UNIVERSITY OF NAIROBI

THE EFFECTS OF INFORMAL URBAN SPRAWL ON THE PROVISION OF INFRASTRUCTURE IN MAKONGENI NEIGHBOURHOOD OF THIKA MUNICIPALITY, KIAMBU COUNTY, KENYA

BY

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DECLARATION

I, Frida Lucy Gichugu Muriithi, hereby declare that this research project is my original work and has not been presented for a degree or any other award in any other university.

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14-04- 2023

This research project has been submitted for examination with our approval as university supervisors.

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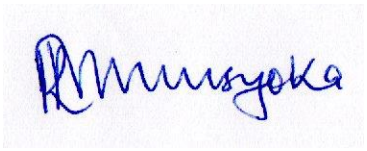
Date: 08/05/2023……



Dr. Rose Musyoka

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DEDICATION

I dedicate this research project to my family for their unending support.

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ABSTRACT

In Africa, rapid urban growth continues to pose adverse challenges to development planning and management. Previous studies have established that informal urban sprawl is a common phenomenon in Kenya's urban areas, including Thika. Undesirable patterns observed in the urban areas include poor land use connectivity, land use conflicts, long traffic jams, poor civic designs, poor drainage systems, and increased slum settlements. However, there is no consensus on what causes informal urban sprawl. Therefore, this research project analyzed why informal urban sprawl occurs in the Thika municipality; its effects on the provision of infrastructure in the Makongeni neighbourhood; coping strategies, and planning options to address the informal sprawl and improve infrastructure provision. The study used a stratified random sampling technique to gather data from households and developers, and purposive sampling to collect data from government offices. The researcher applied both quantitative and qualitative data analysis techniques and presented the data in tabular, graphical, and report formats. From the findings of the study, uncontrolled development has engulfed planned urban extensions in the study area in the last four decades. Investigation into the types of development in the Makongeni neighbourhood revealed that majority (63.4%) are multi-dwelling residential buildings. The compliance level to development control guidelines such as the minimum land size, maximum ground coverage, plot ratio and setbacks is 62.88%. The key drivers of informal sprawl are ineffective planning, ineffective implementation of plans, inadequate enforcement of development control standards, non-compliance to development control standards, and traditional land tenure systems that bypassed planning processes. As a result, uncontrolled development has led to congestion on roads, road user conflicts, insufficient water and sewer connectivity, as well as inadequate housing, health facilities, and public schools. Residents have adopted different coping mechanisms, such as using *bodabodas* to avoid traffic jams and digging boreholes to access water. To address informal urban sprawl and its effects on the provision of infrastructure, the study proposes; the nationalization of development rights, developing policies for the transfer of development rights, compulsory acquisition of land, innovative financing, and adopting Smart Growth strategies. The study recommends further study on the economic benefits and costs of informal urban sprawl and the suitability of development control standards in secondary cities in Kenya

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ABBREVIATIONS AND ACRONYMS

CBO-Community Based Organization

CIDP- County Integrated Development Plan

CoK, 2010-Constitution of Kenya.

GIS-Geographical Information System.

ISUDP- Integrated Strategic Urban Development Plan

KIG-Key Informant Guide

KIPPRA-Kenya Institute for Public Policy Research and Analysis

NLP-National Land Policy

NLUP-National Land Use Policy

SDGs-Sustainable Development Goals

UN-United Nations

UNESCO- The United Nations Educational, Scientific and Cultural Organization

TDR- Transfer of Development Rights

CHAPTER ONE: INTRODUCTION

1.1 Background to the study

Rapid urbanization is a major trend of present-day times, with majority of the world's populace now living in urban areas, and new cities mushrooming in Latin America, Africa, Asia (UN, 2018). In 1950, approximately 30% of the world populace lived in urban areas, and the number is estimated to escalate to over 65% by 2050. The United Nations predicts that rapid urbanization will continue to occur in lower-income and middle-income nations such as Kenya between now and 2050. Approximately 90% of the urban population increase will likely take place in Africa and Asia. The rapid increase in urban population can be attributed to a surplus in births over deaths, rural-urban migration as well as international migration.

Generally, urbanization is a positive force for economic and human development as well as poverty reduction. However, without adequate planning and development control, urbanization leads to informal urban sprawl, which is frequently uncoordinated and outspreads along the borders of urban areas with undesirable outcomes. A study by Liu & Meng (2020) on the global patterns of sprawl revealed that as income rises, urban sprawl escalates. The study quantified urban sprawl using remote sensing for ten years and found that in 2010, metropolitan areas had become more sprawled, unlike in 2000. Urban expansion in third-world countries occurs in a much more uncoordinated and unplanned way compared to first-world countries (Arku, 2009). The unplanned growth results in many urban ills, including congestion and inadequate basic services. The transformation from state-controlled to market-oriented economies over the last two decades, has led to rapid urban expansion and high population growth rates in major cities in Africa. Most national economic growth rates in Africa are lower than the population growth rates. Arku (2009) observes that in some cases, central and local administrations have failed to guide and regulate land development, manage the urban environment, and provide metropolitan infrastructure and services due to rapid urban growth. As a result, there are unbefitting land uses and immense urban sprawl that has led to the depletion of natural resources and the deficit in the provision of infrastructure.

In their study, Muiruri & Odera (2018) found that most developing countries ignore urban spatial expansion. However, when they consider it, they tend to focus on the capital cities and, to a large extent, ignore the subsidiary towns such as Thika in Kenya. After evaluating the

extent of spatial dispersion or concentration of built-up areas in Thika Municipality for 34 years, Muiruri & Odera (2018) concluded that the urban expansion occurring in Thika municipality is omni-directional (leapfrog and scattered) since it occurs in all directions. The urban growth in the area continues to spread farther from the town centre, especially on the eastern side where Makongeni neighbourhood is located. According to UN-Habitat (2019), the urban expansion in the Makongeni neighbourhood is unplanned. In the 1970s, the government conceptualized that the neighbourhood would accommodate 60% of Thika's projected growth and designed schemes to provide serviced plots to specific beneficiaries, mostly low-income earners. However, uncoordinated growth engulfed the planned urban extension. Ayonga (2019) asserts that exclusionary colonial planning policies and laws caused and exacerbated informality in Kenya's urban areas. Over the past few decades, urban informality has escalated tremendously and strained the provision of roads, water supply and sewerage networks, housing, and open spaces (Kitur, 2019).

1.2 Statement of the Research Problem

Urban sprawl is a distinctive occurrence in cities going through rapid urbanization processes. Studies on the causes of urban sprawl provide deep insights into how urban changes alter the patterns and structures of cities (Bekele, 2005; Bhatta, 2010; Habibi & Asadi, 2011). Sprawl may occur along the city's fringe in a radial pattern or along major transportation routes. Due to the growing population, cities in developing nations across the world are experiencing challenges caused by unplanned sprawl. As the population increases, the demand for new roads, housing, schools, health facilities, open spaces, market space, sewerage networks and solid waste management systems also increases. Where secure and affordable sites are not available, people settle in informal settlements that do not adhere to planning and development control standards.

Informal urban sprawl encompasses urban processes and activities that occur beyond the limit of the policies and laws that govern the urbanization process (Roy, 2005). In Europe, urban informal developments occurred during the medieval era when *laissez-faire* in urban development formed undesirable patterns (Ayonga, 2019). During this period, Europe was changing since people were settling in urban communities. The urban areas became the central hubs of the state, commerce and the church. Rapid urbanization resulted in unaesthetic urban developments and inadequate infrastructure provision. To curb the menace, the policymakers

introduced urban planning to create functional cities and determine future urban patterns. Similarly, America experienced informality during the industrialization era and the policymakers responded by creating land use plans guided by public interest to curb urban informality. Generally, policymakers in the West have been successful in creating functional cities by adopting retroactive planning and development control instruments.

In developing countries, planning and development control have been unsuccessful in eradicating urban informality. In Kenya, urban sprawl dates back to the colonial period when exclusionary planning laws exempted African areas from the planning process (Ayonga, 2019). Throughout the years, unplanned urban developments have increased at a fast rate. The Kenyan government acknowledges that planning is fundamental in tackling rapid urban development. Since the country became independent, the government has enacted planning laws and plans to guide development. Under Article 43, the Kenyan Constitution grants its people the right to a healthy and environment, sustainable environmental protection for all generations, high quality health standards, access to adequate housing, equitable sanitation standards; and clean adequate water (Government of Kenya, 2010). Article 60(1) states that land in Kenya shall be held, used and managed in an efficient, equitable, productive, safe and sustainable manner. Currently, the Physical and Land Use Planning Act, the County Government Act, the Urban Areas and Cities Act, and the Land Act guide development and land management in Kenya. However, planning has been largely unsuccessful in addressing urban informality and making progress attaining SDG 11 (sustainable communities and cities) and Vision 2030.

In Thika municipality, the high rates of subdivision, and transformation of agricultural land to commercial and residential land uses have led to urban sprawl. Unplanned expansion of the Makongeni neighbourhood has strained the provision of roads, water supply and sewerage networks, housing, and open spaces. Past studies on urban sprawl have concentrated on the causes and consequences of urban sprawl (Omasire, Kimondiu, & Kariuki, 2009; Shadrack, 2015; Yiran et al., 2020). A gap in the literature exists on the dynamics that lead to the prevalence of informal urban sprawl in Kenya and how it affects the provision of infrastructure. This study explored the factors that cause informal urban sprawl in the Thika municipality and how it affects the infrastructure provision in the Makongeni neighbourhood.

1.3 Research Questions

1. Why does informal urban sprawl occur in Thika municipality?
2. What are the impacts of informal urban sprawl on the provision of physical and social infrastructure in the Makongeni neighbourhood?
3. How do the residents of the neighbourhood cope with the deficit of physical and social infrastructure?
4. Which planning interventions will mitigate informal urban sprawl and the deficit in the infrastructure provision in the neighbourhood?

1.4 Research Objectives

1. To ascertain the factors that contribute to the occurrence of informal urban sprawl in Thika municipality.
2. To assess the impacts of informal urban sprawl on the provision of physical and social infrastructure in the Makongeni neighbourhood.
3. To determine how the residents of the neighbourhood cope with the deficit of physical and social infrastructure.
4. To establish the planning interventions that will mitigate informal urban sprawl and the deficit in the infrastructure provision in the neighbourhood.

1.5 Assumptions

The study proceeded with the following assumptions:

a. With the current land delivery systems in Makongeni neighbourhood, developers are not motivated to provide land for development of infrastructure.

b. There are no plans for any significant policy announcements that would impact the existence of informal settlements in the Makongeni neighborhood in the next five years.

1.6 Justification and Significance

Without adequate planning and development control, urbanization results in haphazard developments that have undesirable outcomes. The phenomenon of urban sprawl usually results in many economic, environmental, and social challenges, including the deficiency in the provision of infrastructure. Therefore, if not controlled, the haphazard developments will continue and the situation will worsen. Past studies on sprawl have concentrated on the causes

and effects of urban sprawl. The main objective of this research was to ascertain why informal sprawl exists in the Makongeni neighbourhood and how it affects infrastructure provision. The study also looks at how the residents cope with the deficit in the physical and social infrastructural provision, and what can be done to remedy the situation. The verdicts of this research will contribute to planning knowledge, the existing database on the subject of sprawl, and can also be replicated in other towns facing similar challenges to promote sustainable urbanization.

1.7 Scope and Limitation of the Study

The study focused and restricted itself to the administrative boundaries of the Makongeni neighbourhood which is located in Thika municipality, Kamenu Ward, Kiambu County. It borders Garissa road, Kiandutu and Kiangombe neighbourhoods. Makongeni neighbourhood lies between $1^0$04'09.02" S and $37^0$07'09.34" E. The study linked informal urban sprawl and the observed void in the provision of infrastructure in the area. The research focused on why informal urban sprawl occurs and the effects of the sprawl on the infrastructural provision. Additionally, the study established the residents' coping mechanisms and the planning options to mitigate informal urban sprawl and the deficiency in infrastructural provision.

1.8 Definition of Terms

This research used several terms in understanding the concept of informal urban sprawl and its effects on the provision of infrastructure. The first term is 'u*rban sprawl*,' which refers to the physical extension of the built environment around an urban centre, commonly accompanied by many grave problems, including incompatible land uses, high dependency on private cars, and high segregation of land uses (UN-Habitat, 2015). In the context of this research, *'informal urban sprawl'* refers to uncoordinated urban expansion that outspreads and brings undesirable outcomes. *'Physical infrastructure'* alludes to the primary physical structures that are essential to the functionality and survival of an economy (IGI Global, 2021). In this study, the physical infrastructure covered are roads, water supply networks, sewerage systems, food market infrastructure and solid waste management systems. *'Social infrastructure'* refers to the networks of spaces, institutions, facilities, and groups that facilitate social connections (Latham & Layton, 2019). In the context of this research, social infrastructure encompasses open spaces, housing, schools and health facilities. The term *'development control*,' refers to the process of managing

land uses and ensuring that they adhere to spatial development plans and policy guidelines made by the planning authority to achieve sustainable land utilization and promote the general welfare of the community (Physical and Land Use Planning Act, 2019). The term *'Smart Growth'* constitutes sustainable utilization of existing resources, channelling development to areas that have the prevailing physical infrastructure, and building on existing urban assets to advance urban development and redevelopment (Bekele, 2005). This research proposes the smart growth concept as a solution to informal urban sprawl. The term *'Transit-Oriented Development (TOD)'* refers to a planning methodology that integrates transport infrastructure and spatial planning to make services more accessible (UN-Habitat, 2018). In this study, TOD entails the consolidation of transport plans and land use plans.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter provides a comprehensive assessment of the concept of informal urban sprawl and its effects on the provision of infrastructure. It outlines the meaning of urban sprawl, the concept of informal urban sprawl, and its theoretical foundations. The chapter also looks at the impacts of informal urban sprawl on the provision of infrastructure, including coping strategies, and further explores various planning interventions that address informal urban sprawl and enhance the provision of infrastructure as well as the case studies. The chapter also outlines the policy and legal framework and concludes with a conceptual framework that defines the relevant variables for this research and maps how they relate to each other.

2.2 The Concept of Urban Sprawl

The term urban sprawl refers to the physical extension of the built environment around an urban centre, commonly accompanied by many grave problems, including incompatible land uses, high dependency on private cars, and high segregation of land uses (Burchell et al. 2000, Holcombe & Williams, 2008; UN-Habitat, 2015). Livingston et al. (2003) and OECD (2018) denote the characteristics of urban sprawl as; resource-consumptive, low-density, automobile-dominated, poorly-accessible outward expansion of an urban area.

The main causes of urban sprawl are economic, demographic, social, geographic, political, and technological factors (Bekele, 2005; Bhatta, 2010; Habibi & Asadi, 2011; Grigorescu et al., 2014; & Sinha, 2015). For instance, rising incomes, growing populations, geographical barriers to contiguous urban growth, individual preferences for living in low-density neighbourhoods, and the technological advancement in transportation systems and car manufacturing industries. Policy-related facts that cause sprawl include specific zoning requirements, maximum density regulations, tax systems that do not match the social costs of low-density development, large investments in road infrastructure, and the underpricing of automobile usage externalities (Bekele, 2005; Bhatta, 2010; & Adaku, 2014).

There are multiple patterns of urban sprawl. Salvati & Carlucci (2016) and Batty et al. (2003) note that urban sprawl occurs in three different patterns; low-density continuous sprawl, ribbon pattern, and leapfrog type of development. In the low-density pattern, people utilize land that is located along the boundaries of existing metropolitan areas, leading to the haphazard

development of fundamental infrastructure such as power, roads, water and sewer. Ribbon sprawl refers to development that takes place along main transportation corridors, from urban to rural areas. As time goes by, the rural lands neighbouring these transport corridors transform into urban areas, as land values rise and the infrastructure extends from the main routes. The leapfrog pattern of sprawl is a common form of development that features irregular urbanization, with areas/parts of developed areas that are substantially distant from each other and the borders of existing urbanized lands.

2.3 Key Actors in Land Transformation Processes

The key actors in land transformation processes are policy makers, private sector producers, public officials, community members, and residents' representatives (Ibrahim, 2016). The policy makers exemplify political power, with regard to character and function. The policy makers can be; authoritarian if they reserve the decision-making processes and disinformation for themselves, manager mediators if they allocate public resources, acknowledge consensus, and work for the community; or regulators if they coordinate sectors. The private sector includes private developers. The public officials are the managers in the planning implementation institutions. The residents' representatives and the community form the social sector which contains diverse groups. This sector acts in urban decision-making processes through public participation.

In Kenya, the National government is the main actor in land use transformation. The national government, through the ministry of lands and housing and the National Land Commission, is in charge of land subdivision, registration, and solving disputes. Also, they formulate and execute land administration policies. The county government of Kiambu is another key actor which prepares physical development plans to lead land management in Thika municipality. The county government is responsible for the approval of building plans and enforcing development control. Other actors include land owners who subdivide land or change to urban use, Kenya Urban Roads Authority which provides road infrastructure, Thika Water and Sewerage Company which provides water and sewerage services, and professional registration boards who enforce the code of conduct in surveying, planning, and valuation. Other actors include sub-county commissioners, chiefs, and local leaders who are government representatives and avail information on land issues as well as solve disputes. Financial institutions also influence land use transformation by providing financing to developers.

2.4 Informality in Urban Sprawl

Rapid urbanization is a major present-day trend in many cities worldwide. A big percentage of the urban growth in the twentieth and twenty-first centuries occurred and is still occurring in the developing world. More specifically, informal sprawl is now perceived as a generalized form of urbanization (Roy, 2005). According to Roy (2005), informal sprawl is a state of exemption from the formal urbanization order. Since urbanization is a process in which a society transitions from a rural way of life to an urban way of life, informal sprawl encompasses urban processes and activities that occur beyond the limit of the policies and laws that govern the urbanization process.

There are two key aspects of informality in urban sprawl: informal economy and informal housing and settlements (Sandoval, Hoberman, & Jerath, 2019). According to UN-Habitat (2015), the informal economy constitutes informal production hubs. This sector encompasses all economic activities by economic units and workers that are insufficiently covered or not covered at all by formal arrangements in law or practice. On the other hand, informal housing includes illegal shelters that fall beyond the purview of government regulations, and are not protected by the state (Roy, 2009). Informal settlements refer to residential areas where occupants do not have the security of land tenure, and the modalities range from squatters to informal renters (UN-Habitat, 2015). Such settlements usually lack access to urban infrastructure and basic services, the houses may not adhere to current regulations and are often located in hazardous zones. This section looks at the dynamics of informality in urban sprawl in North America and Europe. Additionally, it explains in detail the factors contributing to informal urban sprawl in Kenya.

2.4.1 Informality in Urban Sprawl

Urban informality was rampant in Europe during the medieval era, and in North America during the industrial era. According to Lilley (2014), the Middle Ages in Europe was a vital period in the urbanization of the continent. The proliferation of urban life moulded the European landscape demographically, economically, and physically as population levels increased and rising commercialization influenced all cultural and societal aspects. The establishment of towns took place simultaneously with the growth of older-established urban areas to form a new urban Europe map. Due to the lack of laws, *laissez-faire* in urban growth led to undesirable urban patterns (Ayonga, 2019). The resultant urban informality created an agitation for environmental

determinism in the late 19th century. Therefore, planning became necessary for the creation of great cities. According to Taylor (1998), scholars and policymakers agree that planning complements efforts by the private sector to build great cities by integrating public interest. During the enactment of the UK Town and Country Planning Act of 1947, there was an emphasis on the significance of planning to secure public interest in land development processes (Clark, 1948). Public interest is the third party in a development process, besides the purchaser and the vendor. In *laissez-faire* urban development, it is the public interest that suffers (Ayonga, 2019). Therefore, environmental and planning laws are vital due to their capacity to control, influence and guide urban growth.

In North America, informality in urban development became widespread during the Industrial Revolution. The Industrial revolution brought enormous change in America and Europe (Rees, 2016). The development of new technologies, including steam-powered engines and iron smelting technologies, transformed primarily rural societies. People migrated from the countryside into the fast-growing urban areas to work in factories (Rees, 2016). Although the Industrial Revolution promoted economic growth, it came with disadvantages such as environmental damage and squalid living situations for workers and their families. Since there was limited housing in the cities, the more affluent residents moved to the suburbs while the rest lived in dilapidated houses with limited access to water and sewage systems (Atack, Margo & Rhode, 2022). Although much of the urbanization took place during the Industrial revolution, Hall (1999) recognizes a phase during the pre-industrial era where urban areas were informal (Ayonga, 2019). To curb informality in urban development, policymakers enacted laws and regulations to govern development. The famous 1916 Zoning Law in New York City was the earliest citywide zoning code in the country (Marcus, 1991). The law introduced the 'zoning envelope' concept that defined and limited the density and heights of buildings.

After the industrial revolution, two world wars and the great depression, urban reformers gained an opportunity to bring change to urban areas. For instance, the bombed parts of the cities needed reconstruction and the poor layouts of the industrial revolution era and the medieval era needed reorganization (Taylor, 1998). According to Gallion & Eisner (1963), policymakers also decided to implement pre-planned urban development to regulate future urban patterns. Public interest guided the planning processes. Ayonga (2019) observed that western societies were

successful in clearing undesirable development patterns and regulating future development by institutionalizing preplanned urban development models.

2.4.2 Informality in Urban Sprawl in Kenya

In Kenya, the fast-rising urban population reflect the fast urbanization rates. According to Owuor et al. (2004), rapid urbanization in Kenya is a post-independence occurrence that reflects the high frequency of rural-urban migration. Currently, approximately 60% of the Kenyan urban populace resides in informal settlements, commonly in Kisumu, Nairobi, and Mombasa (United Nations, 2020). Although there are many planning policies, laws and instruments governing development in the country, informality still prevails in urban areas. Studies show that most African countries like Kenya use planning instruments borrowed from the developed nations in the west (Owuor et al., 2004; Akoth, 2013; Ayonga, 2019). However, these planning instruments are not quite effective in controlling planning and development in these nations. In Kenya, the duality of urban and rural planning exacerbates informal sprawl that occurs in the space between urban and rural zones due to lack of appropriate planning instruments, capacity and mandate.

Effective urban planning depends on the nature of planning laws (Cullingworth & Nadin, 2006; Mwangi, 1994). Planning laws refer to positive statements formulated by citizens about the processes, measures, and constraints they want implemented to make their cities livable and desirable (Ayonga, 2019). The laws enshrine the power needed to undertake plan implementation. Ayonga (2019) posits that the inadequacy of planning law in Kenya has led to ineffective planning and the prevalence of urban informality. For instance, planning laws during the colonial era served the interests of the Europeans and Asians. Since the relevant planning authorities have not reformed the laws, planning still serves the former Asian and white neighbourhoods. During the post-colonial era, African elites infiltrated these neighbourhoods. The zones that were designated for Africans during the colonial era were still excluded from planning even after Kenya gained independence. The poor resided in these zones in the post-colonial era.

The British colonial administration in Kenya implemented a racist urban policy which influenced the current informal sprawl in Kenyan urban areas. (Akoth, 2013; Ayonga, 2019). The 1902 and 1915 Crown Lands Ordinance contained regulations for the management of rural-based crown land and excluded the African rural areas. Section 15 of the Ordinance decreed that

land lessees should build structures detailed in the lease, during the stipulated timeframe, and use durable and substantial materials (Republic of Kenya, 1924). The Ordinance also required developers to offer reasonable water supply and drainage, and be mindful of the environment. In case of lease termination, developers had to deliver buildings in good condition. The planning laws did not cover the African rural areas, which were segregated into African frontier districts and African rural reserves. Land tenure was communal in both zones, which experienced informality due to a lack of planning laws (Akoth, 2013). Overall, the racist planning laws led to the emergence of two distinct urban areas; the informal African towns, and the planned Asian and European towns.

The planning laws that directed development in the post-colonial era were the Town Planning Act (1948), the Government's Lands Act (Kenya, CAP 280), and the Local Government Act (Kenya, CAP 265). These laws made planning effective only in the areas where planning was previously practised. Later on, the post-colonial government enacted the Land Planning Act in 1968, which seemed to replace the existing three planning laws. However, it brought contradiction and ambiguity in the prevailing planning structure. The contradiction led to the suspension of some town planning rules, allowing informality to develop in previously planned urban areas (Ayonga, 2019). The removal of the Town Planning Rules Ordinance (CAP 133) which called for the apprehension and punishment of those who violated urban development rules also escalated urban informality. Owuor et al. (2004) affirm that the predominant development patterns that exist today still reflect the development of British colonization instead of the African settlement patterns since there has not been a paradigm shift in the management of both rural and urban spaces. The objective of the Physical Planning Act enacted in 1996 was to guide future development rather than reform the urban informality that existed. Similarly, 2019 Physical and Land Use Planning Act focuses on harmonizing future developments. Kimani & Musungu (2010) affirm that the multiplicity of institutions in the planning and development industry also leads to conflicts that inhibit the proper enforcement of development plans in the country.

