) Walking trails [ ] Yes [ ] No (2.) Cycling Paths [ ] Yes [ ] No (3.) Walkways [ ] Yes [ ] No
   a) If yes, describe the condition of each of the facility available?...
   ....

   b) In your opinion, what are some of the things that discourage physical activities in your neighbourhood?...
   ....

17) What are the most attracting things/features in your neighborhood?...
....

18) What is your view in terms of building aesthetics/attractiveness in your neighborhood?
....
....

19) If poor, what can be done to improve the aesthetics of buildings in the neighborhood?
....
....

20) Is your neighborhood free from litters or vandalism? [ ] Yes [ ] No
   a) If not, what is the nature of such litters and vandalism?…………………………………………………………………………………
   ……………………………………………………………………………………..

b) What are the causes of such litters and vandalism?..
....
....
c) What can be done to reverse the above trend?..
....
....

21) How can you rate the conditions of the roads? [ ] Good [ ] Fair [ ] Bad
22) Is there public transport accessibility in your neighborhood? [ ] Yes [ ] No
23) Are you aware of the effects of frequent use of private cars to the environment, please describe the effects?...
....
24) In your opinion, what can be done to encourage car owners to use public transport as an alternative form of transport?...
....
....
25) What is the main source of power for lighting in your household?
26) What is the main source for cooking and water heating respectively? [ ] Electricity [ ] Gas
[ ] Firewood
27) How does the household dispose liquid waste [ ] connection to sewer [ ] pit latrines?
[ ] septic)?
28) Do you face any challenges in disposal of sewerage waste? [ ] Yes [ ] No
a) If yes, please describe the challenges?...
....
b) Are you aware of any adverse effects such challenges may be posing to the environment, if yes please describe?...
....
c) What can be done to address the challenges encountered?..
....
29) Do you face challenges in solid waste management? [ ] Yes [ ] No
a) If yes, please describe the challenges experienced?..
....
b) In your view, how does the challenges in solid waste management affect the environment?..
....
c) In general, how can the state of solid waste management in the neighborhood be improved, briefly explain?..
....
30) What is your primary source of water? [ ] Borehole [ ] Service delivery [ ] Connection to Nairobi water and sewerage company

(5.0) THEME: ENVIRONMENTAL ASPECT (Tick where appropriate)

31) Are you aware of any of the following environmental issues or urban activities outlined below that may contribute to environmental problems in your neighborhood?

1) Environmental Problem	2) Please, briefly describe about the problem (effects to the residents or welfare of the neighborhood) and causes or the effects of the activities to the environment	3) Plausible Remedies in Your Opinion
Air pollution		
Water Pollution of water bodies (rivers, ground water, wetlands if any)		
Land Pollution		
Encroachment of riparian reserves		
Invasion of open spaces such open fields and green spaces.		
Discharge of raw sewer to water courses		
Informal business activities for example garages, roadside eateries, car wash et cetera.		
Dumping of solid waste in inappropriate locations.		

Thank you for your time.

Appendix 2: Key informant Questionnaire

1) From sustainability perspective, how can you describe the state of Ngara estate presently?

Social Factors	Present State	Measures by the Nairobi City County
Social amenities Affordability Livability Security		
Physical Factors	Present State	Measures by the Nairobi City County
Road networks Energy Water supply Sewerage system		

Environment	Present State	Measures taken by the Nairobi City County

2. How can Ngara be reinvigorated to its past state in your view?

....

....

3. What are the existing densities in Ngara estate presently?

Ground Coverage	Plot Ratio	Maximum height

What challenges do you face in development of sustainable urban neighborhoods?

....

....

Appendix 3: Business Questionnaire

1. Type of employment: [ ] self-employed [ ] employed
2. Do you have any other source of employment [ ] Yes [ ] No, If yes, what is the average income…………………………………………………………………………………
   …………………………………………………………………………………………
3. What type of business do you do?...
   ....
4. Do you own the premise here?...
   ....
5. If no, who owns the premise?...
   ....
6. How much do you pay for as rent? 0-5,000 [ ] 5001-10,000 [ ] Above 10,0000 [ ]
7. Why did you choose Ngara to run your business?...
   ....
8. As a business owner, what kind of challenges do you face?...
   ....
   ....
9. Do you feel safe or are your goods safe within the area?
   a) If no, what kind of security challenges do you face?...
      ....
   b) What can be done to address the above security challenge?...
      ....
10. Do you have access to sanitation facilities such as? Sewer [ ] Pit latrine [ ]
11. How do you dispose solid waste or who manages solid waste generated within the market?...
    ....

12. What kind of challenges do you face as far as solid waste management is concerned in the market?..
....

13. Do you receive any kind of services or support whatsoever from the Nairobi City County?...
....

14. What do you think the Nairobi City County Government have failed to do in their part?..
....

15. What do you think Nairobi City County can do to help you and your business to flourish?...
....
....

Appendix 5: Research Permit

UNIVERSITY OF NAIROBI
Department of Geography and Environmental Studies

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P.O. Box 30197-00100
NAIROBI
KENYA

16th July 2020

The Director
National Commission for Science, Technology & Innovation
NACOSTI Building, Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI, KENYA.