Ayonga (2021) observes that the duality of the planning laws still exists today. The colonial government created distinct urban and rural areas that are separated by marked boundaries and governed by different institutional authorities. The two territories are subjected to

different planning instruments due to specific land use regulations enacted by different management structures. As a result, urban and rural-specific developments intended to achieve space-specific objectives emerge. As the developments emerge, they are subjected to specific land transaction costs and land-use development control models. Since the zoning related costs in the city are more expensive, the land, house, and rent values between the two zones vary significantly, and developers move to the areas outside the city fringe to acquire investment land. Eventually, the rural-urban interface develops at a fast rate. This development pattern constitutes informal urban sprawl since it occurs in the rural-urban interface, outside the city's jurisdiction. The rural authorities cannot control development in this area since they do not have the right instruments, capacity and mandate. Therefore, the emerging 'mixed-use' zone remains unregulated.

The results of the prevalent planning system in Kenya have been mostly ineffective; characterized by dominating urban developments, housing and infrastructure constraints, plans and policies that are rarely implemented, and environmental degradation (Kitur, 2019; UN-Habitat, 2019). There are fragments of functional and well-designed sections of major towns. Such fragments occur within the Central Business Districts. The rural-urban interface shaping urbanization in the country features a combination of formal and informal (traditional) municipal land administration systems that are defining rural settlements' transformation and unplanned urban growth. A lack of development plans fuels informal development in Kenya's small and medium-sized towns (UN-Habitat, 2019). If the plans exist, they are poorly executed, leading to spontaneous developments (Kitur, 2019). Additionally, most of the urban centres do not have a structured municipal finance system. As a result, there are minimal investments in critical infrastructure and amenities such as waste management and water supply.

2.4.3 Development Control and Informality in Urban Sprawl.

The term *'development control*,' refers to the process of managing land uses and ensuring that they adhere to spatial development plans and policy guidelines made by the planning authority to achieve sustainable land utilization and promote the general welfare of the community (Physical and Land Use Planning Act, 2019). According to Chapin (1965), development control gives planning authorities the responsibility of making sure that property developers undertake development at the right time and correct place, construct structurally

certified buildings and supply occupants with essential services. The developers also have a responsibility to protect the environment. Therefore, the absence of or ineffective development contributes to or escalates informality in urban development and subsequent deficit in the provision of infrastructure.

Various factors hinder effective planning and development control and promote urban informality. According to Ogundele et al. (2011), factors such as inadequate planning equipment and tools, lack of enough professionally qualified planners, insufficient funding of the planning agency, absence of a well-organized public awareness campaign, unproductive development control procedures, and corruption among the planning officials hinder effective development control. Ogundele et al. (2011) also note that in planning agencies, there is an absence of up-to-date land use maps that depict development trends as well as insufficient vehicles for planning and development control purposes. Additionally, the fact that there lacks easy access to law enforcement officials when there is a need to act quickly in case of a defiance development means that there is ineffective development control. Ogundele et al. (2011) further observe that instead of viewing urban planning programmes and activities as social services, local governments view them as a source of revenue, and therefore fail to adequately fund these programmes. The absence of enough public awareness makes people construct illegal buildings to satisfy their selfish interests without taking into consideration the adverse impacts of their actions. Essaghah et al. (2013) affirm that the efficiency of a planning authority determines the effectiveness of a plan or strategy. In a system that is rational, strategy issues should be based on ideology, mission, goals and the vision of the planning authority.

According to Foley (1960), the main role of town planning and development control is to improve the physical environment to support and promote a healthy life for every human being. However, Essaghah et al. (2013) posit that planning authorities are often manipulated by corrupt politicians and civil servants, raising the question of democratization, autonomy and organizational effectiveness. In his investigation into issues that affect the implementation of urban strategic plans, Rotich (2017) emphasizes that the key factors are top leadership support, resource allocation, project team composition and stakeholder involvement. Adequate top leadership support, enough resource allocation, skilled team members and adequate stakeholder involvement are key to successful planning and development control.

Alnsour & Meaton (2009) conducted a study to establish aspects that impact the extent to which urban housing observes planning standards. The study concluded that the varying socio-economic attributes of the residents of the city are critical in determining the level of compliance with development control standards. Although the residents are aware of the housing standards and regulations, there lack complete compliance with the standards. The study divided factors that have a significant influence on the degree of compliance into three; administrative practices, socio-economic aspects and the uncertainty of housing standards (Alnsour & Meaton, 2009). Administrative practices are classified into administration culture, enforcement and monitoring. The administration culture comprises the values and norms that guide planners in managing the local urban environment. The municipal culture is crucial in controlling and managing urban development.

Alnsour & Meaton (2009) further explain that it is challenging for managers to enforce housing standards since they face the dilemma of choosing between fully enforcing planning standards and maintaining friendships, kinship ties and special interests. Such hesitation allows for construction that does not comply with housing standards. Therefore, if current administration practices do not change, they will probably increase the spread of illegal developments in urban areas. The study further highlights factors that hinder effective monitoring of development activities as lack of budgets, inadequately trained and skilled personnel, over-centralization and lack of information. Concerning socioeconomic characteristics, Alnsour & Meaton (2009) further assert that large family sizes, inadequate public awareness of housing regulations, low-income levels, and inadequate housing finance facilities lead to a surge in the demand for public housing. Once the housing demand accelerates under these conditions, there is an increased lack of compliance with planning standards. In this study, the uncertainty of building standards refers to ambiguity, lack of knowledge during decision-making, and complexity of the planning process. Although uncertainty is expected among the members of the public, sometimes planners confuse the planning rules and regulations (Alnsour & Meaton, 2009). Therefore, the uncertainty among the public leads to non-compliance with the standards, while confusion at the management level contributes to failure in addressing the problem.

2.4.4 Development Control in Kenyan Urban Areas

Kenya's efforts to implement development control can be traced back to the colonial era when the British administration enacted the 1902 and 1915 Crown Land Ordinances (CLO) to control land use. The 1902 CLO subjected all land to the Governor's authority while the 1915 CLO extended the settlers' leases from 99 years to 999 years (Okoth-Ogendo, 1991). The 1931 Planning Ordinance outlined the legislation for controlling development in all land in towns (Syagga, 2006). The Land Planning Act (CAP 303) had a supplementary legislation-the Development and Use of Land regulations (1961) - which made provision for land use development and planning. The legislation mandated that all planning applications should consider the health and social amenities of the communities, and adhere to the proper land density during development (The Republic of Kenya, 2015).

The building Code introduced in 1968 by the Minister for Local Government required the approval of all developments before construction commencement (The Republic of Kenya, 1968). Additionally, all the structures under construction had to be supervised and given the Certificate of Occupation once completed. The code also outlines physical planning standards that developers should adhere to. The Physical Planning Act (CAP 286) enacted in 1996 provided a framework for preparing and implementing physical development plans as well as conducting development control. Statutory instruments that currently guide development control in Kenya include; the Constitution of Kenya (2010), the Physical and Land Use Planning Act (2019), the Urban Areas and Cities Act (2012), the County Government Act (2012), the EMCA (1999), and Public Health Act (2012). Section 66 (1) of the 2010 Kenyan constitution gives the state the power to conduct development control via land use regulation. The statutory instruments provide regulations for controlling the development of buildings to promote orderly development. The non-statutory instruments include the Physical Planning Handbook, Planning and Building Regulations made by Local Authorities, political decisions, and notices from ministries, departments, and county committee meetings.

Many scholars agree that development control is largely ineffectual in most of Kenya's urban areas (Abuya, Oyugi & Oyaro, 2019; Ayonga, 2019; Omollo,2019). The ineffectiveness of development control in Kenya began in the post-colonial era when the Town Planning Rules Ordinance (CAP 133) was removed from the statutes that governed planning. This ordinance

contained rules that governed urban development and required property developers to acquire development and occupation permits (Ayonga, 2019). This law also called for the apprehension and punishment of those who violated the plans. Without the Ordinance, the Local Authorities did not have rules to guide them during plan approval, and the obligation for developers to obtain development or occupation permits was no longer compulsory. Also, the use of specified building materials for the walls, roofs, and floors ceased to be a legal requirement. The developers were no longer mandated to follow specific guidelines for setbacks, minimum room sizes, and minimum road sizes. The two approving authorities-the Commissioner of Lands and the Local Authorities- lacked coordination since they approved subdivisions and building plans respectively (O'Brien & Alliance, 2011; Ayonga, 2019). Due to ineffective urban planning and development control, the Commissioner of Lands alienated land and allocated it to the elites during the early years of the post-colonial period. Grabbing of public utility land became prevalent (O'Brien & Alliance, 2011; Ayonga, 2019). Fueled by capitalism, developers constructed many houses, to accommodate the low and middle-income population without adhering to development control guidelines. The exclusion of former African land from planning and development control escalated informality.

In the modern era, the main responsibility of county planning departments is development control (UN-Habitat, 2019). The efficient implementation of planning and development control guidelines is hindered by several challenges. According to Abuya, Oyugi & Oyaro (2019), previously developed physical development plans are yet to be implemented due to inadequate coordination among different institutions, lack of financial and technical capacity, and absence of a political will. Lack of cooperation from residents also occurs due to previous unpleasant experiences and multiple unfulfilled promises that create mistrust in government development processes. UN-Habitat (2019) observe challenges that affect the institutional capacity for development control as; insufficient number of employed planners, inadequate expertise, dysfunctional urban boards, little regard for planning by political leaders, lack of coordination between planning and budgeting, reliance on discretionary decisions, and corruption. These factors lead to insufficient development control that leads to informal urban sprawl and affects infrastructural provision in the country.

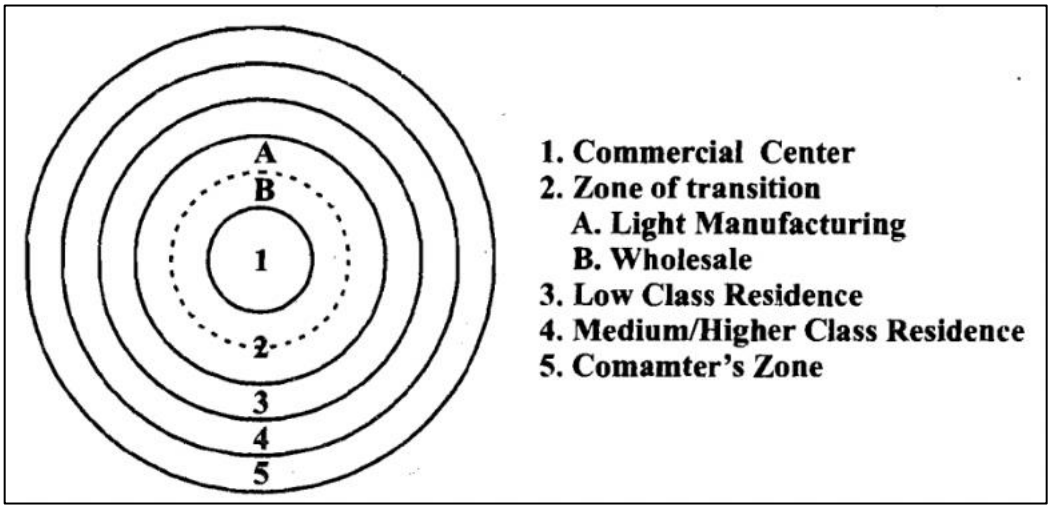
2.5 Theoretical Foundations of Informal Urban Sprawl

The study of urban sprawl is based on different land use theories or models. Generally, scholars developed these theories to explain land use patterns in the early industrial metropolises in developed nations, predominantly in Europe and North America. According to Hitchcock and Hughes (1995), theories and models assist researchers and scholars to make statements about specific actions and events to enable them to analyze their causes, effects, and processes. McDonagh (1997) asserts that different economic, social and political factors affect land use distribution in cities. Therefore, a single factor cannot be sufficiently analyzed in isolation. In this regard, this study will adopt the concentric zone theory, the bid rent theory, the ocean wave analogy, and the multiple nuclei model, and study their applications to urban sprawl.

2.5.1 Concentric Zone Theory

This theory states that cities develop and grow outwards in concentric zones (Reiffenstein, 2017). Both physical land use patterns and human relationships impact the zones. There are five concentric zones. The first one (innermost zone) is the Central Business District (CBD) which has a high concentration of civic, commercial and social facilities. It attracts a large number of people since it is accessible from all directions. The land rates in the CBD are high, and it is usually congested during working days due to the concentration of commercial and other activities. The subsequent sector is the zone of transition which features social disorganization and physical deterioration. The zone has light industries, low-income households, and slums, and it is characterized by encroachment and congestion. The third zone is the working-class residence which has planned residential buildings. The zone is occupied by middle-income and higher-class residents who live close to places of work. Although it is impacted by the transition zone, the working-class residence has proper infrastructure. The working-class zone is divided into two, depending on the social classes of its residents and existing infrastructure. The outermost zone is the commuter zone which features small towns, cities and hamlets. Although people living in this zone commute daily to the CBD for business and employment purposes, they live in their small towns.

Figure 1: Concentric Zone Theory



Source: Reiffenstein, 2017.

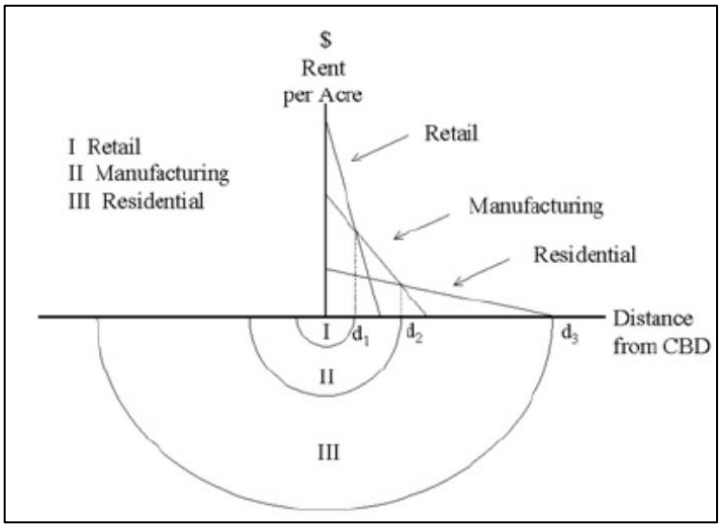
This theory provides a descriptive framework that explains the integration of physical land use patterns and human interactions. Using Chicago as a case study, Burgess established that as a city grows outwards, the relations among individuals and their social, economic, and political organizations expand outwards radically (Banai, 2019). Burgess termed the dynamic spatial patterns of residential areas as a practice of 'invasion' and 'succession' (Reiffenstein, 2017). As the city continued to develop, the CBD exerted pressure on the zone of transition. This process continued with each successive neighbourhood. Many scholars agree that this theory applies to many cities worldwide. For instance, Splansky (1966) argues that the concentric theory applies to the growth of the city of Ibadan, Nigeria. As people migrate into the city, there is competition for limited space and people move into areas that are further away from the CBD due to land availability. Those who can afford to pay high amounts of money get advantageous locations close to the CBD for their homes and businesses. These locations have better infrastructural provisions than areas that are further away from the CBD since economic activities located in these areas have the highest returns. This theory applies to Thika municipality. Makongeni neighbourhood, is located at the periphery of Thika town. Due to competition for limited space, people move into areas that are further away from the CBD, like Makongeni, due to land availability. The theory demonstrates the existing conflict between

periphery zones and city dwellers. It also explains the process of segregation and concentration of social classes with the expansion of the city structure.

2.5.2 Bid Rent Theory

Location and land use theories address the geographic locations of economic activities and cover the question of why a specific economic activity is located in a specific area. The location of economic activity can be an individual site, a city block, a neighbourhood, a zone or a metropolitan area. William Alonso's bid rent theory addresses intra-urban differences in land use (Alonso, 1964). The theory explains how much different sectors of the economy are prepared to pay for the land. This theory applies accessibility requirements to the city centre for industrial, commercial and residential land uses. Every land use form has its bid rent curve or rent gradient. The curve sets the highest rent amount that any type of land use will produce for a specific location. Industries, commercial facilities and houses compete for locations based on each bid rent curve and accessibility to the city centre. For example, since land is cheaper at the city's periphery, people who do not need to access the city often will settle at the city's fringe. Those who settle at the periphery tend to be wealthier (Alonso, 1964). People who require to access the city's centre more often settle near the city and compete with industrial and commercial establishments for space. These settlements form a segregated land use system.

Figure 2: Bid rent theory



Source: Alonso, 1964

The bid rent theory relies heavily on the analysis of the market, the prices, and the bids actors. Property markets like commercial and retail uses are typically enthusiastic to pay higher rents to be in the city centre, where there is a higher population concentration (Narvaez, Penn, & Griffiths, 2013). They also choose these locations since the activities are normally movement-rich compared to other areas in the metropolis. The theory proposes that as the distance from the city centre rises, land is available at lower prices. Accessibility for agricultural uses and housing affordability are offered less intensely away from the CBD (Narvaez, Penn, & Griffiths, 2013). When urban residents earn higher incomes, they move to the periphery due to the availability of more land. This trend can be observed in Thika municipality. Since urban land uses have higher profits than the initial agricultural uses, land owners are selling their lands to city residents. The increasing housing demand eventually leads to the construction of more houses and the expansion of the city. Eventually, the area continues to sprawl.

2.5.3 Ocean Wave Analogy

This analogy posits that urban sprawl develops through activities that originate from the city centre, just like ocean waves (Boyce, 1971).The turbulence in the inner parts of the city, such as crime, urban decay, and congestion, makes people move towards the urban fringe, just like the turbulence in the ocean pushed pebbles and waves towards the ocean's edge.

2.5.4 Multiple Nuclei Model

This model by Harris and Ullman states that land use patterns in cities tend to develop around a number of small centres rather than one main centre (Schwirian, 2007). The growth points are known as 'nuclei.' The number of nuclei depends on location forces as well as the historical expansion of the city. Economic and social forces along with the characteristics of individual sites determine the structure of a city. The central business district is located where it is easily accessible by all land uses, and specific land uses that benefit from cohesion or association are placed together. For example, financial and office buildings as well as retail trade areas can be located around an industrial area to facilitate the ease of transport and communication. Also, land uses that are detrimental to each other are far from each other (Schwirian, 2007). For example, high-class residential areas and heavy industrial land use. The ability to pay rent also determines the location of land uses.

The multiple nuclei theory suggests that vehicle-based intraurban dispersal creates a multiple-nuclei urban land use structure in newer cities (Juybari, 2021). The improvement in mobility enables regional centres to specialize in economic activities. The 'nuclei' can be universities, ports, government centres, neighbourhood businesses, parks, and airports. These evolving CBDs typically develop in the city's outskirts close to the more high-class residential areas (Juybari, 2021). In the study area, the 'nuclei' can be identified as Gretsa University, Ananas mall, or the multiple industries located in the area. As multiple nuclei continue to develop, transportation hubs are constructed, allowing industries to be established with reduced shipping charges. The commutes from the suburbs also become shorter. Thika town continues to grow as more economic activities develop along the transportation hubs. This trend leads to urban sprawl as the population and housing demand increase.

2.6 The Impacts of Informal Urban Sprawl

2.6.1 The Impacts of Informal Urban Sprawl on the Provision of Physical Infrastructure

Urban physical infrastructure comprises assets that facilitate the provision of services, and capital investment, and promote resilient and sustainable urban development (Bobylev & Jefferson, 2014). In this study, physical infrastructure refers to sewerage networks, roads, solid waste disposal systems, water supply networks and food market infrastructure. Generally, informal sprawl tends to limit land as a resource.

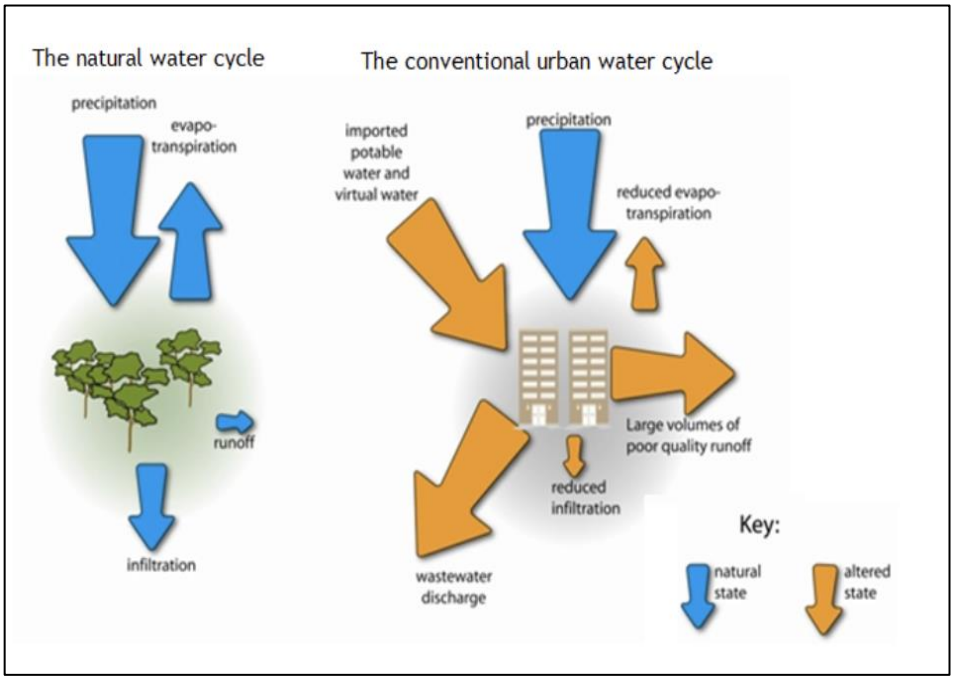
Informal urban sprawl has significant negative impacts on road transport systems. Bekele (2005) notes that unplanned urban development leads to land use patterns that do not favour the construction of sustainable transport modes and thus increase the usage of private vehicles in the suburbs. Barnes et al. (2001) also record that sprawling land development patterns make it difficult to establish mass transit systems. The lack of spatial or physical development plans means that planning standards are compromised through the informal land development processes. Therefore, the access roads that are provided are substandard. Most of the land subdivisions that supply urban land are not coordinated since they are done on an ad hoc basis without any guiding framework and this makes the provision and development of infrastructure expensive and difficult, if not impossible (Barnes et al., 2001). As a result, trip lengths, air pollution, fuel consumption and congestion increase. According to Ewing (2008), poor accessibility is the main impact of informal urban sprawl on the provision of physical

infrastructure. In addition, informal developments increase societal costs for transportation brought about by the challenges in retaining traffic flow near construction areas, increased costs of right-of-way, and regular opposition by the local communities.

Abuya, Oyugi & Oyaro (2019) also assert that land use changes in sprawling urban areas lead to traffic congestion. The land use changes observed by Abuya, Oyugi & Oyaro (2019) include the decline of agricultural lands and open spaces, increased land fragmentation, and the rise in built-up areas. The dense nature of development without expansion of urban infrastructure leads narrow access roads, previously used as footpaths to single dwelling units and agricultural farms. According to McElfish (2007), traffic in sprawling cities and towns is usually worse on the weekends when travel is more spread out, as residents develop strategies to avoid rush hour. Onyango (2018) points out that the expansion of slums in Kisumu town, Kenya, led by urban sprawl creates transport challenges for the residents of the town. The unplanned nature of informal settlements causes poor road infrastructure development that features unpaved narrow roads and congestion.

Informal urban sprawl presents a challenge for water supply and sanitation management. The growing population in sprawled areas outstrips the capacity of cities to provide adequate water and sanitation facilities to their residents (Senn, 2020). Senn (2020) makes a comparison of the natural water cycle and the current water cycle in these sprawled areas, as shown in plate 2 below.

Plate 1: Natural water cycle versus the urban water cycle



Source: Senn, 2020

Due to increased development in the sprawled areas, the natural water cycle is altered and the amount of groundwater available decreases. Discharging sewerage from residential, commercial and industrial areas recklessly also contaminates the groundwater (Senn, 2020; & Abuya, Oyugi & Oyaro, 2019). The increase in informal settlements in sprawled areas calls for more provision of sanitation and water facilities. However, due to the insecurity of tenure in informal settlements, it is challenging to invest in large water and sanitation infrastructure (Corcoran, 2010). Most times, water provision and sanitation utilities do not extend to these informal settlements. Additionally, majority of the people in these areas live below the poverty line and cannot adequately pay for water and sanitation services (Solomon (2011). The spontaneous nature of development in these areas as well as their distance from the core urban area makes it expensive and difficult for the expansion of water and sanitation networks (Muoria, Moturi & Eshiamwata, 2018). As a result, people in these areas usually experience water rationing. To cope with the situation, residents of sprawled areas dig boreholes, harvest rainwater, or buy water from water vendors. Shallow water wells get polluted by onsite sanitation systems such as pit latrines. Due to the inadequacy of conventional sanitation

facilities, some residents use pit latrines while others openly dispose of their excreta, a practice commonly known as 'flying toilets.' Insufficient water and sanitation facilities often lead to diseases and high death rates due to exposure to polluted environments and consumption of unsafe water.

Uncoordinated urban developments also affect the provision of solid waste infrastructure. Solid waste sources in urban areas include industries, food markets, institutions, healthcare facilities, commercial premises and residential areas (Majale-Liyala, 2011). In his study on the solid waste management trends in cities in East Africa, Okot-Okumu (2012) revealed that waste management trends have significantly changed over the years due to issues such as population growth and the unavailability of resources such as waste collection trucks. In the early 20th century, the Municipal solid waste management system was common in East African cities, and it involved the collection of solid wastes by refuse trucks from transfer points or sources to selected waste dumps. According to Okot-Okumu (2012), this system was efficient since the urban population was lower during that time. With time, the urban population grew and the centralized solid waste management system evolved into a mixture of solid waste management strategies that involve the private sector. The new system is not as efficient as the old centralized system since some private solid waste management entities do not adhere to the proper waste management standards (Okot-Okumu, 2012).

According to Solomon (2011), residential areas generate the highest amount of solid waste, followed by commercial areas and food markets. One major feature of informal urban sprawl areas is dense population. As a result of the growing population, a lot of solid waste is generated in these areas. Waste collection in these areas is mainly done by private companies, urban councils, CBOs, and NGOs. Solomon (2011) notes that CBOs and NGOs mainly focus on the less privileged urban population in sprawled areas. Residents usually transport wastes to designated transfer points on specific days before collection is done by the relevant waste collection agency. Okot-Okumu (2012) states that the most commonly used transport mode for solid waste in these areas is trucks. These trucks are usually uncovered, and they litter and release bad odour into the environment. After recycling, the final disposal of these wastes is mainly done in environmentally sensitive zones such as woodland edges, wetlands or areas next to water bodies.

Food vendors in sprawled areas face numerous challenges due to insufficient provision of market infrastructure. According to Satterthwaite, McGranahan & Tacoli (2010), informal urban sprawl leads to inadequate planning, maintenance and management of food market infrastructure, such as market stalls, garbage collection points and sanitation facilities. In her study on informal food retail in Africa, Skinner (2016) notes that this industry is a key source of food for low and middle-income households. The study highlights that informal food traders operate under difficult conditions, without access to proper shelters, water, electricity and toilets. Ahmed et al. (2015) note that the physical constraints of sprawled areas such as insufficient water reticulation, poor road conditions, congested public spaces and minimal sewerage networks negatively affect food vendors. Inadequate infrastructure and services in food markets pose threats to the health and food safety of the inhabitants since selling food products near uncollected garbage, lack of proper storage facilities, insufficient water and sanitation as well as lack of refrigeration contaminates the food. Insufficient lighting in the food markets elevates insecurity in these areas and forces the traders to operate only during day time. According to Skinner (2016), the majority of the food vendors in informal areas are women, who often have limited access to capital or limited skills.

Generally, unplanned developments have adverse effects on the provision of urban infrastructure. McElfish (2007) notes that informal urban sprawl challenges the effective maintenance of existing infrastructure due to increased population. According to Ewing (2008), informal urban sprawl increases the inefficiency in the delivery of fundamental infrastructure due to increased costs. In addition, inefficiency also occurs in the maintenance and operation of existing infrastructure as well as in the delivery of public services. Prevailing urban areas usually have water systems, sewers, transit systems, food market infrastructure and solid waste management systems that are usually maintained (Ewing, 2008). However, unplanned developments draw away people from these existing developed areas to new areas that require the construction of new infrastructure. To avoid construction costs in these new areas, the residents temporarily use septic tanks, dig boreholes or buy water from vendors, operate from substandard food market infrastructure, and rely on undersized roads that eventually require high upgrading expenses. As a result, the population shifts regionally, causing a reduction in the pre-existing urban tax base. This reduction leads to an increase in urban rates and taxes required to

maintain the existing infrastructure across a smaller population, or postponement of maintenance operations.

2.6.2 The Impacts of Informal Urban Sprawl on the Provision of Social Infrastructure

Social infrastructure are facilities that draw attention to the textures, depth and breadth of sociality in urban environments (Latham & Layton, 2019). In this study, social infrastructure refers to open spaces, schools, medical centres and housing. Ewing (2008) states that informal urban sprawl leads to insufficiency in open spaces, which are pieces of land that are undeveloped and available to the public. Often referred to as green spaces, open spaces include community gardens, parks, public seating areas and playgrounds. Apart from recreational purposes, these spaces have ecological impacts as well as human health significance. Uncoordinated urban developments often lead to encroachment of these spaces by private developers, which brings forth negative consequences such as air, noise and land pollution as well as the destruction of habitat. In their study on the dynamics of urban sprawl, Sperandelli, Dupas & Dias Pons (2013) explain that uncoordinated sprawl usually leads to a reduction in green spaces due to increasing population. Additionally, since the land on which sprawl occurs is mainly private and the owners are profit-motivated, public-purpose uses are disadvantaged because they are not profitable.

Informal urban sprawl often leads to the development of low-quality infrastructure such as education centres, medical facilities and housing. More specifically, these types of development, which are mainly privately owned, do not adhere to planning standards (Habibi & Asadi, 2011). Most of these facilities are usually developed without the proper planning procedures to serve the growing population. McElfish (2007) notes that communities in sprawled areas usually lack access to social infrastructure since most of these facilities are privatized and made available only to a small percentage of the population. Ngware (2013) points out that sprawl also affects the provision of public schools and the quality of education. According to Ngware (2013), about 47% of school-going children living in informal settlement areas attend private schools while 53% attend government-owned schools. Sittoni (2012) notes that although the majority of pupils and students in sprawled low-income areas attend public schools, their parents and guardians barely have enough resources to sustain them in schools. This is due to the fact that public schools depend on parents and guardians to raise money for buying school uniforms and equipment such as desks. As a result, the quality of education in these areas is sub-

standard. Kirk (2017) states that public schools are not centrally located to enable easy access by students. Kirk (2017) further notes that suburban sprawl continues to complicate the accessibility of schools by students, and this trend has led to the increased time spent reaching school every morning due to haphazard developments.

Unplanned developments in urban areas affect housing provision and quality. Sinha (2015) explains that the increasing population creates a demand for housing. Additionally, since land is cheaper in sprawling areas, housing becomes cheaper due to the development of flats. Eventually, middle-income earners settle in these areas. Low-income earners tend to settle in sprawling areas, especially open spaces and as a result, there is the development of slums which feature poor housing facilities, with limited access to basic infrastructure such as adequate water, proper roads, sanitation facilities and open spaces. In Nairobi city, middle-income earners are likely to settle in multi-story buildings while low-income earners stay in informal settlements that constitute shacks (Habitat for Humanity, 2021). The building materials used to construct the majority of houses in sprawled areas are not durable, and therefore prone to fires, crime and accidents.

Daef (2002) expounds on the causes and impact of unplanned sprawl on housing in Assiut City, Egypt, in his publication. Although geographical characteristics have an impact on housing typology, the main driver of housing demand in the city is rural-urban migration and demographic characteristics. The enactment of the Open Door Economic Policy in Egypt stimulated investment and speculation by the upper and middle class, which led to an inflation of approximately 25%. The retreat by the public sector to provide housing led to an increase in housing costs that made it difficult for the growing population to pay for minimum housing. Due to the nature of the free housing market, middle-income earners settled outside the city while low-income earners settled in informal settlements. Owing to the character of the unplanned sprawl, the quality of housing deteriorated. People started building shacks and living in houses made of mud bricks and cardboard. Unfortunately, this is the case in many sprawled regions in developing nations.

2.7 Planning Interventions that Address Informal Urban Sprawl and Enhance Provision of Infrastructure

Addressing informal urban sprawl as well as the provision of adequate infrastructure calls for inclusive and people-centred development strategies, flexible planning solutions, and efficient risk management. Effective planning interventions are based on the amalgamation of economic, environmental, and social dimensions. The provision of infrastructure should be cost-efficient, equitable and environmentally friendly. According to UN-Habitat (2018), integrating infrastructure and land-use planning tends to minimize infrastructure costs by restraining the extension of physical infrastructural networks and optimizing the size of the population served. Effective planning interventions call for the engagement of all main stakeholders as well as vertical and horizontal collaboration in government agencies, NGOs and private institutions. Planning interventions that address informal urban sprawl and the provision of infrastructure are discussed below.

2.7.1 Interventions that Address Informal Urban Sprawl

Informal urban sprawl significantly impacts the provision of adequate infrastructure to the urban population. Therefore, it is crucial to address it to improve the provision of infrastructure. To deal with unplanned urban growth, there is a need to understand the leverage opportunities and underlying conditions of land tenure (UN-Habitat, 2018). It is important to recognize and settle land tenure issues to enable long-term physical and social infrastructural investments. Building structures on pieces of land with unconfirmed ownership states or disputed tenure limits development. Bekele (2005) identifies smart growth as the solution to informal urban sprawl. The term ‘smart growth’ was invented in the United States of America to address unplanned urban expansion in the country.

The smart growth concept constitutes sustainable utilization of existing resources, channeling development to areas that have the prevailing physical infrastructure, and building on existing urban assets to advance urban development and redevelopment. As a result, less land is utilized for the housing, roads and commercial buildings. Smart growth encourages mixed-use zoning, high-density development, reduced reliance on private cars, preservation of open spaces, and revitalization of older infrastructure. By applying smart growth, American planners confirmed that they were able to control informal urban sprawl in some states (Bekele, 2005). By

implementing the smart growth concept, it is possible to confine more people into existing urban areas and ultimately curb informal urban sprawl in developing countries such as Kenya.

Turok (2011) notes that implementing smart growth in cities requires three key elements; state-driven processes that will avail land for development; financial actions to influence household and location preferences; and government incentives for market producers. Developing countries like the United States have previously applied these measures to achieve smart growth in their cities (Bekele, 2005). However, it may take a long time for developing countries to realize smart growth due to a strain on the financial resources needed to reform land tenure through participatory planning processes (Alnsour & Meaton, 2009). Additionally, financial resources are needed to buy and avail land for development. This challenge implies that zoning is currently the most feasible option for most developing countries to curb unplanned developments.

Zoning is a planning and management tool that synchronizes the built environment and creates well-designed real estate markets (Maantay, 2001). Zoning involves apportioning land that contains the legislative region of a local authority into segments, allowing specific land uses on certain sites to form the urban area's layout and permit several types of land use developments. This process determines the location, size, and utilization of structures, and regulates the density of city blocks (Maantay, 2001). Jean-Paul Rodrigue (2020) identifies four categories of land use zoning; form-based zoning, functional zoning, incentive zoning, and intensity zoning. Form-based zoning defines zones based on their physical features, mainly from an urban identity view, such as the uptown or downtown area. Functional zoning defines zones according to their function, such as industrial, residential or commercial. Every zone category has specific regulations based on the activities taking place in the zone to increase efficiency and alleviate externalities linked to incompatible land uses.

Incentive zoning occurs as part of development or revitalization plans where authorities allow developers to build manufacturing, commercial, or residential projects in certain areas by giving incentives such as basic infrastructure (public transport services, utilities, roads) or tax abatement. The authorities can also grant developers lower restrictions on density limits if they develop infrastructure and social amenities such as parks (Jean-Paul Rodrigue, 2020). Intensity zoning categorizes zones according to the acceptable intensity levels such the permitted

commercial surface or quantity of residential units per unit square metres. This type of zoning provides developers with the flexibility of choosing their preferred types of developments, as long as they are permissible in the specific area. This process also sets minimum development measures to prevent the uneconomical usage of real estate. Generally, zoning provides opportunities to slow down or stimulate development in certain areas to prevent informal sprawl (Shertzer, Twinam & Walsh, 2022). In Kenya, zoning is effected using zonal regulations and plans that focus on the sizes of plots, the types and density of land uses and buildings, and the size and height of buildings. Ayonga (2019) points out that zoning of land in Kenya failed since post-independence land use laws encouraged future development while ignoring existing informalities. Therefore, development proceeded without planning and the situation could not be reversed easily. The main development control tool in the Makongeni neighbourhood is the Thika town Integrated Strategic Urban Development Plan (ISUDP). It entails zoning and development control regulations for the area, including minimum plot sizes, setbacks, packing space requirements, and plot ratios. However, there is a need to improve the enforcement of zoning regulations to curb sprawl.

Appropriation of land is another planning intervention that is used to guide developments in urban areas. Sjaastad & Bromley (1997) define land appropriation as a legal process of shifting the purpose of land to another statutory purpose, on condition that the land is no longer needed for the initial use. In the appropriation process, local authorities convert specific third-party property rights to a compensation payment to facilitate development, as per the planning permission. The authorities either transfer the land allocation from its current purpose to another planning purpose or acquire land for planning purposes (Sjaastad & Bromley, 1997). In Kenya, the constitution decrees the National Land Commission to manage public land on behalf of the county and national governments, among other functions. However, the Constitution does not stipulate how the commission should discharge its mandate to ensure that access, control, and ownership of land are efficiently managed (Koissaba, 2016). The nature and complexity of ethnic-based, economic and political interests in land issues in the country challenge the management of land. Pratomo, Samsura & Krabben (2020) point out that land appropriation should bring significant improvement to the local people's livelihoods and improve their social, environmental, and economic well-being. In developed countries, especially Europe, local governments successfully acquire land through compulsory acquisition to prevent agricultural

land from being converted to urban land uses (Samsura & Krabben, 2020). Such processes coordinate urban growth and encourage sustainable sprawl. Land appropriation in the study area is applicable since the Community Land Act permits the compulsory acquisition of public land in Kenya. Though, for this process to be successful, the amount of compensation that the local authorities give to the landowners should be equal to or higher than what the developers offer the landowners. Ayonga (2019) explains that nationalizing development rights to allow the national and local governments to govern the types of development in specific areas through planning solves the issues of compensation. Additionally, public participation is key to appropriation and land use development.

Transfer of Development Rights (TDR) is also an effective way of addressing sprawl. TDR is a zoning strategy that protects land with conservation value, such as, green spaces and farm land, by diverting the intended development to a planned zone that accommodates growth and development (Kaplowitz, Machemer & Pruetz, 2008). This strategy involves compensating the land owner for choosing to forgo developing their land. The land from which the owner sever their development rights is protected through a restrictive covenant or conservation easement. This strategy is effective in preventing sprawl and its detrimental effects. For this process to be successful in Kenya, local authorities require sufficient finances to adequately compensate the land owners.

2.7.2 Interventions that Enhance Provision of Infrastructure

2.7.2.1 Theoretical Foundation of Infrastructure Provision

Frischmann's Infrastructure Theory

This theory provides economic insights into why some vital resources should be managed and sustained in an openly accessible manner, as opposed to private control. The approach focuses on demand-side considerations and explores how infrastructure resources create value for consumers. Economists propose two generalizations regarding traditional infrastructure (Frischmann, 2004). First, the government plays a vital and widely-accepted part in guaranteeing the delivery of various traditional infrastructures such as transport and communication networks. Although markets and private parties play a crucial role in providing traditional infrastructure (through public-private partnerships), the role of the government as the provider, regulator and coordinator of traditional infrastructure stays intact in many societies. Second, traditional

infrastructures are commonly regulated in an openly accessible way in which all community members who wish to utilize them may do so. For instance, roads, water supply connections, and communication lines, either publicly or privately owned, usually operate as common carriers that intersect and serve the public in a non-discriminatory way. Three main insights that emerge from this theory are; (i) infrastructure resources are essential resources that produce value when utilized as inputs in various production processes, (ii) the yields from these productive processes are usually non-market and public goods that create positive externalities that profit society, and (iii) managing infrastructure in an openly accessible way is socially desired if it enables the downstream activities (Frischmann, 2004). This theory applies to the provision of infrastructure in sprawling cities in developing nations such as Kenya.

2.7.2.2 Interventions that Enhance Provision of Adequate Roads

The informal sector in most urban areas in developing republics makes the streets vibrant due to the presence of hawkers and vendors. As a result, these streets experience congestion and road-user conflicts. UN-Habitat (2018) recommends that adopting a suitable street design at various levels of the transport network improves the efficiency of road transport. Roads should be designed in such a way that they accommodate all road users; transit riders, pedestrians, cyclists and motorists. There is a need to set aside sufficient space for non-motorized transport, such as bike lanes and walkways. Modal split ensures each mode has its space/lane in the transport corridor and thus addresses user conflicts (Brost, Funke & Lembach, 2018). Integrating spatial and infrastructure planning, public transport as well as financing and commerce is crucial in ensuring adequate provision of road infrastructure. The transit-oriented development approach integrates the above-named critical elements with an aim of bringing people closer to services while at the same time minimizing the dependency on private vehicles.

The transit-oriented development approach consolidates transport plans and land use plans, in which public transport confluences are located near high-density mixed-use areas (Singh et al., 2014). According to UN-Habitat (2018), an efficient public transport system minimizes the dependence on private cars and overcrowding in urban areas, while making transport affordable. Therefore, to improve the efficiency and affordability of public transport in sprawled areas, there is a need to engage with the informal transport sector, such as *matatus* in Kenya, to make reforms and reorganize the system. A good example of high quality and high-

capacity mass transport system is the Bus Rapid Transport system. Investing in appropriate car parking policies minimizes congestion on the roads, which is usually caused by reckless parking on the roads, especially by public transport vehicles.

2.7.2.3 Interventions that Enhance water supply and sewerage networks

Planning interventions to enhance water supply can be applied at many stages along the supply pattern from the source to the consumer. These interventions include protection of the source, mechanical abstraction, as well as proper storage, treatment and distribution facilities (Pedley, Pond & Joyce, 2011). The World Health Organization recommends that adopting technologies such as piped household water connections, rainwater harvesting, public taps, boreholes and wells improve water supply in sprawled areas. The residents of sprawled areas often consume groundwater which is unsafe. Pedley, Pond & Joyce (2011) recommend that the construction of barriers around the abstraction points protects the quality of groundwater. Additionally, wastewater should be treated and used again for urban agriculture and green space management.

Abuya, Oyugi & Oyaro (2019) note that proper running of water supply infrastructure necessitates better equity in distribution, improved accessibility, enhanced quality, reliability and safety as well as sufficient quantities with appropriate smell, taste and colour. Coordination of different interested parties such as government agencies, NGOs and CBOs is crucial in ensuring that water is accessible to all people, including disadvantaged groups. With the growing population in urban centres, water supply and sewerage networks should be expanded to accommodate the population.

2.7.2.4 Interventions that Improve Provision of Solid Waste Infrastructure

Informal urban sprawl often leads to inadequacy or total lack of solid waste infrastructure that includes collection bins, solid waste transport systems as well as recycling facilities. Al-Khatib et al. (2009) note that increasing the number of litter bins in public spaces and on the streets minimizes littering. Hazra & Goel (2009) emphasize that currently, solid waste enclosures overflow with wastes and release a bad odour to the environment. To curb this problem, waste collection agencies should design the enclosures by overestimating the waste generation instead of underestimating it. Upgrading of transport equipment such as tracks should be done by the relevant solid waste collection agency to improve the efficacy of waste transportation.

Additionally, the waste collection should be conducted more frequently to prevent the buildup of solid wastes in residential and commercial areas.

In his study on solid waste management in Africa, Oteng-Ababio (2011) notes that it is significant for local communities to coordinate and put in place common waste management disposal and recycling stations to improve waste management. Through such initiatives, there would be a creation of informal employment and a reduction of resources and money used in solid waste management. The creation of landfills that cross-cut the environmental, economic and social needs of local communities also improves solid waste management in sprawled areas.

2.7.2.5 Interventions that Enhance Provision of Food Market Infrastructure

According to the FAO (2020), market infrastructure, services and facilities are significant components of the food distribution and supply system. Therefore, they must be correctly planned, managed, maintained and developed to accommodate the growing population and demand for food. Equipping the food markets with modern stalls, refrigeration facilities, proper storage equipment, solid waste collection points and suitable sanitation facilities improves the quality of food traded in the markets. Proper lighting is also required in the market areas to improve security. Skinner (2016) notes that it is important for planners to consult food vendors during the creation of appropriate designs for the market and its infrastructure.

2.7.2.6 Interventions that Improve Provision of Social Infrastructure

In this study, social infrastructure refers to housing, open spaces, medical facilities and schools. UN-Habitat (2018) recommends that in order to realize affordable housing for everybody in sprawled areas, there is a need to adopt an integrated housing and land use plan, as well as financing strategies. Together with sufficient institutional capacity, it is possible to provide quality housing to the urban population. Rather than concentrating only on the quantity of housing units constructed, it is also important to focus on the creation of neighbourhoods and the quality of space. Currently, in Kenya, major urban areas are characterized by informal settlements caused by informal urban sprawl. To address this problem, UN-Habitat (2018) recommends two approaches: infill housing approach and redevelopment. The infill housing approach features developing underutilized and vacant land in built-up areas to increase the housing supply.

Through the infill development approach, there will be enhanced compact development, minimized informal urban sprawl, maximized utilization of existing infrastructure and minimized distances from residential areas to workplaces as well as social amenities (Tiitu et al., 2018). This type of development approach also features upgrading of infrastructure due to the increasing population. The redevelopment approach features a conversion of land use, extension of infrastructure, and total reorganization of an area to provide adequate housing. This form of development approach requires public-private partnership in the distribution of infrastructure and services to the urban population. Using this method, low-income families living in slums can be relocated to upgraded settlements.

According to UN-Habitat (2018), the provision of adequate social infrastructure requires sorting out space and land constraints. Many urban areas in developing countries face a critical deficit in public social infrastructure due to the ineffectual governance of urban lands. For example, in Kenya, there have been many documented cases of forfeiture of public land originally set aside for the construction of public amenities. Therefore, there is a need for stakeholders to measure the quantity of available land, reclaim lost land and capitalize on the availability of land for the provision of social infrastructure. Additionally, there is a need to create an inventory of all public spaces to determine their adequacy and plan for their provision, for both the current and future generations.

2.8 Policy and Legal Framework

The allocation, usage, and development of any land in Kenya are administered by plans, policies and laws governing land use. The policy and legal frameworks play an imperative role in ensuring the sustainable development of land in the country. Therefore, it is vital to evaluate the policies and laws that pertain to urban sprawl.

2.8.1 Policies and Plans

i. **Sustainable Development Goals (SDGs)**

The SDGs provide a blueprint for sustainable global development (United Nations, 2015). Goal 11 on sustainable communities and cities declares that there is a need to transform the way we utilize our urban spaces. Due to growing population sizes in urban spaces, the quality of cities especially in developing nations has deteriorated. To build resilient economies and societies, SDG 11 calls for development strategies such as improving urban planning and management,

investing in infrastructure, improving green urban spaces, and enhancing public participation. SDG 11 recognizes that the current urban growth trends are unprecedented. As more people move into cities, there is a need to adopt strategies that will make cities sustainable.

ii. Agenda 2063

Agenda 2063 serves as Africa's strategic blueprint for propelling the continent towards becoming a dominant global force within the next 50 years (African Union, 2015). The master plan prioritizes inclusive social and economic development, democratic leadership, and other issues that will reposition Africa to become a dominant continent. Africa's common agenda centres on infrastructure development, agri-business, health and education, and value addition. Agenda 2063 has several projects such as the high-speed train system project that aims at improving urban livability. As more people in Africa move into the cities, there is a need for the establishment of more infrastructure. Agenda 2063 provides a blueprint for developing infrastructure to achieve sustainability.

iii. Kenya Vision 2030

Kenya's national long standing development blueprint, slated to achieve a globally competitive and prosperous nation with a high standard of living by 2030, strives to transform the country into a newly industrialized, middle-income nation that guarantees a high quality of life for all its citizens in a secure and environment. The Vision 2030 comprises of economic, social and political sectors that are based on the practicalities economic growth, infrastructural development, innovation and technology, and land policies (Government of Kenya, 2007). Although there has been a substantial improvement in infrastructural provision in the country, Vision 2030 notes that there is still a huge infrastructure deficit, and aims to address the issue by implementing targeted programmes and projects.

iv. The Big Four Agenda

This is a development scheme whose main themes are affordable housing, food security, affordable healthcare and manufacturing (KIPPRA, 2021). The government aims at establishing more affordable homes and increase food production to enhance food security in the country. The government is also enhancing manufacturing to ensure that the sector will contribute 20% of the Gross Domestic Product. Additionally, the government aims to achieve universal health

coverage by investing in health facilities. The Big Four Agenda drives the Kenya Vision 2030 Third Medium Term (2018-2022) which aims to improve Kenya's economy by a 10% growth rate. Currently, the government is implementing affordable housing projects in various regions of the country under the Big Four Agenda to solve housing challenges caused by urban informality.

v. National Land Policy (NLP) of 2009

This policy guides the state towards well-organized, sustainable, and rightful land utilization for prosperity and the benefit of future generations. It intends to; promote constructive land reforms that improve the livelihoods of Kenyans through the establishment of accountable and transparent laws, institutions, and structures dealing with land (Government of Kenya, 2009). Generally, the objective of the NLP is to protect rights over land and provide for sustainable growth, investments, and minimize poverty as per the Government's overall development intentions.

vi. National Land Use Policy (NLUP) of 2017

This is a statement of intent that outlines long standing objectives for land use management (Government of Kenya, 2017). It is the key to the realization of the SDGs, Vision 2030, and the Big Four Agenda. It addresses issues linked to land resources and their utilization by outlining principles and procedures for proper land management to uphold sustainable development.

vii. National Urban Development Policy (NUDP) of 2016

The policy distinguishes planning as a fundamental instrument in bringing urban development and revolution in the nation. It has an important role to play in the regulation of urbanization in the country. The policy further enunciates the role of planning in synchronizing land use activities through public participation to protect public interest (Government of Kenya, 2016). It provides a structure for the planning, development, and management of various social and physical infrastructures.

viii. National Spatial Plan (NSP) (2015-2045)

The NSP backs the execution of strategic national projects, precisely the Kenya Vision 2010 flagship projects (Government of Kenya, 2016). The plan indicates the spatial locations of the projects and provides a structure for sectoral planning to link physical and economic planning.