RESEARCH PERMIT: EVANS KIPROTICH MAIYO – C50/23824/2019

This is to confirm that the above named is a Masters student at the Department of Geography and Environmental Studies, University of Nairobi. He is pursuing Master of Arts in Environmental Planning and Management.
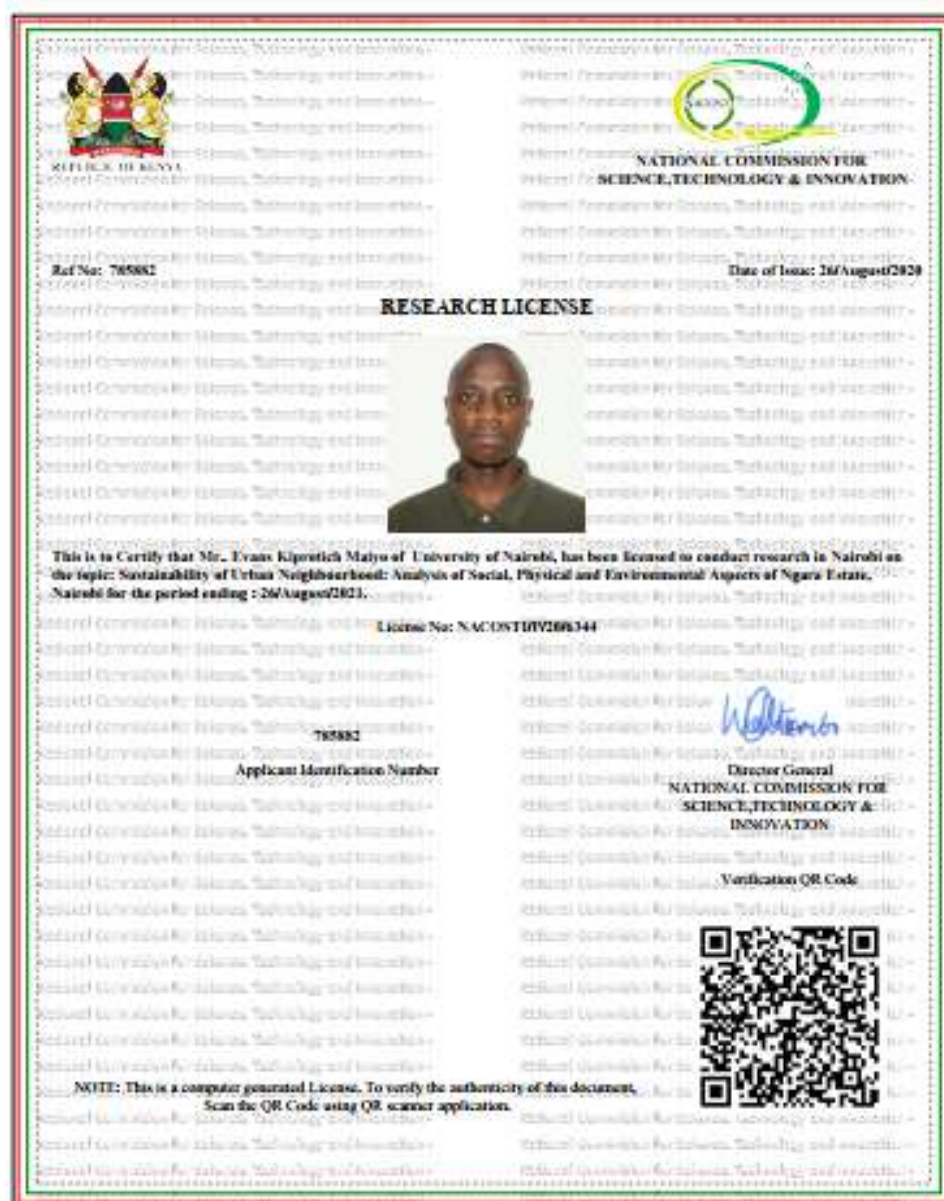
He is currently undertaking a research project titled: "**Sustainability of Urban Neighbourhoods: Analysis of Social, Physical and Environmental aspects of Ngara Estate, Nairobi**"

Any assistance accorded to him will be highly appreciated.

Dr. Boniface Wambua
Chair, Dept. of Geography and Environmental Studies

Appendix 6: Research License

Appendix 7: Chi-Square Table

| | $P(X \le x)$ | | | | | | | |
| | 0.010 | 0.025 | 0.050 | 0.100 | 0.900 | 0.950 | 0.975 | 0.990 |
r	$\chi^2_{0.99}(r)$	$\chi^2_{0.975}(r)$	$\chi^2_{0.95}(r)$	$\chi^2_{0.90}(r)$	$\chi^2_{0.10}(r)$	$\chi^2_{0.05}(r)$	$\chi^2_{0.025}(r)$	$\chi^2_{0.01}(r)$
1	0.000	0.001	0.004	0.016	2.706	3.841	5.024	6.635
2	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210
3	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.34
4	0.297	0.484	0.711	1.064	7.779	9.488	11.14	13.28
5	0.554	0.831	1.145	1.610	9.236	11.07	12.83	15.09
6	0.872	1.237	1.635	2.204	10.64	12.59	14.45	16.81
7	1.239	1.690	2.167	2.833	12.02	14.07	16.01	18.48
8	1.646	2.180	2.733	3.490	13.36	15.51	17.54	20.09
9	2.088	2.700	3.325	4.168	14.68	16.92	19.02	21.67
10	2.558	3.247	3.940	4.865	15.99	18.31	20.48	23.21

Appendix 8: Turnitin Report

Turnitin Originality Report

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26TH NOVEMBER 2020

Assessment of Urban Neighborhood
Sustainability: A Case Study of Ngara
Estate, Nairobi By Evans Kiprotich

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