The NLP, NLUP, NLUDP and the NSP recognize that urban areas in Kenya are growing at a rapid rate, and attribute the growth to high population growth, poor implementation of plans, inadequate enforcement of development control, and improvement in transportation networks. The plans note that urban sprawl in cities and towns has led to land use conflicts, pollution of land, water, and air resources, incompatible land uses, and loss of agricultural land. Therefore, they provide frameworks for sustainable planning and infrastructure provision.

ix. Kiambu County Integrated Development Plan (CIDP) (2018-2022)

CIDPs adhere to the County Government Act of 2012 (Articles 108, 112 and 113) by providing a development blueprint for counties. The Kiambu CIDP is aligned with Vision 2030 and facilitates the implementation of the flagship projects and other projects that will enhance the achievement of Vision 2030 (County Government of Kiambu, 2018).

x. Thika town Integrated Strategic Urban Development plan (2015-2035) and Thika Municipality Spatial Plan (Integrated Urban Development Plan)

These plans are development blueprints for Thika town and Thika Municipality respectively. The plans play a key role in regulating urbanization and strengthening infrastructural and service delivery in the Makongeni neighbourhood and the whole county (County Government of Kiambu, 2018).

2.8.2 Legal Framework

Under Article 43, the Constitution of Kenya grants its people the right to a healthy and safe environment, sustainable environmental protection for all generations, high quality health standards, access to adequate housing, equitable sanitation standards; and clean adequate water (Government of Kenya, 2010). Article 60(1) states that land in Kenya should be utilized and managed in an efficient, equitable, safe, productive and sustainable manner. This aligns with the National Land Policy. It further outlines the principles of land policy which include; the rightful access to land, protection of land rights; sustainable administration of land resources; transparent and economical land administration; comprehensive conservation of ecologically sensitive zones; eradication of gender discrimination in law, and land-related customs and practices; and encouraging land dispute settlements through lawful local community initiatives. The statutes of the Constitution are discussed below.

i. Physical and Land Use Planning Act

It guides the substantive and procedural aspects of physical and land use planning at various scales. Section 46 of the Act encompasses the purposes of the local physical and land use plans. They include; zoning, urban renewal, or redevelopment; guiding and coordinating the development of infrastructure; and regulating the land use and land development (Government of Kenya, 2019).

ii. County Government Act

The Act specifies the principles and objectives of planning, and mandates counties to develop county spatial plans, county integrated development plans, county sector plans, and city or municipal plans (Articles 108, 109,110,111). The plans control development at the county level and localize national and regional plans (Government of Kenya, 2012). They classify land uses and priorities for service delivery and infrastructure investments; fortify relations between towns, cities, growth centres and their hinterlands; and direct cohesive county development and sustainable human settlement structures.

iii. Urban Areas and Cities Act

The Act provides a framework for the conferment of urban areas into town, municipal ad city status (Articles 7, 9 and 10). Article 6 focuses on infrastructure provision and management in cities. The Act also outlines the governance structures for urban areas which are regulated by Boards of cities and municipalities. The Act also encompasses the rights of the residents in the management of urban areas (Government of Kenya, 2019).

iv. Land Act of 2012

This Act identifies forms of land tenure as freehold, leasehold and customary (Article 5), and provides strategies on land management and institutions (Article 6). The Act also addresses the acquisition and conversion of ecologically sensitive public land (Articles 11, 12) (Government of Kenya, 2012).

v. The Land Value (Amendment) Act, 2019.

The Act outlines the land tenure schemes; leasehold and freehold, and provides the land value index for each land type (Articles 107A, 107B) (Government of Kenya, 2019).

The legal context for planning and development control has some limitations. First, the 2010 constitution does not stipulate the acceptable minimum land sizes, an aspect which contributes to land use conversion and urban sprawl. Also, it does not recognize the existing urban informality in Kenya. Second, the PLUPA and County Government Act do not state the systematic duration and order for preparing and implementing plans. Additionally, the planning laws create ambiguities and overlap in decision-making. These factors exacerbate urban informality.

2.9 Case Studies of the Best Approaches to Urban Sprawl and Infrastructure Provision

2.9.1 The Finger Plan of Copenhagen

Meynard (2016) identifies the Finger Plan of Copenhagen as a best practice for controlling the development of an urban area. Established in 1947, the initial aim of this plan was to control and organize the extension of Copenhagen city due to the rapid surge in population. Structured like a human being's palm, the plan focused on organizing the expansion of the city according to five construction corridors assimilating residential, business and recreational areas. Since the growth of activities in the city centre had created congestion, the Finger plan would redistribute the flow of activities and people in the city of Copenhagen. This plan improved the quality of life in the metropolis by creating attractive density to compact urban development to reduce the distance between different land uses in the city. With time, planners and researchers came up with designs that promote greener means of transportation in the city discourage the use of vehicles and promote cycling and walking.

2.9.2 Zurich's transit program

The reliable and easy-access nature of the city's public transport structures makes it one of the best transit programs in the world (Nash, 2003). In the city of Zurich, the majority of residents use public transport (trams and buses) to go to work, while the minority use private cars. The integration of multi-modal passes and urban management systems increases the efficiency of public transport. Not only does the transport management agency ensure that high-

frequency departures occur both day and night, but also that future developments in the city take place around the public transport lines. Additionally, development in the city is compact since there are short walking distances between residential areas, workplaces, schools, commercial areas and public amenities. The high-quality service of the public transport grid in the city has led reduction in greenhouse gas emissions, economic growth and enhanced social life.

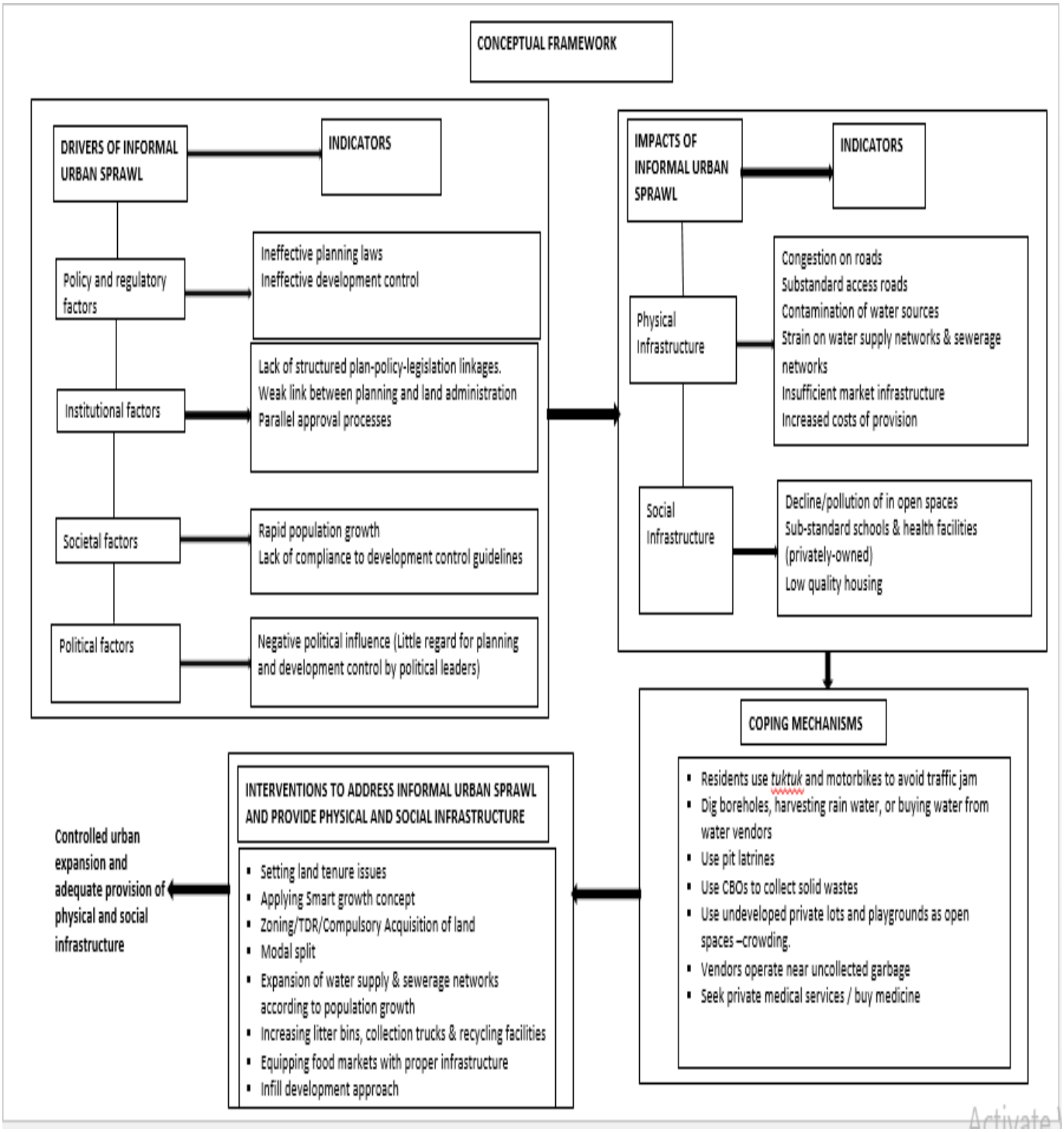
2.9.3 Solid waste management program in Latin America

Ciudad Saludable (Healthy City) is a non-profit association that has transformed solid waste management in Latin America (UN-Habitat, 2018). Currently, the organization works in Peru, Bolivia, Colombia, Venezuela, Mexico and Brazil. Not only does the organization efficiently collect, sort and recycle solid wastes, but it also empowers the local communities such as those living in informal urban sprawled areas through the provision of jobs. The organization collects approximately 290,000 tons of recyclable wastes, with a market value of approximately USD 18 million. Through this waste management program, the organization has tremendously improved environmental protection in Latin America.

2.9.4 Singapore's Urban Water Management

Singapore's water management structure integrates both water provision and wastewater management (Tortajada, 2006). The country has significantly invested in water and wastewater management infrastructure that ensures all residential and industrial areas have public sewerage systems in which residents and industries drain their wastewater. All households have access to adequate piped, clean water. Stormwater drainage systems in the country drain into reservoirs and rivers while wastewater drains into treatment and recycling plants. The separation of stormwater drainage and wastewater systems prevents pollution of water reservoirs. Before any development in Singapore takes place, planners scrutinize the proposals to ensure that the proposed structure will not damage the existing wastewater systems (Chiplunkar, Seetharam & Tan, 2012). Additionally, the law requires every developer in the country to connect to the available sewerage network.

2.10 Conceptual Framework



CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the types and sources of data, sampling techniques, data collection tools, description of variables for measurement, data analysis, and presentation techniques.

3.2 Selection of the Study Area

The study was conducted in the Makongeni neighbourhood, a residential neighbourhood of Thika municipality. In terms of geographical coverage, the Makongeni neighbourhood covers a total land mass of 10.2 sq. km (KNBS, 2019). Map 1 shows the boundary of the study area.

Map 1: Google Earth Image of Makongeni Neighbourhood

Source: Google Earth, 2021

3.3 Research Design

The research used a non-experimental research design. The study used both qualitative and quantitative research techniques. Quantitative research refers to the structured empirical study of perceivable phenomena via mathematical, statistical or computational methods. On the other hand, qualitative research encompasses several research methods that examine the what, when, where,

how and why activities take place. Qualitative research methods include observation and conducting one-on-one discussions. Specific activities undertaken in this study are the dissemination of household questionnaires, in-depth interviews with key informants, observation, use of grounded theory and examination of case studies.

3.4 Sampling Procedure

3.4.1 Target Population

The term 'population' in research refers to an inclusive group of individuals, objects, or institutions with common characteristics that interest a researcher. The target population entails all the persons and institutions involved in this study. They are; household members and developers in the Makongeni neighbourhood, and Kiambu county government employees (Thika municipality sub-county physical planner, development control officers in the Thika sub-county planning office, and the Kamenu ward administrator). The key informants were vital in providing critical information on issues affecting planning and the enforcement of development control and the provision of infrastructure in the neighbourhood. The household members and developers of the Makongeni neighbourhood were the main target population since they provided first-hand information on the research objectives. According to the 2019 Kenya Population and Housing census, the total population of the Makongeni neighbourhood is 86,581 persons (KNBS, 2019). The researcher used an accessible population (target population available) during the research process.

3.4.2 Sampling Plan

Sampling denotes the process of selecting a subset of a population to make statistical inferences from the sample and estimate the characteristics of the entire population. Mugenda & Mugenda (1999) define sampling as the methodical procedure of selecting some individuals for a study to represent the larger group. Sampling is cost-effective and time-convenient. According to the 2019 Kenya Population and Housing census, the total population of the Makongeni neighbourhood is 86,581 persons. The number of households is 32,756 households, and the number of group quarters is 96 (KNBS, 2019). Makongeni neighbourhood has a population density of 6076 persons per square km. (KNBS, 2019). To determine the sample size, the researcher implemented the stratified random sampling method that involved apportioning the whole population into homogeneous clusters called strata. The researcher selected random

samples from each stratum. The classification of the strata was based on high-density, medium-density and low-density parts of the neighbourhood, as shown in plate 2 below. This study used Slovin's formula to estimate the sample size since the confidence level was 95%. (Tejada & Punzalan, 2012).

Formula: $n= N/1+Ne^2$

Where n=sample size, N=total population and e=error tolerance.

Therefore, n=86, 581/1+ ($86,581x0.05^2$); n=398

Due to time constraints and inadequate finances, the researcher decided to sample 100 people (70 household members and 30 developers). The researcher considered that the sample size was accurate to provide the obligatory representativeness of the whole population.

Plate 2: Classification of Makongeni neighbourhood into three strata (Author's construct)

3.4.3 Sampling Techniques

The study used stratified random sampling (as discussed in section 3.4.2 above) and purposive sampling techniques to collect the data. Stratified random sampling was useful in collecting data from the household members and developers in the area. Purposive sampling was

useful in collecting data from key informants who are knowledgeable about planning, land and infrastructure issues in the Makongeni neighbourhood.

3.5 Data Collection

3.5.1 Types and Sources of Data

The study used both primary and secondary data. The researcher collected the primary data directly from the field (study area) and the secondary data through a document review of the dynamics of planning and developmental control in Kenya. The materials studied included books, internet resources, dissertations, reference materials, empirical and evidence-based articles, theses, conference papers, theses, magazines and journals, Landsat images, and Google Earth imagery. The secondary data helped rationalize why it was necessary to conduct this study, and identified data gaps and need. The data also aided in understanding the concept of informal urban sprawl and its impacts, previous planning efforts, and the guiding principles and legal framework. The secondary data facilitated the formulation of the conceptual framework.

3.5.2 Data needs Matrix

The data needs matrix entails the specific types of data needed (why informal urban sprawl occurs, impacts of informal urban sprawl on infrastructure provision, coping strategies, and planning interventions); data collection strategies; data sources and collection instruments; data analysis methods; and presentation methods. The data matrix facilitated a comprehensive data collection and analysis process. A comprehensive data need matrix is presented in appendix 1.

3.5.3 Data Collection Instruments

The data collection instruments used in this study were; household questionnaires, interview guides, observation checklists and key informant guides. The household questionnaires enabled the researcher to reach out to a substantial number of respondents within a short time. They also enhanced the confidentiality of the information given and reduced bias. The household questionnaire captured the demographic characteristics of the population and main areas of investigation guided by the research objectives. The researcher employed the interview guides to gather data from the developers in the Makongeni neighbourhood. The observation checklists were used in recording observed data such as land use forms, types and quality of infrastructure. The researcher used the key informant guides to gather specific information on informal urban

sprawl and the provision of infrastructure from various departments of the county government. They include the department of Land, Planning and Housing; Infrastructure, Public Works and Transport; Health Services; and Education. Secondary data was collected through desktop review.

3.5.4 Data Collection Process

The gathering of data began with the administration of household questionnaires to residents of the Makongeni neighbourhood and the administration of interviews to the developers in the neighbourhood. During this process, the researcher also collected features of interest using the observation checklist and photography. Thereafter, the researcher conducted interviews with the key informants to collect the relevant data.

3.5.4.1 Landsat Image Classification and Analysis for Land Use

Materials

The study adopted Landsat images for the years 1988 (Landsat 4-TM), 2003 (Landsat 7), 2015 (Landsat 8), and 2021(Landsat 8). To undertake land use/land cover change studies, NDVI was calculated using the red and near-infrared bands. The features of interest were vegetation, built-up area, bare land, and water body. The red and near-infrared bands combination was used for Landsat 2 (5, 6), Landsat 4 (3, 4), Landsat 7 (3, 4), and Landsat 8 (4, 5) respectively. ArcGIS ArcMap 10.7 software environment was used for the studies.

Method

The method of analysis entailed downloading Landsat images from earth explorer, extracting and storing them in a folder, running ArcMap software and loading the red and infrared bands, and running NDVI using the image analysis tool based on band wavelength. The analysis process also entailed using a data management tool to clip the imageries to the zone of interest and running the re-class tool on the data management spatial analyst tool to determine the number of classes needed and allow for statistical analysis. The next step was opening the attribute table and adding class type and area fields, editing the raster, inputting class type, and calculating the area of each class by multiplying class count by 900m2 i.e., 30m by 30m cell size, and exporting the table to excel or add it as a legend to the map. The images were processed

under the same parameters, using wavelength and the same number of classes for the area of interest to ensure the same characteristics.

3.5.5 Validity and Reliability

This research aimed to establish why informal urban sprawl occurred in Thika municipality, its effects on infrastructure provision in Makongeni neighbourhood, and the coping mechanisms of the residents. The researcher aimed at collecting accurate field data. Therefore, the researcher administered eight questionnaires during the reconnaissance visit to the neighbourhood, and thereafter analyzed the data to determine any obscurities in the data collection instrument. The researcher made changes to the questionnaire by adding some relevant questions to enhance validity and reliability.

3.5.6 Ethical Considerations

Ethics has vital implications for data collection and analysis during the research process. Therefore, the researcher maintained ethics with regard to privacy, data confidentiality, anonymity, and honesty. The researcher clarified to the respondents that the study was for academic purposes. The respondents participated voluntarily and were free to decline since they had informed consent to decide whether to partake in the research or not. The researcher guaranteed the respondents' privacy and anonymity.

3.5.7 Response Rate

Table 6 illustrates the response rates of various types of respondents from the fieldwork. The overall response rate was 94%.

Table 1: Response Rate

Research Tool	Expected Replies	Received Replies	Response rate
Household questionnaires	70	66	94%
Developers' questionnaires	30	25	83%
Key informant guides	4	4	100%

Observation checklists	35	35	100%
Total	138	124	94%

Source: Author

According to Mugenda & Mugenda (2003), a 50% response rate is acceptable for data analysis and reporting, and a 60% response rate is good. However, a response rate of 70% and above is excellent. Therefore, this study's response rate of 94% was suitable for conclusive data analysis and reporting.

3.6 Data Analysis and Presentation

Both quantitative and qualitative methodologies were used for data analysis. Quantitative data from the questionnaires were coded and entered into the computer for the computation of descriptive statistics. SPSS version 26 was used to analyze descriptive statistics, for instance, percentages and frequencies used present the quantitative data in form of graphs and tables. The qualitative data produced from open-ended questions were classified into themes according to the research objectives and presented in a narrative form together with the quantitative presentation.

CHAPTER FOUR: THE STUDY AREA

4.1 Introduction

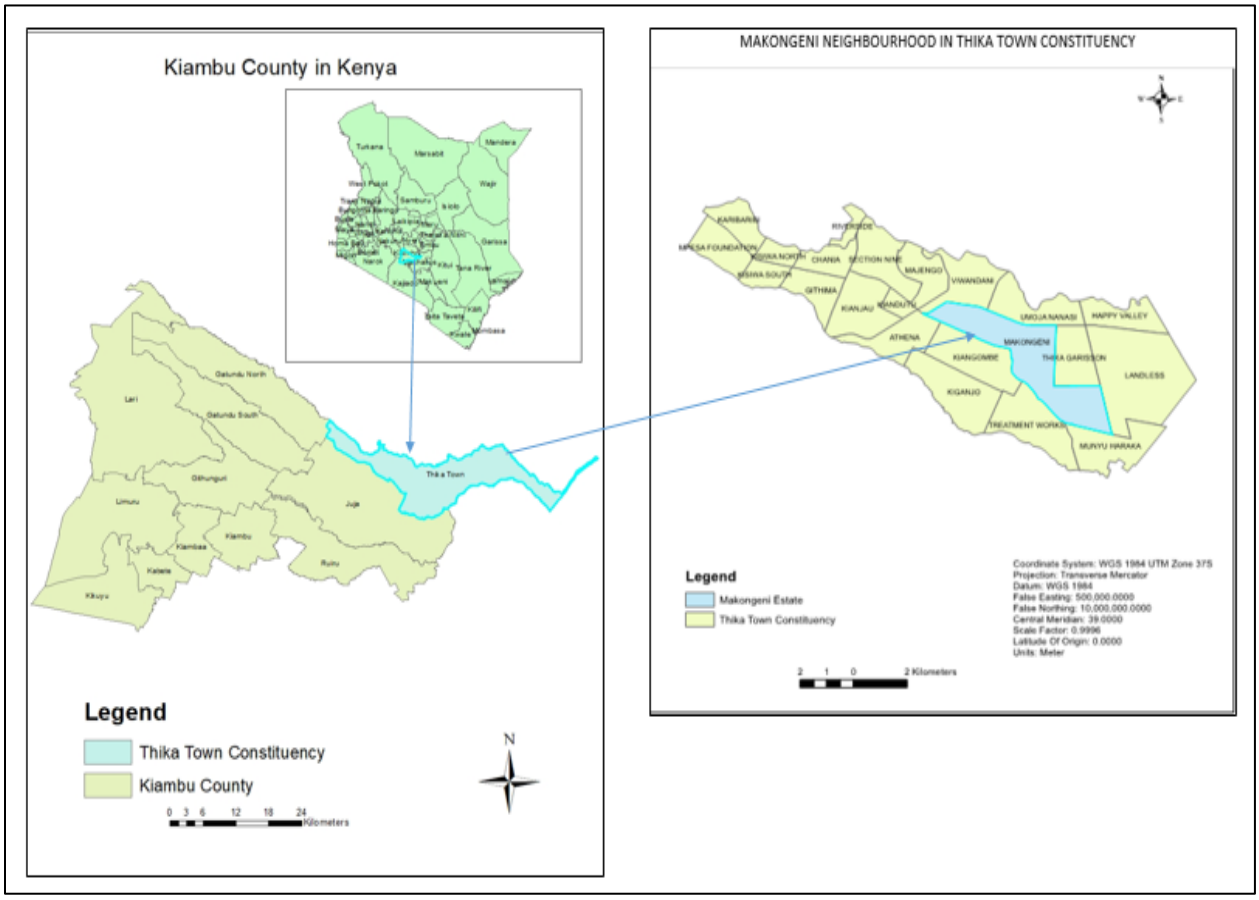
This chapter presents the background data on the historical, geographical and social characteristics of the Makongeni neighbourhood. More specifically, the chapter covers the location and size, physiographic conditions, infrastructure, and administrative and political units of the neighbourhood.

4.2 The General Setting of the Study Area

4.2.1 Location and Size

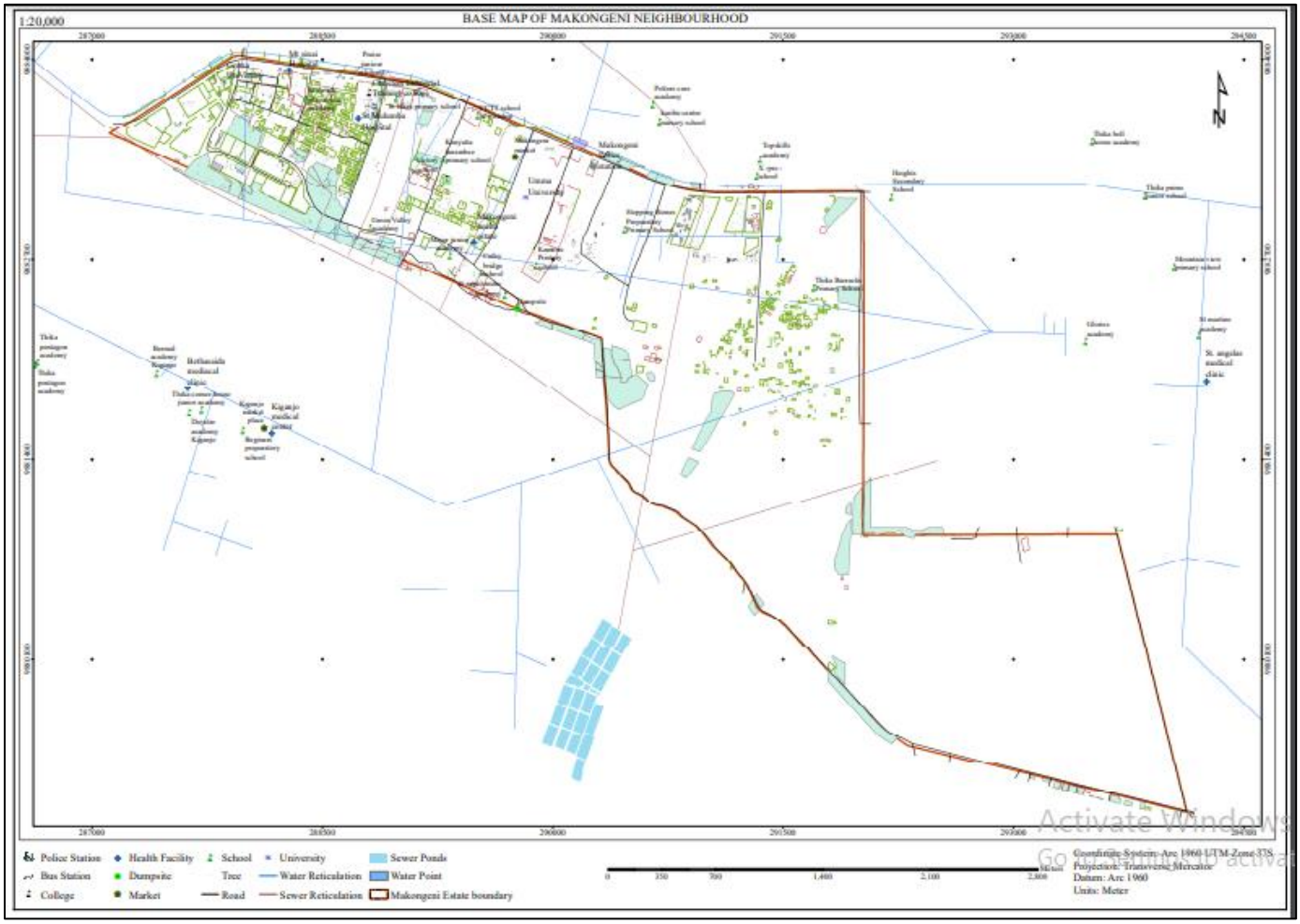
Makongeni neighbourhood is located in Kiambu County, Thika Municipality, Thika town constituency, Kamenu ward. Makongeni neighbourhood lies between $1^0$04’09.02” S and $37^0$07’09.34” E. The neighbourhood has a total land mass of 14.2 sq. km. It borders Garissa road, Kiandutu and Kiangombe neighbourhoods. The neighbourhood is located on a gentle plain before the ascension into the central highlands. Makongeni neighbourhood has small valleys on the northern and western edges due to the Thika and Chania Rivers that meet on the northwestern part of Thika town.

Map 2: Map of the study area



Source: Author's construct

Map 3: Basemap of Makongeni neighbourhood



Source: Author's construct

4.2.2 Historical Development of the Study Area

Makongeni is a residential neighbourhood of Thika town. Thika is an industrial town in Kiambu County, situated on the A2 road 40 km northeast of Nairobi, near the convergence of the Thika River and Chania River. Just before the end of the 19th century, foreigners started settling in this outpost as an expedient resting spot between Nairobi and the upcountry highlands for British settlers. Europeans and Asians settled in Thika, the former setting up farms and the latter shops. The British erected a monument in the shape of a pillar in the early 1900s in Thika CBD, commemorating the launch of Thika as a town. The government gazetted the town in 1924. When the nation became independent in 1963, it was promoted to a municipality, and the first

mayor was chosen in 1968 (Thika ISUDP, 2015). Makongeni is one of the oldest residential neighbourhoods in the Thika Town constituency.

According to UN-Habitat (2018), the Kenyan government planned schemes to deliver serviced plots to specific recipients, mostly low-income earners, due to the rising housing challenge in the 1970s. The schemes were planned for the Makongeni neighbourhood in Thika and Dandora and Umoja neighbourhoods in Nairobi. The government conceptualized that Makongeni would accommodate 60% of Thika's projected growth. Although the projects were not entirely effective as planned, they marked a milestone in Kenya's planning system. Efforts towards planning and investments in infrastructure expedited new urban areas for development during this era.

Map 4: 1982 Thika Structure Plan (Source: Ministry of Lands and Physical Planning)

4.3 Demographics Dynamics

Makongeni neighbourhood has a total population of 86,581 persons (KNBS, 2019). The total number of males in the neighbourhood is 43,752 persons, while the females are 42, 823 persons. The area has 32,756 conventional households and a population density of 6076

individuals per square kilometre. In 2009, the Kamenu ward (in which the Makongeni neighbourhood is located) had a total of 74,149 persons (KNBS, 2009). Makongeni neighbourhood had approximately 24,716 persons. The high population growth rate in the Makongeni neighbourhood is attributed to industrial and commercial development in and near the neighbourhood that attracts more labour force (Field survey, 2021). Additionally, the establishment of tertiary institutions such as Gretsa University, Umma University, and Riwan College of technology led to an influx of students in the area.

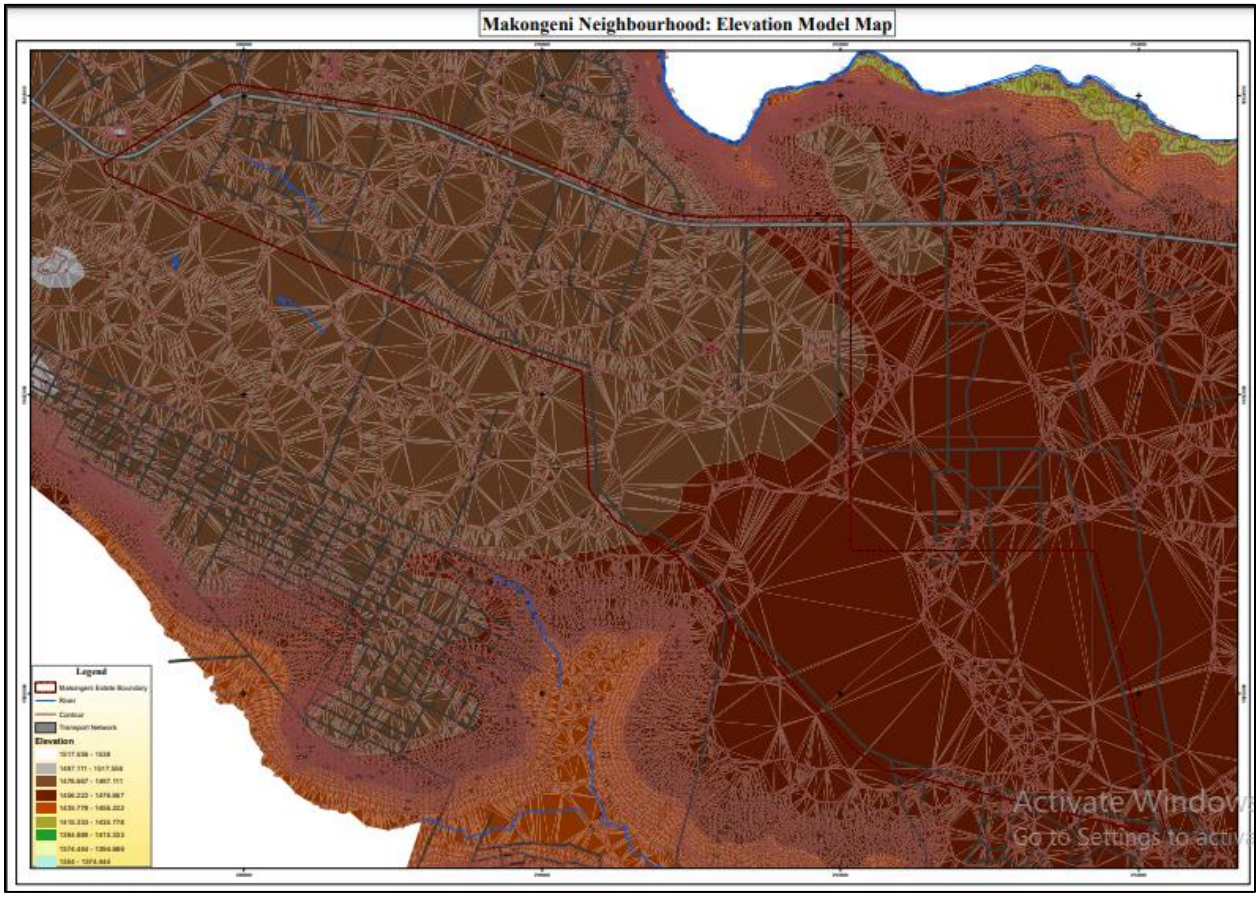
4.4 Physiographic and Climatic Features

Generally, development starts from one point and spreads to other areas, depending on diverse structuring elements such as physiographic and environmental characteristics. Topography and environmental features are vital in understanding land use special patterns and impacts of human activities on open spaces (Levin, Singer & Lai, 2013). With this regard, this section outlines the topography and environmental settings of the Makongeni neighbourhood.

4.4.1 Topography and Drainage

Makongeni neighbourhood is situated in the lower midland region of Kiambu county on a gentle plain. The area slopes gently from the southeastern part to the northwestern part. Overall, the neighbourhood slope ranges from 1435.778 to 1476.667 metres above sea level. Development in the neighbourhood mainly occurs in the North and Western parts of the neighbourhood since the area is relatively flat.

Map 5: Makongeni neighbourhood elevation model

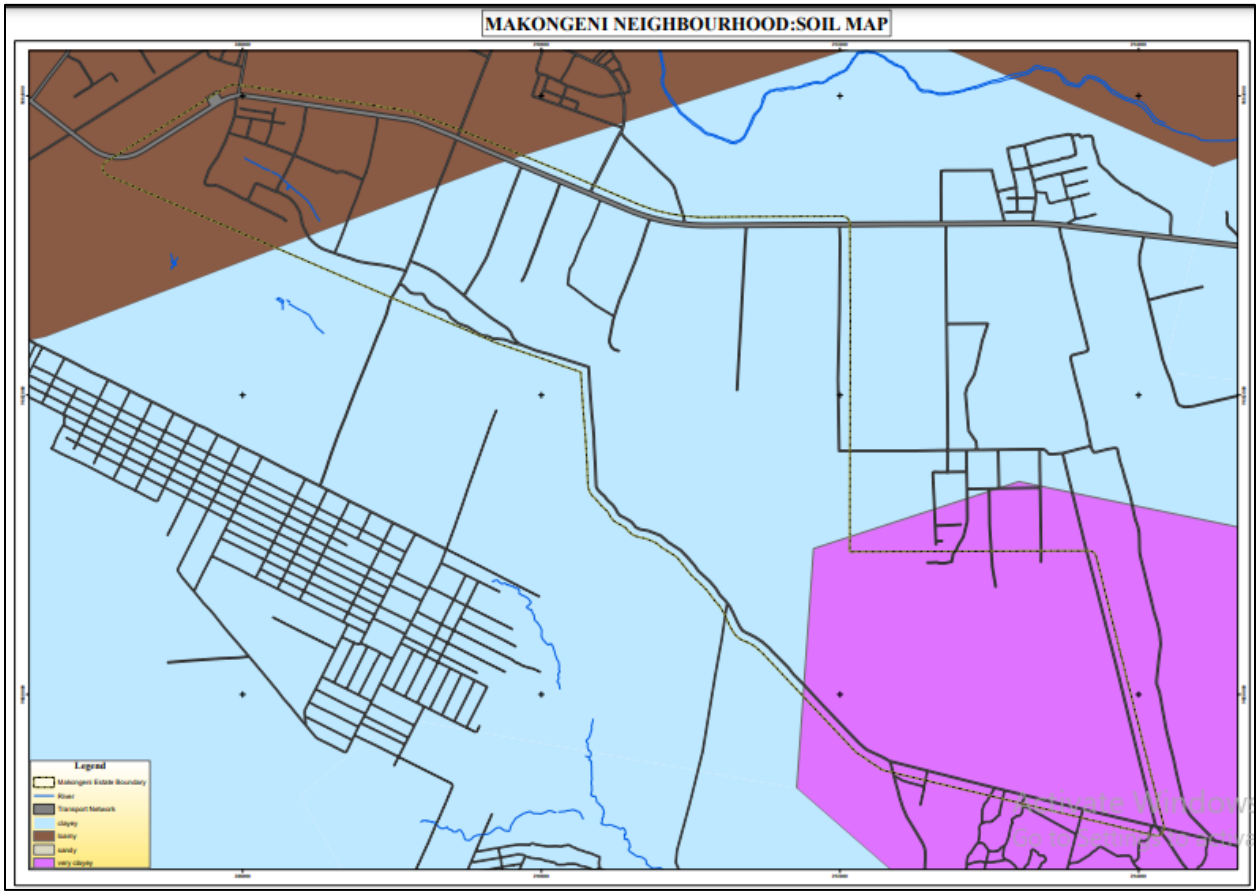


Source: Author's construct

4.4.2 Geology and Soils

The geology of Thika Municipality (including the study area) mostly encompasses volcanic rock Tertiary to Pleistocene, underlain by ancient (i.e. Pre-Cambrian) Basement rocks that are mostly gneisses (CIDP, 2018). The rocks are a source of building materials. Makongeni neighbourhood has loamy soils in its Northern part, clayey soils in its central part and very clayey soils in its southern part. The loamy and clayey soils support development while the very clayey soils hinder development in the neighbourhood's southern part.

Map 6: Makongeni neighbourhood soil map



Source: Author's construct, 2021

4.4.3 Climate

Makongeni neighbourhood experiences a bi-modal form of rainfall. The long rains fall between Mid-March to May followed by a cold season usually with drizzles from June to August, and the short rains between mid-October to November. The average rainfall received by the area is 1,200 mm. The average temperature in the county is 26°C. July and August are the months during which the lowest temperatures are experienced, whereas January to March is the hottest months. The area's average relative humidity ranges from 54 per cent in the dry months and 300 per cent in the wet months of March up to August (CIDP, 2018).

4.5 Socio-economic Profile

The predominant economic activities in the study area are industrial manufacturing and processing activities, wholesale and retail business activities, and small-scale farming.

Makongeni neighbourhood has experienced immense economic growth over the past few decades. Economic growth refers to a rise in the production of economic services and goods over a period of time (Kuznets, 1973). Indicators of economic growth in the Makongeni neighbourhood include; the establishment of industries, growth of commercial developments, higher incomes, advancements in transportation networks, growth of real estate, increased private car dependency, and establishment of more private education and health centres. Industries located in the Makongeni neighbourhood include; Capwell Industries Limited, Chania Feeds manufacturing industry, Maycorn maize meal company, Homecare industrial detergents chemicals, Jungle Nut Kenya, Avoil Industries Limited, and Ngwawama timber yard. These industries were established within the last three decades. The neighbourhood has also experienced rapid commercial developments within the last decade. Similarly, the real estate industry in the neighbourhood has increased within the last four decades, evidenced by the increase in the neighbourhood's built-up area. Additionally, there are multiple private education and health centres in the area. The field survey revealed that cheaper land rates were the main cause of urbanization and economic growth in the neighbourhood. Investors, developers, and residents decided to settle in the neighbourhood due to its proximity to Thika town CBD and cheaper land rates. In the 1980s and 1990s, an acre of land in the neighbourhood cost between Ksh 40,000 and Ksh 100,000. In 2021, the cost of an eighth of an acre is approximately Ksh 3 million. These findings resonate with Ernest Burgess' concentric zone theory and William Alonso's theory of location and land use (bid rent theory).

The concentric zone theory states that cities develop and grow outwards in concentric zones (Reiffenstein, 2017). Both physical land use patterns and human relationships impact the zones. As cities expand, the interaction among human beings and their social, economic and political systems also create radical outward expansion and shape the concentric zones. As people migrate into the city, there is competition for limited space. Those who can afford to pay high amounts of money get advantageous locations for their homes and businesses. The bid rent theory explains how much different sectors of the economy are prepared to pay for the land. This theory applies accessibility requirements to the city centre for industrial, commercial and residential land uses. Every land use type has its bid rent curve or rent gradient. The curve sets the highest rent amount that any type of land use will produce for a specific location. Industries, commercial facilities and houses compete for locations based on each bid rent curve and accessibility to the city

centre. For example, since land is cheaper at the city's periphery, people who do not need to access the city often will settle at the city's fringe. Those who settle at the periphery tend to be wealthier. People who require to access the city's centre more often settle near the city and compete with industrial and commercial establishments for space. These settlements form a segregated land use system.

Plate 3: Industries in Makongeni neighbourhood

Source: Field Survey, 2021

Plate 4: Commercial developments in Makongeni neighbourhood

Source: Field Survey, 2021

Although the neighbourhood has experienced immense economic growth over the past few decades, it features haphazard mixing of incompatible land uses that bring undesirable effects such as congestion, noise, longer commuting periods, and land pollution.

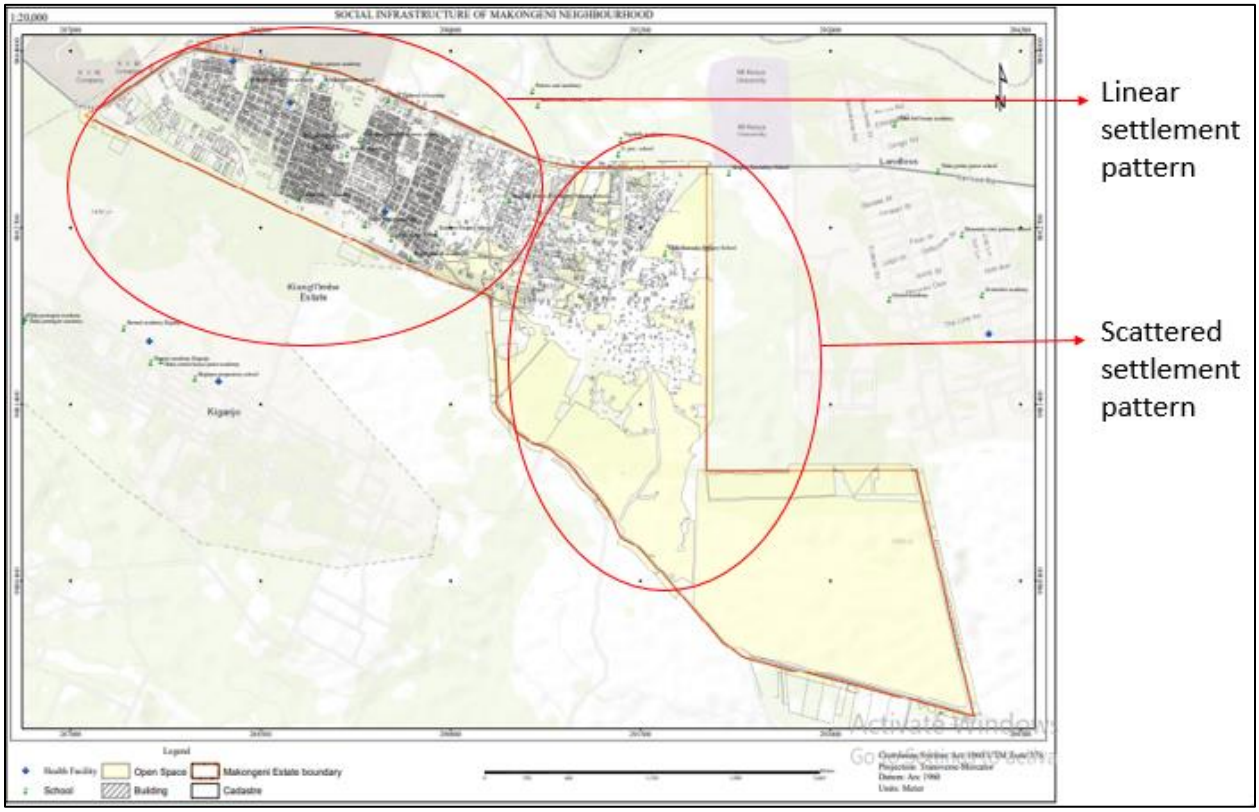
Plate 5: Incompatible land use practices

Source: Field survey, 2021

4.6 Human Settlement Patterns

A human settlement denotes the entirety of a community of humans with all the cultural, social, organizational, material, and spiritual elements that support it (Živković, 2018). Any human dwelling, whether small or large, where groups of people reside and work, is understood as a settlement. A human settlement can be temporary or permanent, urban or rural, sedentary or mobile, and agglomerated or disseminated. Overall, human settlements reflect human abilities and needs, along with economic, political and social relations. Makongeni neighbourhood has linear and scattered settlement patterns. The linear settlements occur along Garissa road and the collector roads in the neighbourhood. The human settlement patterns in the neighbourhood are depicted in map 7 below.

Map 7: Settlement patterns

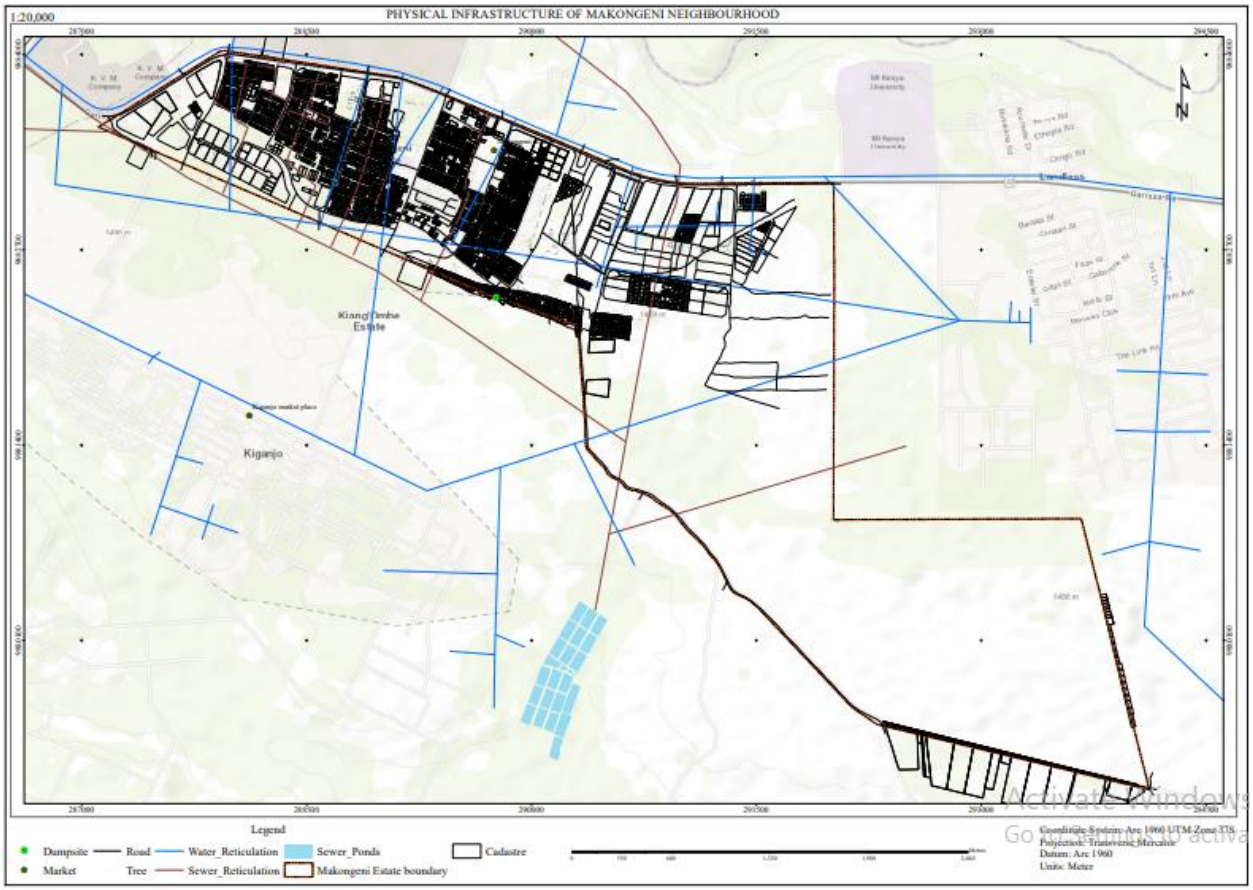


Source: Author's Construct

4.7 Physical Infrastructure

Physical infrastructure refers to the basic physical structures required for an economy to function and survive, such as transportation networks, a power grid, sewerage networks, and waste disposal systems (IGI Global, 2021). In this study, the physical infrastructure covered are roads, water supply networks, sewerage systems, food market infrastructure and solid waste management systems. Map 8 below shows the physical infrastructure in the Makongeni neighbourhood.

Map 8: Physical Infrastructure

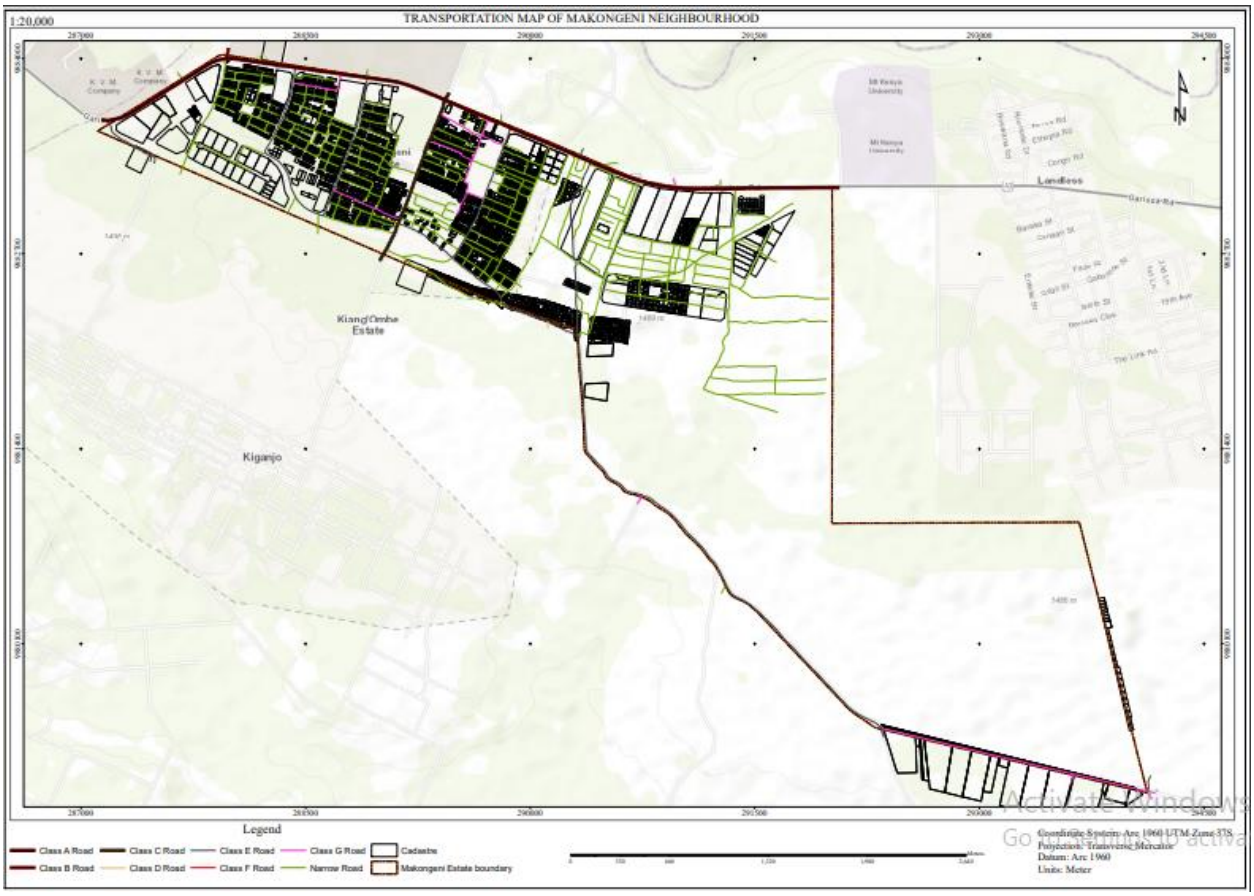


Source: Author's construct

4.7.1 Roads

Makongeni neighbourhood is bounded by Garissa road (Class A3 road) to its northern side. The area also features tarmacked collector roads within the neighbourhood that connect to Garissa road. The neighbourhood also has access roads which are mainly murram and earth roads in its interior. Road transport is the only transport mode in the Makongeni neighbourhood.

Map 9: Transportation Map



Source: Author's construct

4.7.2 Water Supply Networks

Water is a fundamental resource for healthy ecosystems, socio-economic development, and human well-being. Thika Water and Sewerage Company are responsible for distributing water in the neighbourhood. Map 8 shows water reticulation in the neighbourhood. The field study revealed that the average daily consumption of water is 55 litres per day (for drinking and hygiene activities). The field study also revealed that only 70% of the inhabitants can access to piped water. Water rationing is common in the area since the demand is more than the supply. Residents who do not have piped water harvest rainwater, use borehole water or buy water from the vendors.

Table 2: Theoretical daily water demand for the area

	Population	Demand per housing type			Other users	Total cubic metres/day	Existing Supply	Gap
		High	Medium	Low	% of residential	Unaccounted for at		
Proportion		5%	25%	70%	25%	25% of supply		
Litres/p/day		250	150	75				
Year								
2015	143 357	1 792	5 376	7 526	3 674	22 960	30 000	7 040
2025	229 483	2 869	8 606	12 048	5 881	36 753	30 000	-6 753
2035	317 067	3 963	11 890	16 646	8 125	50 780	30 000	20 780

Source: Thika town ISUDP.

4.7.3 Sewerage Networks

Makongeni has inadequate sewer reticulation, as depicted in Map 8. The study revealed that 40% of the houses do not have a connection to a sewerage system. Therefore, the residents use septic tanks and pit latrines. One of the main problems facing the sewerage system in Makongeni is frequent blockage of the sewer pipes.

Table 3: Theoretical future demand for sewerage (m3)

Year	Population	Water consumption	Sewerage flow	Capacity of existing	Gap
			80%		
2015	143 357	22 960	18 368	6 100	12 268
2025	229 483	36 753	29 403	6 100	23 303
2035	317 067	50 780	40 624	6 100	34 524

Source: Thika town ISUDP.

4.7.4 Solid Waste Management

The county government of Kiambu collects solid waste in the Makongeni neighbourhood. The residents take waste materials to designated waste collection points within the neighbourhood where garbage trucks collect the waste weekly. The study found that private companies also collect solid waste from the residents every week and transport it to the dumpsite located in the southern part of the neighbourhood. Solid waste production in the neighbourhood exceeds collection. Only 70% of the waste is collected daily (Thika town ISUDP). Both the

county government and the private solid waste companies charge the residents a waste collection fee of Ksh 100-200 per month. Residents from low-income families who are unable to pay openly dump the waste around the neighbourhood, leading to environmental degradation.

Table 4: Solid waste demand assessment in the area

Year	Population	Quantity per head/ day (kg)	Total/day (kg)	Other sources	Total/day (tonnes)
2015	143 357	0,80	114 686	100 000	215
2025	229 483	0,80	183 586	160 078	344
2035	317 067	0,80	253 654	221 173	475

Source: Thika town ISUDP

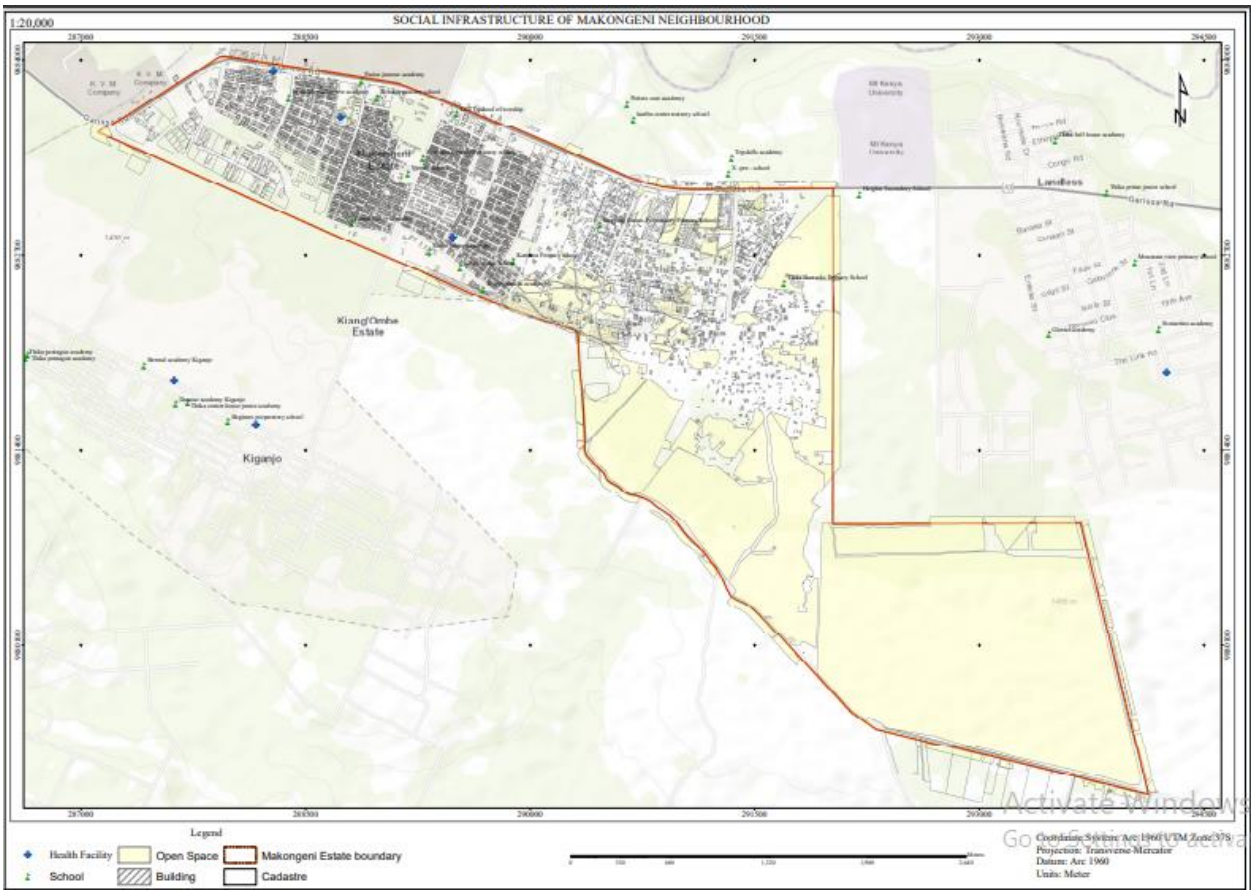
4.7.5 Markets

Makongeni neighbourhood has a fresh food Market where people buy and sell fresh farm produce in retail and wholesale. Currently, the market has inadequate market infrastructure and poor waste management systems. More specifically, the market lacks refrigeration facilities and has inadequate stalls, inadequate lighting, and inadequate waste bins.

4.8 Social Infrastructure

Social infrastructure refers to the networks of spaces, facilities, institutions, and groups that create affordances for social connection (Latham & Layton, 2019). In the context of this research, social infrastructure encompasses open spaces, housing, schools and health facilities. Map 10 below shows the social infrastructure in the Makongeni neighbourhood.

Map 10: Social Infrastructure



Source: Author's Construct, 2021

4.8.1 Housing Typologies

Housing is a basic requirement for human survival. It indicates a household's level of living standards along with the welfare of individuals. Additionally, it accounts for a substantial share of an individual's income. Makongeni neighbourhood has both high-rise buildings and single-dwelling units. The neighbourhood has mainly mixed-density residential developments. The neighbourhood also has informal settlements in the southern part, which are characterized by low-quality housing. Map 11 shows the housing typologies in the Makongeni area.

Map 11: Housing typologies

Source: Author's construct, 2021

4.8.2 Health Facilities

Makongeni neighbourhood has only one public dispensary called Makongeni dispensary, which is a level II health facility. The dispensary has no in-patient services and only provides consultation and treatment for minor illnesses. However, the dispensary provides rehabilitative, preventive and promotive services. The Physical Planning Handbook of 2008 recommends that a dispensary should serve a populace of 5,000 persons. Since the population of the Makongeni neighbourhood is 86, 581, the neighbourhood should have a level 3 or level 4 health facility. The study found that most residents in the area receive treatment from private hospitals and clinics.

4.8.3 Schools

Makongeni neighbourhood has one public nursery school and primary school (Kenyatta primary school) and a single public secondary school (Kimuchu secondary school). However, the area has several private primary and secondary schools, including Glorybell primary school, Furaha primary school, Mwangaza primary school, St. Appolonuh's secondary school and St.

Mulumba academy. The neighbourhood has one public tertiary learning institution (Makongeni Educational Vocational Training Centre). Private tertiary institutions include Gretsa University and Amboseli Institute of Hospitality and Technology, Thika.

Table 5: Requirements for education facilities

School	Catchment population	Pupils per class	Recommended distance	Land requirement
Nursery school	4000		300-500m	0.15-0.25Ha
Primary school	4000	40	500m-2km	3.9Ha
Secondary school	8000		500m-3km	3.4Ha-4.5Ha

Source: Physical Planning Handbook (2008)

Since the population of the Makongeni neighbourhood is 86,581 persons (KNBS, 2019), the current number of public schools is not sufficient to serve the population. The residents mainly rely on private schools. The majority of the private educational facilities in the neighbourhood do not adhere to the minimum land requirements stipulated in the physical planning handbook.

4.8.4 Open Spaces

An open space is any open piece of land that has no built structures and is accessible to the community members. Open spaces include green spaces such as parks, cemeteries, community gardens. Playgrounds, schoolyards, public plazas, public seating areas and vacant lots are also open spaces. These spaces have aesthetic, environmental and health advantages. Currently, there lacks a gazetted open space in the Makongeni neighbourhood. However, the neighbourhood has many vacant lots where people rest and engage in recreational activities.

CHAPTER FIVE: RESEARCH FINDINGS AND DISCUSSIONS

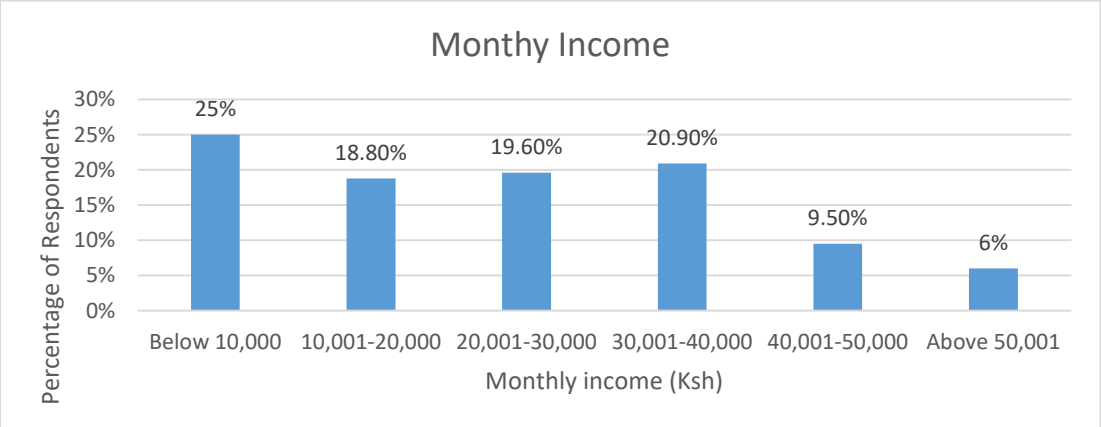
5.1 Introduction

This section provides a comprehensive analysis of why informal urban sprawl occurs in Thika municipality, the impacts of informal urban sprawl on the delivery of infrastructure in the Makongeni neighbourhood, how the inhabitants cope with the deficit in infrastructure provision, and the planning options to curb informality and provide infrastructure.

5.2 Socio-Economic Background of the Respondents.

53% of Makongeni neighbourhood residents interviewed were male while 47% were female. The residents' ages varied from 19 years to 70 years. The majority of the residents (47.2%) are formally employed in government institutions, learning institutions, and industries located in and near the neighbourhood. About 34.7% of the residents engage in businesses while approximately 8% of the residents are students. Approximately 10.1% of the population is unemployed. The occupations explain the monthly income levels of the residents. About 25.2% of the residents earn below Ksh 10,000 while 18.8% earn between Ksh 10,001 and Ksh 20,000 monthly. Approximately 19.6% of the residents earn between Ksh 20,001 and Ksh 30,000 while approximately 20.9% earn between Ksh 30,001 and Ksh 40,000 monthly. About 9.5% of the residents earn between Ksh 40,001 and Ksh 50,000 while approximately 6% earn above 50,000. The income levels explain why the majority of the residents (about 81.2%) rent houses while approximately 18.8% of the residents are house owners.

Figure 3: Monthly Income of Residents



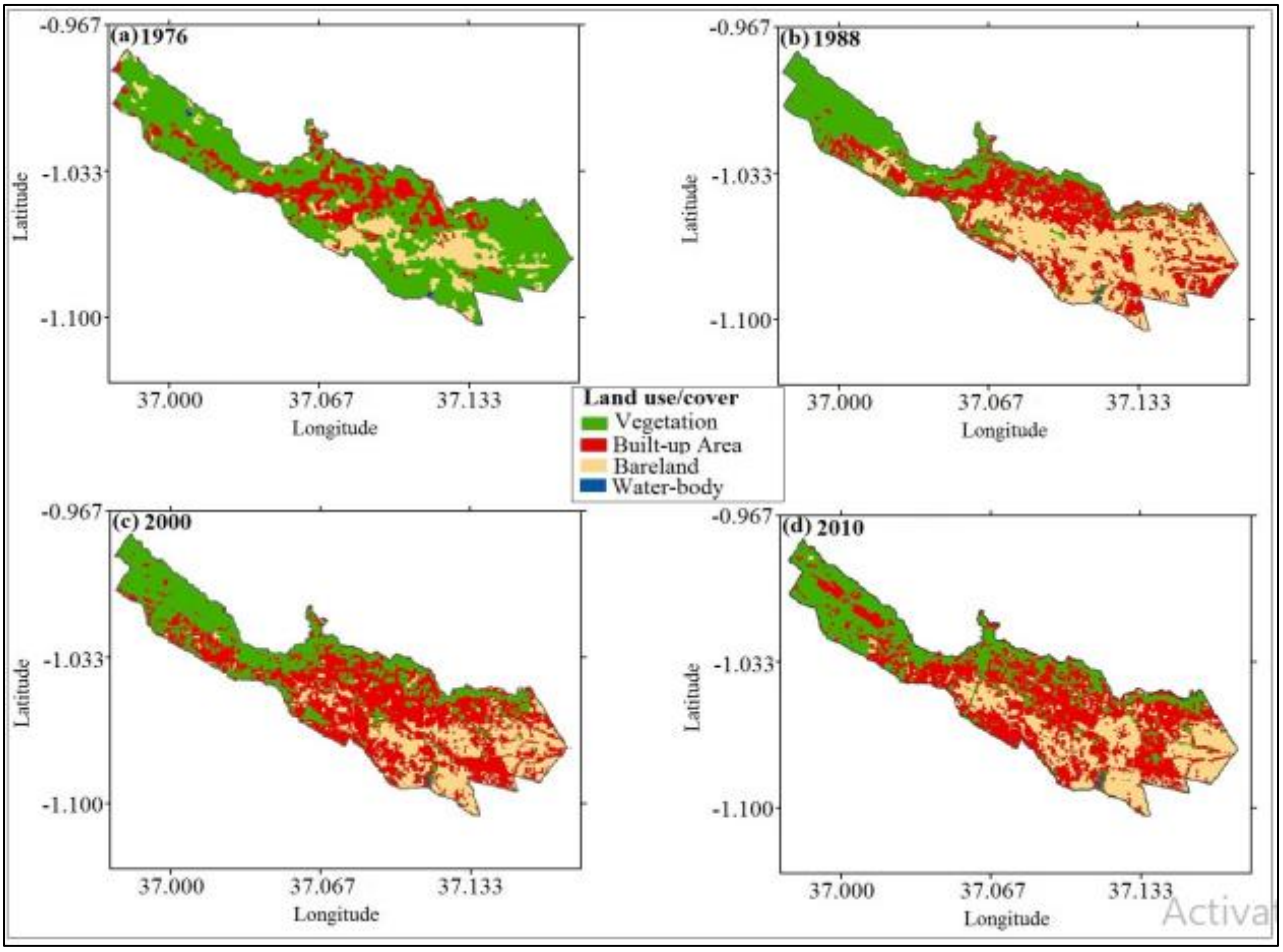
Source: Field Survey, 2021

Out of the 25 developers who were interviewed, 60% were male while 40% were female. The ages of the developers ranged from 24 to 80 years. A substantial number of the developers (about 39%) were aged below 40 years, indicating that younger persons are increasingly investing in realty. The literacy levels among the developers are high since approximately 89% completed their high school education, and about 73% of the developers have tertiary education. More than 85% of the developers work in civil services or businesses. The approximate monthly returns from the properties ranges from Ksh 30,000 for semi-permanent row houses to Ksh 600,000 for flats. The profits from real estate entice more developers to continue investing in the neighbourhood. These statistics resonate with Ayonga's (2021) observation that areas that are immediately outside the city peripheral usually give a minimum cost-maximum profit prospect to developers. This factor attracts speculative property developers who aim to maximize profits.

5.3 Rate of Urban Expansion

Makongeni neighbourhood is one of the fastest-growing residential neighbourhoods in Thika Municipality. According to Muiruri & Odera (2018), the rate of urban expansion in the municipality in the last 34 years is 0.91%. The type of sprawl in the area is multi-directional (leapfrog and scattered). Muiruri & Odera (2018) used Shannon's Entropy method to measure the urban expansion rate in the area. The study noted that agricultural land use has significantly decreased while the built-up area has increased considerably in the last 34 years. Map 12 shows the land use cover in Thika municipality from 1976 to 2010.

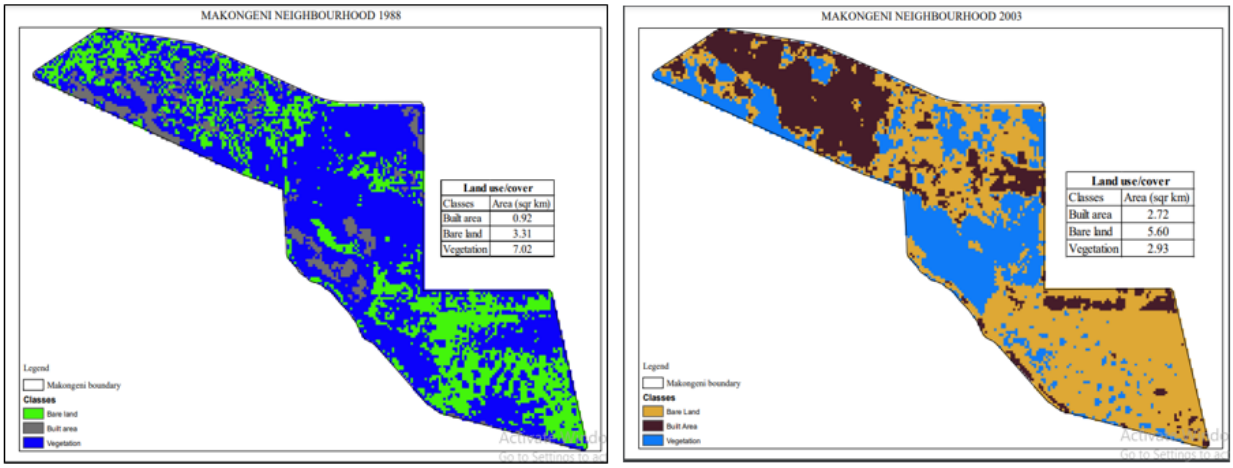
Map 12: Land use cover in Thika municipality



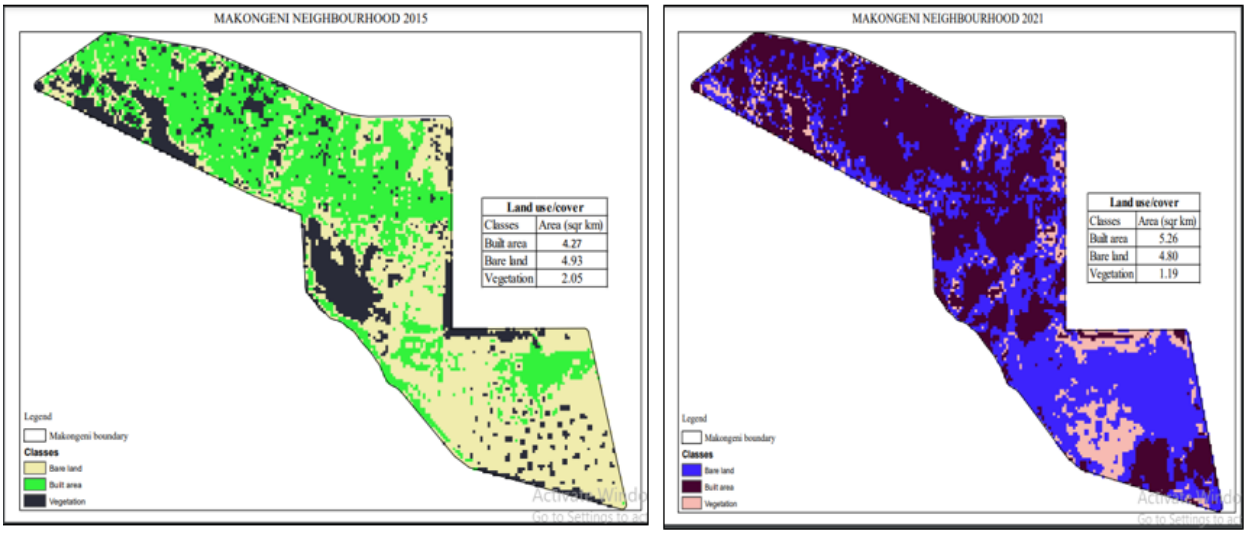
Source: Muiruri & Odera, 2018

This study used Landsat image classification to map the land use cover changes in Makongeni neighbourhood from 1988 to 2021. The built-up area in the neighbourhood increased from 0.92 square kilometres in 1988 to 5.26 square kilometres in 2021. The area covered by vegetation decreased from 7.02 Sq. Km to 1.19 Sq. Km during the same period. The maps indicate that urbanization in the neighbourhood is progressive.

Map 13: Land use cover in Makongeni neighbourhood 1988 and 2003



Map 14: Land use cover in Makongeni neighbourhood 2015 and 2021



Source: Author's construct

Investigation into the types of development in the Makongeni neighbourhood revealed that 63.4% were multi-dwelling residential buildings, 22.1% were commercial buildings, and 14.5% were single-dwelling units (bungalows and maisonettes). The study area contains a mix of controlled and uncontrolled developments, as indicated in Map 11.

5.4 Informal Urban Sprawl in Makongeni Neighbourhood.

This section seeks to answer the question '*why does informal urban sprawl occur in Thika municipality*?' This section outlines the rate of urban expansion, trends in land acquisition, trends in migration, economic growth, and the drivers of informal urban sprawl, including inadequate planning, inadequate implementation of existing plans, insufficient enforcement of development control codes of practice, and defiance to development control regulations.

5.4.5 Key Drivers of Informal Urban Sprawl in Makongeni neighbourhood

5.4.5.1 Ineffective Planning

The main planning tools in the Makongeni neighbourhood are the Thika town ISUDP and the Thika Municipality Spatial Plan. The County Governments Act 2012, the Urban Areas and Cities Act 2011, and PLUPA 2019 give county governments authority to control or forbid the use and development of land and structures to endorse; orderly, proper, and optimal land use, protection and conservation of the environment, public health and safety, and public participation in both rural and urban areas. The Land, Housing, Physical Planning & Urban Development department of the County Government of Kiambu is responsible for providing spatial planning strategies to promote sustainable urban and rural management and development. The Thika town ISUDP and the Thika Municipality Spatial Plan apprise and control all planning development and verdicts in Thika municipality, and guarantees full annexation of all functions. However, the escalation of informality in the municipality indicates there is planning did not adequately address the pre-existing urban informality in the area.

Urban informality in Thika municipality began during the post-colonial era after the removal of CAP 133 which called for the apprehension and punishment of those who violated urban development rules. During the colonial era, the municipality was occupied by Europeans and Asians, and development was guided by the 1902 and 1915 Crown Lands Ordinance that contained regulations for the management of crown land. Section 15 of the Ordinance decreed that land lessees should build structures detailed in the lease, during the stipulated timeframe, and use durable and substantial materials (Republic of Kenya, 1924). The Ordinance also required developers to offer reasonable water supply and drainage, and be mindful of the environment. After the removal of CAP 133 post-independence, developers did not obtain development or occupation permits since it was no longer compulsory. Additionally, they did not

use specified building materials for the walls, roofs, and floors since it was no longer a legal requirement. Also, the developers were no longer mandated to follow specific guidelines for setbacks, minimum room sizes, and minimum road sizes. This phenomenon led to the construction of substandard buildings that had inadequate water supply and sewerage networks. The grabbing of public land by the African elites during this period also escalated informality (Ayonga, 2019). Fueled by capitalism, developers constructed a lot of substandard housing to accommodate the low-income and middle-income populations, leading to informal urban sprawl.

The rising housing challenge in the 1970s compelled the administration to design systems to provide serviced plots to specific recipients, mostly low-income earners (UN-Habitat, 2018). The schemes were planned for the Makongeni neighbourhood in Thika and Dandora and Umoja neighbourhoods in Nairobi. The government conceptualized that Makongeni would accommodate 60% of Thika's projected growth. However, the plan was not successful since more people continued to migrate to the neighbourhood and informal sprawl increased. Map 16 shows the planned Makongeni neighbourhood engulfed by unplanned urban growth. Although the projects were not entirely effective as planned, they marked a milestone in Kenya's planning system and new urban areas mushroomed during this era.

Map 15: Planned urban extension overrun by unplanned extension

Source: UN-Habitat, 2019.

Urban informality in Thika municipality continues to increase since the urban planning tools mainly focus on harmonizing future developments and to a large extent, ignore the pre-existing informality. For instance, the Thika town ISUDP defines a vision for prospective development of the area for the next twenty years. However, the plan does not adequately include strategies, such as the compulsory acquisition of land or transfer of development rights (TOD) that would reduce informality and enhance infrastructure provision. To improve sustainable development, the plans should also substantially define the extent of existing informal sprawl and suggest ways to curb unplanned urban growth. Similarly, the PLUPA 2019 mainly provides provisions for guiding and coordinating future developments. These findings agree with Ayonga's (2019) observations that the planning laws in Kenya are proactive, and cannot reform informal patterns that developed during the colonial and post-colonial ages. The current planning laws are based on the Town Planning Act (CAP 134) which was imported into Kenya from the Town and Country Planning Act (TACPA) of the UK by the British colonialists (Ayonga, 2019). TACPA endorsed the nationalized development rights in which planning came before development and every developer needed a development permit (Taylor, 1998). The contrast in the development systems of former European and African areas limited the effectiveness of the planning laws in Kenya, and urban informality increased. The duality of planning in the study area also exacerbates informal urban sprawl. The sprawl occurs just outside the city's fringe, in the rural-urban interface, where there is no clear jurisdiction. The rural authorities cannot control development in this area since they do not have the right instruments, capacity and mandate. Therefore, development occurs without approval.

5.4.5.2 Ineffective implementation of urban plans

Inadequate implementation of urban plans in Thika municipality escalates informal urban sprawl in the area. Factors that affect plan implementation in the study area are; little coordination between county departments, particularly in planning and budget implementation facets, limited technical know-how, and political interference. Lack of coordination between the county departments underpins the operationalization of planning as an independent entity, instead of the coordinating unit for lining up departmental plans and financial investments with a definite spatial development framework. This leads to missed chances in tapping land-based funding of strategic investments and under-funding of plans. The Thika ISUDP contains Capital Investment Plans (CIPs) that would guide plan implementation. However, the high budgets

required to operationalize the CIPs hinder implementation due to the currently limited revenue streams. Limited technical know-how, evidenced by the few employed planners and reliance on private consultants, also hinder the effective implementation of plans. Political interference occurs when political leaders or other departments have little concern for planning. Since previous planning practices have had limited impact in creating sustainable built environments, leaders may prioritize other activities with immediate outcomes, such as road construction.

5.4.5.3 Inadequate Enforcement of Development Control Standards

The field survey revealed that inadequate enforcement of development control standards leads to uncoordinated urban growth in the Thika municipality. The Thika Sub-county planning office is responsible for undertaking development control initiatives in the neighbourhood. The main development control tool in the Makongeni neighbourhood is the Thika town ISUDP, which was completed in 2015. It entails zoning and development control regulations for the Makongeni neighbourhood, as illustrated in Tables 7, 8 and 9.

Table 6: Development control guidelines for residential developments

Development control guidelines (Zoning Code 02)	Housing Typology	Dimensions
Minimum plot size	Bungalow detached/plotted development	500 Sq. metres
	Row and semi-detached housing	350 Sq. metres
	Multi-family residence	220 Sq. metres
Number of dwellings per ha.	Bungalow detached/plotted development	16
	Row and semi-detached housing	32
	Multi-family residence	60

Maximum plot coverage for sewered plots (%)	Bungalow detached/plotted development	55
	Row and semi-detached housing	55
	Multi-family residence	55
Maximum plot coverage for unsewered plots (%)	Bungalow detached/plotted development	50
	Row and semi-detached housing	45
	Multi-family residence	45
Plot Ratio for sewered plots (%)	Bungalow detached/plotted development	60
	Row and semi-detached housing	150
	Multi-family residence	250
Plot Ratio for unsewered plots (%)	Bungalow detached/plotted development	50
	Row and semi-detached housing	80
	Multi-family residence	150
Setbacks	Bungalow detached/plotted development	Front 6m, Side 0m, Side 2 0m, Rear 3m
	Row and semi-detached housing	Front 6m, Side 0m, Side 2 0m, Rear 3m
	Multi-family residence	Front 6m, Side 0m, Side 2 0m, Rear 3m

Parking Space	Per 2 (1-bedroom dwelling units)	1
	Per 1 (2-bedroom dwelling unit)	1
	Per 1 (3-bedroom dwelling unit)	1.5
Cul-de-sac	Accesses maximum of 10 plots	Length-60m; Turning radius-15m

Source: Thika town ISUDP

Table 7: Development control guidelines for commercial developments

Development	Subdivision level (Minimum Ha)	Minimum frontage road with in metres	Ground coverage (%)		Plot Ratio (%)		Special Conditions
			Sewered	Unsewered	Sewered	Unsewered	
Supermarket	0.4	18	50	35	500	150	
Retail shop	0.045	15	80	50	500	200	
Hotels	0.2	18	50	35	500	150	Alternative mechanized disposal systems can apply on sewer standards
Offices	0.1	18	80	60	500	150	
Vegetable kiosks	0.010	6	90	90	90	90	One community toilet per 50 kiosks

Source: Thika town ISUDP

Table 8: Development control guidelines for educational developments

Schools	Minimum plot size (Ha)	Maximum ground coverage (%)	Plot Ratio	Maximum Number of floors
Primary schools	3.25	20	0.4	2
Secondary schools	3.4	30	0.6	3
Secondary schools (2 streams)	3.5	30	0.6	3
Special schools	3	30	0.6	3
Youth polytechnic	4.5	30	0.6	3

Source: Thika town ISUDP

Development control guidelines for mixed-use developments include; a minimum plot size of 0.045 Ha (the plot length vs. width should not be more than 1:2); 1 car park per 80 m2 of covered area, and Building line: 3m for plots fronting road reserve ≤ 15m; 0m for ≥ 18m. The land use regulations for a basic health sub-centre are; a minimum plot size of 2Ha, maximum ground coverage of 30%, plot ratio of 1%, and a maximum of 3 floors (Thika town ISUDP).

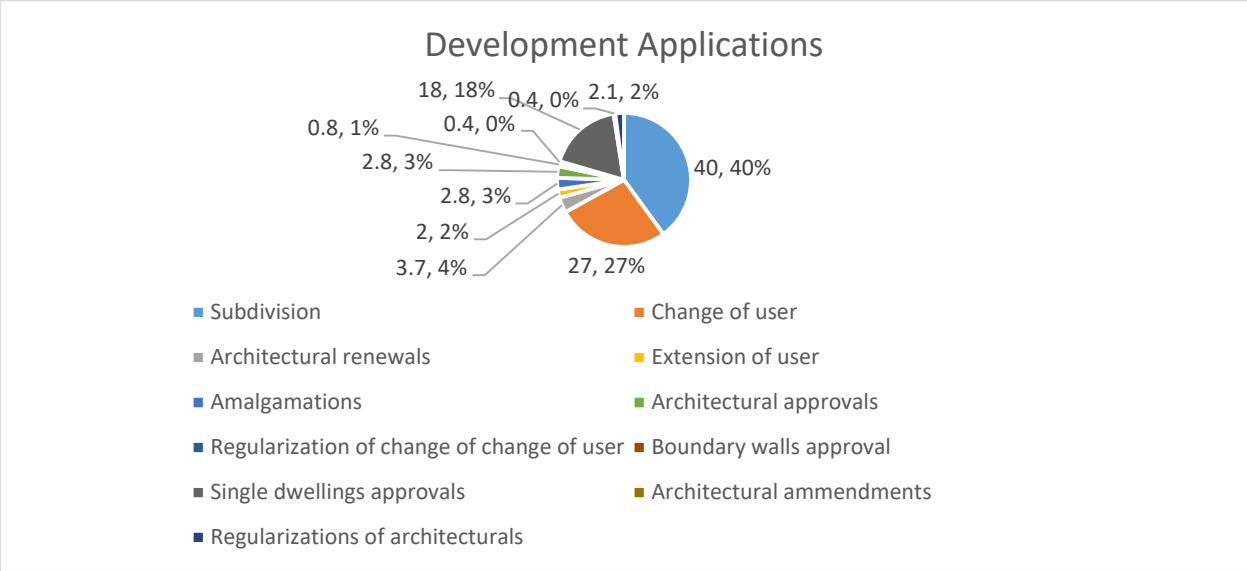
The field survey revealed that the main challenges facing the execution of development control standards in the Makongeni neighbourhood are insufficient resources, inadequate digitization of old records, and an absence of a well-organized public awareness campaign. Insufficient funding and minimal resources, such as one car for the whole sub-county, restrict the development control officers from checking developments regularly. Additionally, minimal resources hinder the officers from acting quickly in case of a defiant development in the neighbourhood. Inadequate digitization of old records and maps leads to the inadequate depiction of development trends in the area. The absence of a well-organized public awareness campaign causes people to construct illegal structures that negatively impact the provision of infrastructure,

the environment, and overall livability in the neighbourhood. These outcomes are consistent with a previous study by Ogundele et al. (2011) that concluded that insufficient funding of the planning agency, absence of a well-organized public awareness campaign, unproductive development control procedures, and corruption among the planning officials hinder effective development control in the area. Ogundele et al. (2011) also observed that the absence of enough public awareness makes people construct illegal structures with an aim of satisfying their selfish interests without taking into consideration the negative impacts of their actions.

5.4.5.4 Non-compliance to development control standards

According to the field survey, defiance to development control standards contributes to urban informality in the Makongeni neighbourhood. Development applications in the Makongeni neighbourhood include subdivision (40%), change of user (27%), single dwellings applications (18%), architectural renewals (3.7%), architectural approvals (2.8%), extension of user (2%), amalgamations (2.8), regularizations of architectural (2.1%), regularizations of change of user (0.8%), architectural amendments (0.4%), and boundary wall approvals (0.4%).

Figure 4: Development Applications



Source: Field survey, 2021

The field survey revealed that the general compliance level to development control regulations in the Makongeni neighbourhood is approximately 62.8%. The compliance level with

the minimum land size regulations in the neighbourhood is 97%. According to the Thika town ISUDP, the minimum size of plots in the Makongeni neighbourhood should be 300 sq. metres. The majority of the developments meet this criterion. However, the 3% of developers whose land sizes are smaller than 300 sq. metres are single dwellings developers who inherited land from their parents. The compliance level to maximum ground coverage in the area is 48%. The maximum ground coverage requirements vary according to the type of development, as illustrated in section 5.4.5. Most residential, mixed-use and commercial flats do not adhere to maximum ground coverage requirements since the developers are profit-oriented. As a result, these types of developments offer minimal spaces for parking or access roads. Adherence to plot ratio requirements in the neighbourhood is 42%. Most residential, mixed-use and commercial flats developers in the area do not adhere to the plot ratio requirements to maximize their profits. As a result, most of these buildings lack spaces for expansion or construction of social amenities and infrastructural facilities, as postulated in the Physical Planning Handbook of 2008.

The level of compliance to setbacks is 39%. According to the Thika ISUDP, the minimum setbacks for houses in the Makongeni neighbourhood are 3m for the rear side and 6m for the front side. Most developers try to maximize the available space since they perceive that the setbacks are a waste of space. Additionally, most residential flats developers extend their balconies beyond their property boundaries to maximize space, as shown in plate 6. Non-compliance to building setbacks leads to a lack of privacy, lack of uniformity, and narrow access roads. Compliance with parking space requirements in the neighbourhood is 51%. Educational and health facilities have the highest adherence to parking requirements while row houses have the least compliance with the parking provisions. The field survey established that adherence to parking requirements is indirectly proportional to plot ratio and maximum ground coverage. When developments occupy more space, they leave less space for parking. The compliance level to the building heights requirements is 100%. All the sampled buildings in the neighbourhood had an acceptable number of floors.

Table 9: Compliance with development control regulations

Development Control Regulation	Compliance level
Minimum land size	97%

Maximum ground coverage	48%
Plot ratio	42%
Setbacks	39%
Parking Space	51%
Maximum number of floors	100%
Overall compliance level	62%

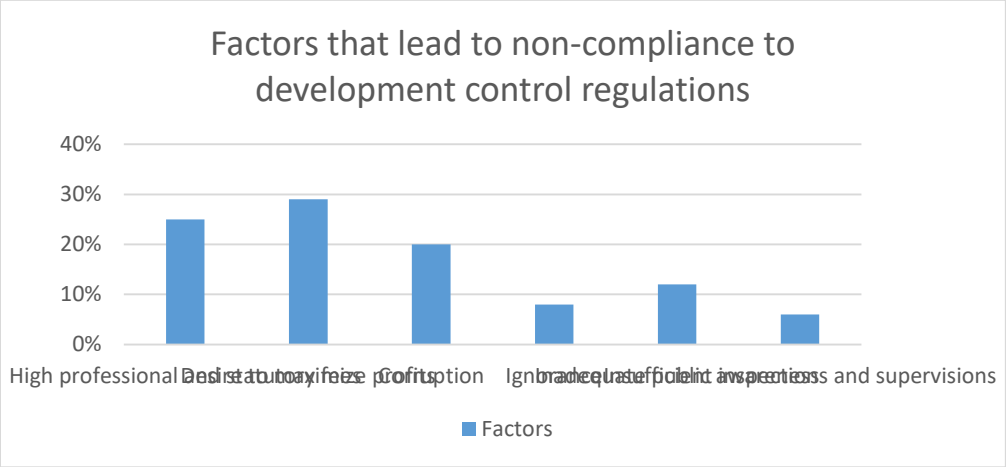
Source: Field survey, 2021

Plate 6: Buildings with inadequate setbacks

Source: Field survey, 2021.

Factors that contribute to infringement of development control regulations in the Makongeni neighbourhood include; the desire to maximize profits (29%), high statutory and professional fees (25%), corruption (20%), inadequate public awareness (12%), ignorance (8%), and insufficient inspections and supervisions (6%).

Figure 5: Factors that lead to non-compliance



Source: Field survey, 2021

The majority of the participants (29%) cited that the desire to maximize profits is the main contributor to non-compliance to development control guidelines in the Makongeni neighbourhood. Developers tend to violate development control regulations such as setbacks, parking spaces, and maximum ground coverage requirements by utilizing all the available space. The development control officers who were interviewed also cited that the majority of residential and mixed-use flats developers in the area violate these regulations to maximize their profits. Mwangi (2016) asserts developers in sub-Saharan Africa, including Kenya, violate planning laws and development control regulations as they seek to maximize profits.

Approximately 25% of the respondents stated that high statutory and professional fees contribute to non-compliance with development control regulations. The development process requires developers to consult professionals such as structural engineers, architects, planners, and environmental experts. About 25% of the respondents believe that these professionals charge exorbitant fees that hinder developers from consulting them. The Architects and Quantity Surveyors Act (cap 525) stipulate that the total rate of professional fees should be 6% of the entire project costs (Government of Kenya, 2010). The 6% professional fees entail the architect's fees (2%), the quantity surveyor's fees (1.5%), the electrical technicians' fees (0.5%), and the mechanical technicians' fees (0.5%). The field survey revealed that the professionals may charge up to 10% of the total project costs. Developers who do not afford to hire professional services tend to hire underqualified or unqualified individuals who prepare non-compliant development

proposals, leading to the construction of developments that do not adhere to development control regulations.

Approximately 20% of the respondents agreed that corruption contributes to non-compliance in the neighbourhood. The residents, developers, and key informants cited that corruption among development control officials is a big menace. Some developers offer the development control officials money to approve their illegal development proposals. In other cases, the development control officials request money from the developers to approve physical development plans that do not comply with development control regulations. Alnsour & Meaton (2009) affirm that corruption in the development control process hinders sustainable urban growth. Alnsour & Meaton (2009) further explain that it is challenging for development control officials to enforce housing standards since they face the dilemma of choosing between fully enforcing planning standards and maintaining friendships, kinship ties, and special interests. Such hesitation allows for construction that does not comply with housing standards.

Approximately 12% of the respondents cited that there is inadequate public awareness of development control standards in the Makongeni neighbourhood. Lack of awareness leads to violation of the development control codes of practice. The key informants noted that the public did not adequately understand development control regulations due to the absence of development control sensitization programs by the sub-county planning office. The development control officers cited that minimal resources hinder them from conducting the sensitization programs in the neighbourhood. According to Ogundele et al. (2011), the absence of enough public awareness makes people build illegal constructions to satisfy their selfish interests without taking into consideration the negative impacts of their actions. Omollo (2019) also confirms that developers who are uninformed about regular building inspections tend to violate development control regulations.

Approximately 8% of the respondents agreed that developers tend to ignore development control standards and construct non-compliant buildings. Some developers choose to ignore the development control guidelines despite being knowledgeable about the development control processes. According to Ojo-Fajuru & Adebayo (2018), ignorance of development control regulations often leads to a rise in illegal structures that encroach on public spaces. The field survey also revealed that there are insufficient inspections and supervision in the Makongeni

neighbourhood. Approximately 6% of the respondents agreed that development control officers do not inspect the building regularly. This trend has led to a rise in non-compliant developments in the area. The development control officers cited that minimal resources, such as one car for the whole sub-county prevented them from carrying out regular inspections.

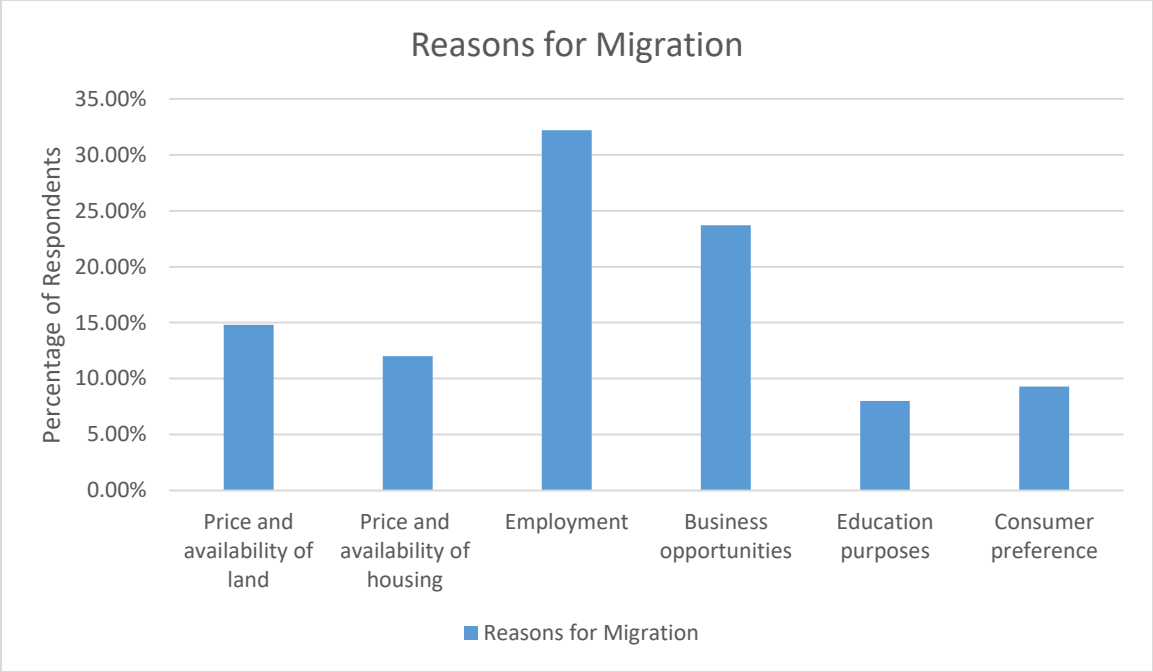
5.4.5.5 Traditional Land Tenure Systems Bypassed Planning

Traditional land tenure systems in the Makongeni neighbourhood created informal urban sprawl by allowing subdivision, change of use, and other land use processes to take place without planning permission or approval. Land owners would only seek the services of a surveyor and then conduct land use changes. This section looks at migration into the neighbourhood, and the trends in land acquisition and utilization in detail.

Migration into Makongeni Neighbourhood

The knowledge of migration trends in the Makongeni neighbourhood is vital in explaining urban development in the area. According to the field survey, about 76% of Makongeni's residents moved into the neighbourhood in the period between 1980 and 2021. The majority of the residents (about 69%) migrated from rural areas in Kiambu county and neighbouring counties such as Machakos and Murang'a counties. The reasons for migrating into the neighbourhood include; price and availability of land (14.8%), price and availability of housing (12%), employment (32.2%), business opportunities (23.7%), education purposes (8%), and consumer preference (9.3%). Those who migrated due to consumer preference cited reasons such as low transportation costs and proximity to Thika town CBD. These findings agree with the conventional knowledge that rural-urban migration contributes to urban growth (Tacoli, McGranahan & Satterthwaite, 2015)

Figure 6: Reasons for Migration in the neighbourhood

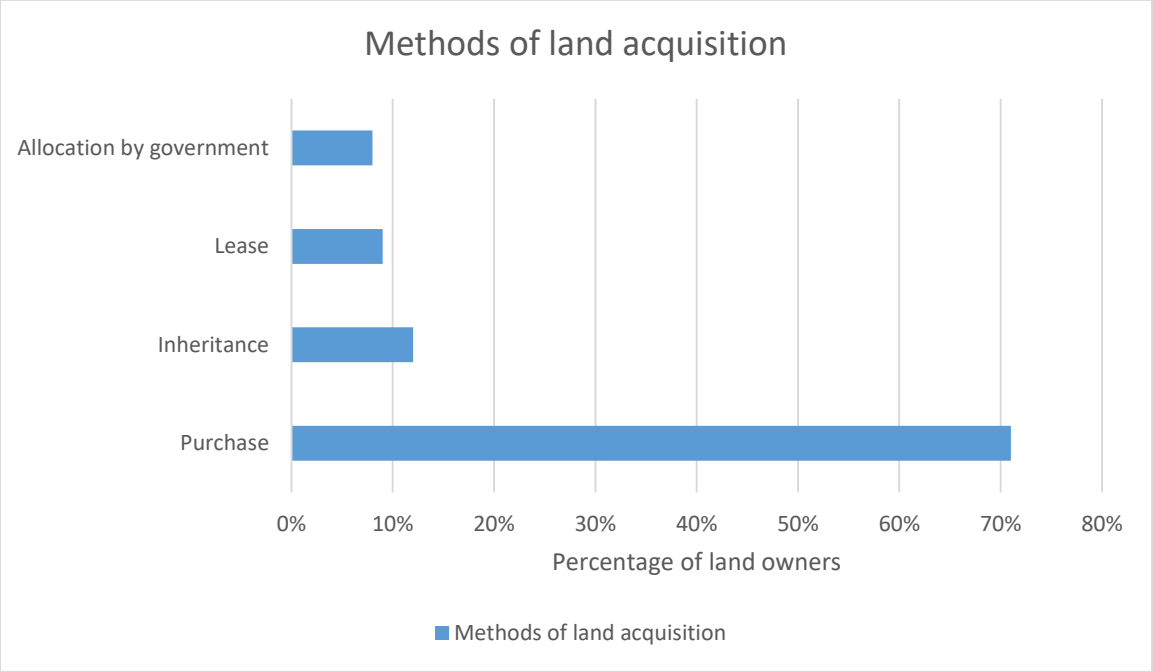


Source: Field Survey, 2021

Trends in Land Acquisition and Utilization

The field survey revealed that approximately 69% of Makongeni neighbourhood residents do not own the plot they live in while 31% of the inhabitants are land owners. The land holding sizes range from 0.04 to 1.7 acres. Those whose plot sizes are less than 0.07 acres violate the Thika town ISUDP regulation on minimum plot sizes of 300 sq. metres in the neighbourhood. The majority of the land owners (about 71%) purchased their lands while 12% of the land owners inherited from their parents. Approximately 9% of the landowners acquired their plots through leasing while 8% were allocated their plots by the government. Figure 7 shows the methods of land acquisition in the neighbourhood.

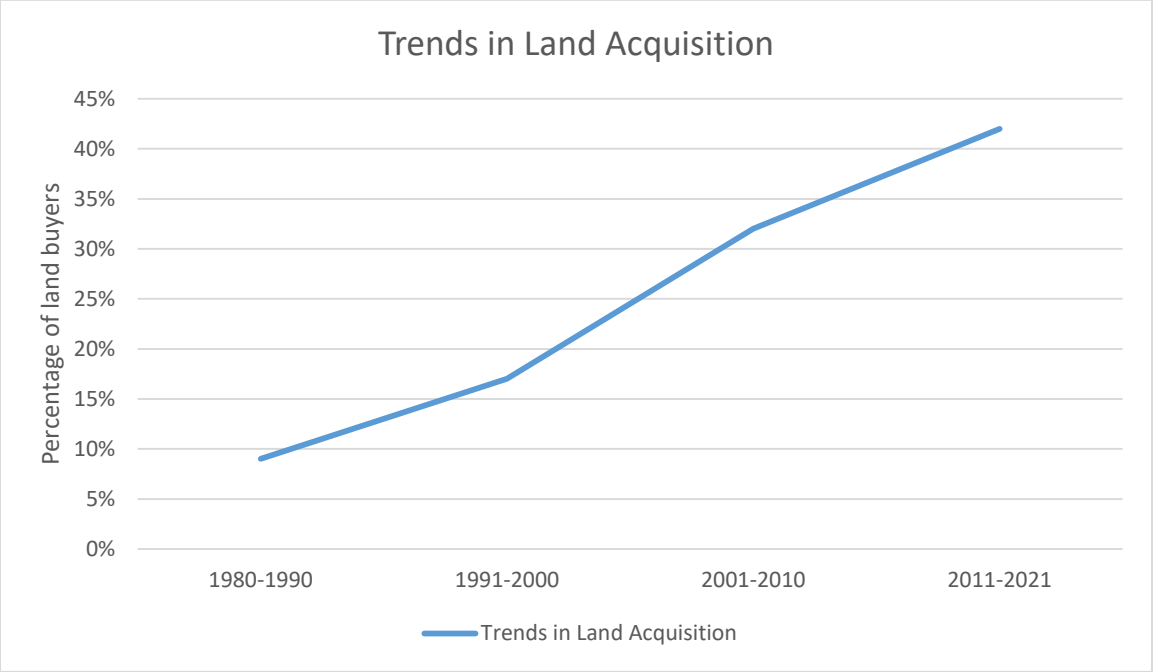
Figure 7: Methods of Land Acquisition



Source: Field Survey, 2021

The knowledge of the year of land acquisition is useful in explaining the trends in urban expansion in the Makongeni neighbourhood. According to the survey, the majority of the land buyers in the neighbourhood acquired their plots between 2001 and 2021. Approximately 9% of the land buyers acquired land between 1980 and 1990 while 17% of the land buyers acquired land between 1991 and 2000. About 32% of the land buyers acquired land between 2001 and 2010, while 42% acquired land between 2011 and 2021. About 95% of land buyers who acquired their plots between 2001 and 2021 have invested or plan to invest in real estate. This trend explains the significant increase in the neighbourhood's built-up area in the last two decades. The land acquisition trends also indicate that more landowners in the neighbourhood are subdividing their lands and selling them to developers. These findings are consistent with a previous study by Nuissl & Siedentop (2020) that urban land use changes, including land subdivisions, lead to urbanization and urban sprawl. Nuissl & Siedentop (2020) also assert that rapid urban land use changes often have environmentally detrimental effects.

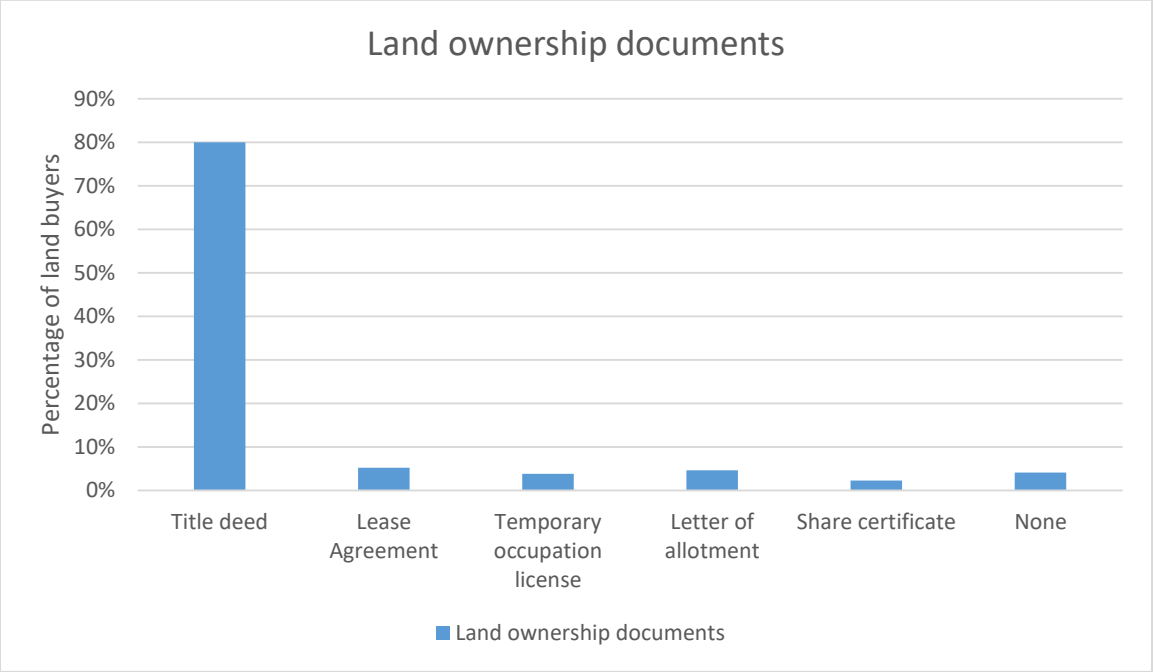
Figure 8: Trends in Land Acquisition



Source: Field Survey, 2021

The field assessment revealed that approximately 80% of the landowners in the Makongeni neighbourhood have title deeds. Figure 8 shows the various land ownership documents in the neighbourhood. About 5.2% of the landowners have lease agreements while 3.8% have temporary occupation licenses. Approximately 4.6% have letters of allotment while 2.3% have share certificates. About 4.1% of the landowners do not have any land ownership documents. Despite lacking any land ownership documents, some residents have built single-family dwellings on their plots. Respondents who do not have any land ownership documents cited reasons such as; they are yet to secure title deeds due to the slow processing of the documents, the process of succession/land transfer is incomplete, and the parents have the land ownership documents. Most of these respondents have constructed residential buildings, mainly single-family homes, without development permits. This trend contributes to urban informality in the neighbourhood since they do not follow planning and development control standards.

Figure 9: Land Ownership documents



Source: Field Survey, 2021

5.5 Impacts of Informal Urban Sprawl on the Provision of Infrastructure

This section seeks to answer the inquiry '*what are the impacts of informal urban sprawl on the provision of infrastructure in the Makongeni neighbourhood.'* In this study, the physical infrastructures covered are roads, water supply networks, solid waste management systems, sewerage systems, and food market infrastructure. Social infrastructure encompasses open spaces, housing, schools and health facilities.

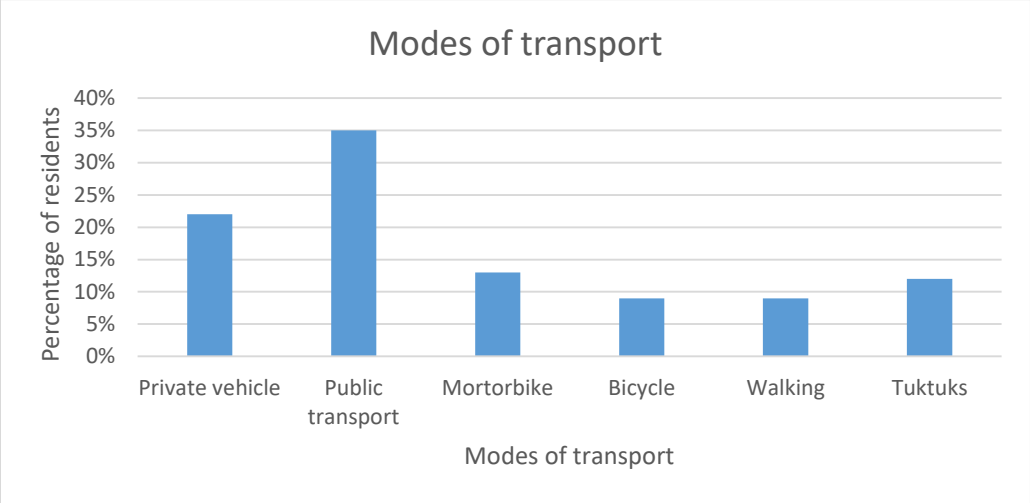
5.6 Impacts of Informal Urban Sprawl on the Provision of Physical Infrastructure

5.6.1 Roads

The impacts of informal urban sprawl on roads include; bad road conditions, narrows access roads, road-user conflicts, congestion on roads and bus terminus, and obstruction of stormwater drainage systems. Road transport is the main means of transportation in the Makongeni neighbourhood. The main road in the area is Garissa road (class A3). The study area features several collector roads and multiple access roads, as shown on map 9. According to the field survey, 22% of Makongeni neighbourhood residents use private vehicles as their means of transport, 35% use public transport (matatus and buses), 13% use motorbikes, 12% use *tuktuks*,

9% use bicycles, and 9% prefer walking. The findings are consistent with Bekele (2005) who notes that sprawl leads to land use patterns that do not favour the construction of sustainable transport modes and thus increase the usage of private vehicles in the suburbs. Barnes et al. (2001) also record that urban sprawling land development patterns make it difficult to establish mass transit systems.

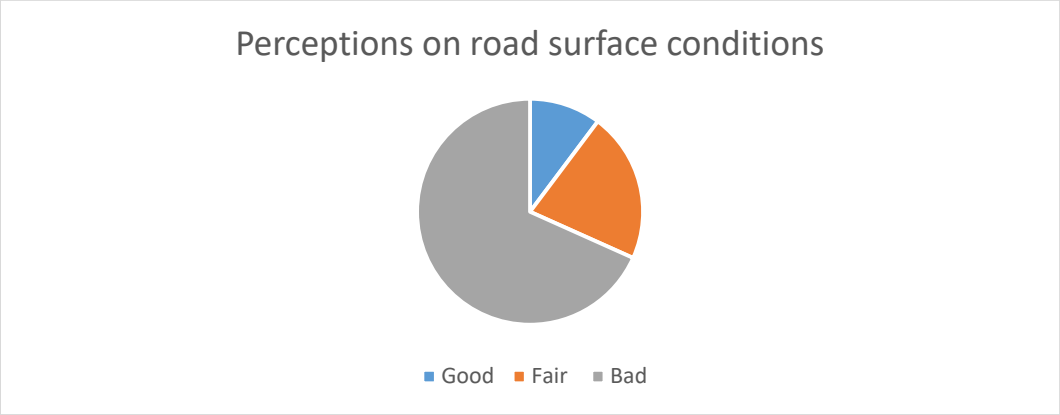
Figure 10: Modes of transport



Source: Field survey, 2021

Approximately 21% of Makongeni neighbourhood residents perceive the road surface conditions as good. About 44% perceive the road conditions as fair while 35% perceive the road conditions as bad. Apart from Garissa road and collector roads, the field survey revealed that all the other roads in the area are murram or earth roads. These roads are generally in poor condition due to low maintenance. The access roads are narrow and hardly motorable during the rainy seasons. Bad road conditions affect the transportation of goods and services.

Figure 11: Perceptions of road surface conditions



Source: Field survey, 2021

Plate 7: Bad road conditions

Source: Field survey, 2021

Informal sprawl in the study area has led to road-user conflicts and congestion on the roads. Individuals who work in Thika town noted that they spend approximately 50 minutes to 1 hour to reach their places of work during rush hour times (6-9 am and 4-8 pm). During other times, the residents spend approximately 10 minutes to cover the 4.4 km distance to Thika town. The residents experience longer commuting times due to congestion on the roads. Public transport vehicles cause road-user conflicts as they pick up and drop off at undesignated areas along Garissa roads. The intrusion of the road reserves by hawkers and parked vehicles also leads to congestion in the planning area. The roads do not have non-motorized transport systems.

Plate 8: Parked vehicles and hawkers encroaching road reserves

Source: Field survey, 2021

Informal sprawl also causes congestion in the public transport terminus facility located in the neighbourhood. The terminus serves many vehicles, including buses, tuktuks, and matatus. The terminus is unpaved and lacks shades. During the dry season, the terminus generates a lot of dust. During the rainy season, it becomes muddy and hardly motorable.

Plate 9: Bus terminus

Source: Field survey, 2021.

Urban informality in the Makongeni neighbourhood has also led to obstruction of stormwater drainage systems, causing flooding on the roads during the rainy season. Garissa road has a

narrow stormwater drainage (0.5 m) that is clogged by garbage. The blockage of the drainage system also leads to water pollution and damage to the aesthetic value. Lack of stormwater drainage on the access roads and some collector roads in the neighbourhood contribute to flooding in the area.

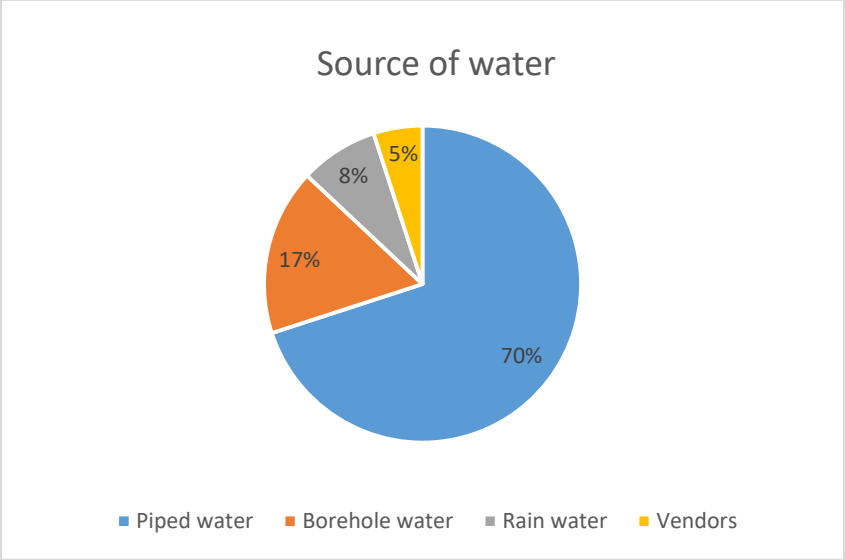
Plate 10: Blocked stormwater drainage

Source: Field survey, 2021

5.6.2 Water Supply Networks

The main challenge facing water supply in the neighbourhood is water rationing. Thika Water and Sewerage Company (Thiwasco) is responsible for the water supply in the Makongeni neighbourhood. Approximately 70% of the residents have piped water while 17% use water from boreholes. About 8% of the residents harvest rainwater while 5% buy water from vendors. The average daily consumption of water is 55 litres per day (for drinking and hygiene activities). The field study revealed 90% of the residents perceive the quality of water as good.

Figure 12: Source of water



Source: Field survey, 2021

On average, the residents who have piped water receive water for only four days a week. The field study revealed that Thiwasco has limited funds to invest in the water supply. Additionally, consumers have a limited ability to pay for a better service. According to Ewing (2008), informal urban sprawl increases the inefficiency in the delivery of fundamental infrastructure due to increased costs. In addition, inefficiency also occurs in the maintenance and operation of infrastructure in addition to the delivery of public services. Solomon (2011) also notes that water provision facilities in sprawled areas are inadequate, due to the increasing population and spontaneous nature of development.

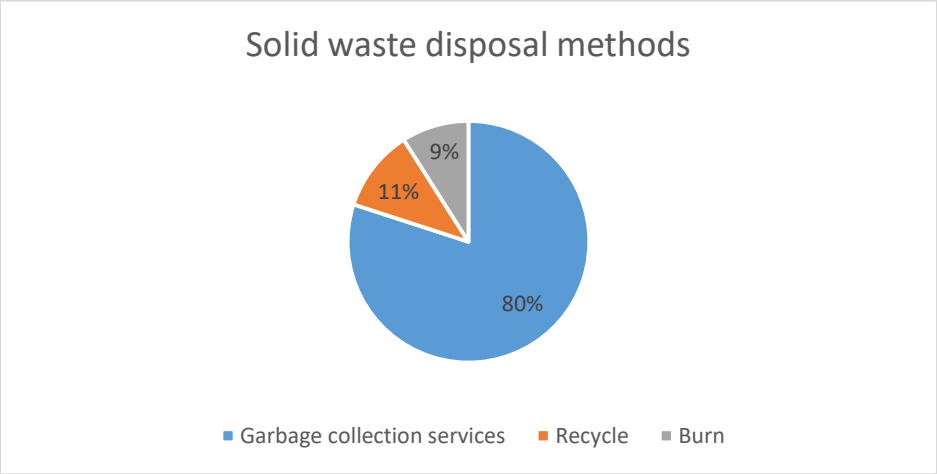
5.6.3 Solid waste management systems

The main challenge facing solid waste management in the Makongeni neighbourhood is the open dumping of wastes. Residents openly dump waste due to insufficient waste collection bins in the neighbourhood. Additionally, the county government does not have sufficient garbage trucks to collect the waste. Therefore, the solid wastes in designated collection points such as near the food market sit for too long before collection. This trend has led to bad odour and loss of aesthetic value.

Solid waste production in the neighbourhood exceeds collection. Only 70% of the waste is collected daily (Thika town ISUDP). According to the field survey, 80% of the residents use

garbage collection services, 11% recycle their waste, and 9% prefer to burn their solid waste. Those who use garbage collection services pay Ksh 100 to Ksh 200 per month.

Figure 13: Solid waste disposal systems



Source: Field survey

Plate 11: Open dumping of wastes

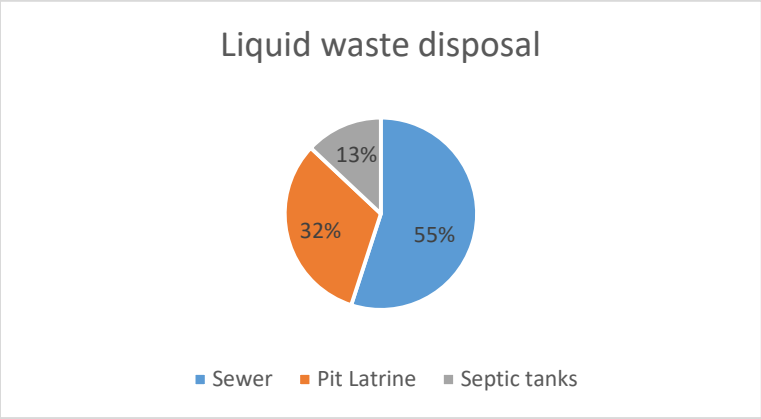
Source: Field survey, 2021

5.6.4 Sewerage systems

The main challenge facing the provision of sewerage systems in the neighbourhood is the overloading of sewer pipes due to the increased population. Thika Water and Sewerage Company (Thiwasco) is responsible for sewerage systems supply in the Makongeni

neighbourhood. Map 8 shows the sewer system reticulation in the neighbourhood. The study revealed that about 55% of the Makongeni neighbourhood residents have sewer systems. Approximately 32% use pit latrines while 13% use septic tanks.

Figure 14: Liquid waste disposal methods



Source: Field survey, 2021

The research revealed that new developments in the southern part of the neighbourhood do not have sewerage systems. According to Ewing (2008), prevailing urban areas usually have water systems, sewers, transit systems, food market infrastructure and solid waste management systems that are usually maintained. However, informal urban sprawl draws away people from these existing developed areas to new areas that require the construction of new infrastructure.

5.6.5 Food market infrastructure

Makongeni neighbourhood has one main food market where people buy and sell fresh fruits and vegetables. The field survey revealed the challenges facing the food market as; congestion, hygiene problems due to delays in garbage collections; blocked drainage system; lack of refrigeration facilities; insufficient permanent stalls; lack of parking for vendors, suppliers and buyers; insufficient lighting; inadequate sanitation facilities; and security problems at night. The Kiambu county government is responsible for providing infrastructure and regular maintenance in the market. The vendors pay a Ksh 30 to the county government daily to operate their businesses.

Plate 12: Makongeni food market

Congested Makongeni market

Fruits and vegetables supply lorries parked along the road

Source: Field survey, 2021

According to Satterthwaite, McGranahan & Tacoli (2010), informal urban sprawl leads to inadequate planning, maintenance and management of food market infrastructures, such as market stalls, garbage collection points and sanitation facilities. In her study on informal food retail in Africa, Skinner (2016) highlights that informal food traders operate under difficult conditions, without access to proper shelters, water, electricity and toilets. Ahmed et al (2015) record that the physical constraints of sprawled areas such as insufficient water reticulation, poor road conditions, congested public spaces and minimal sewerage networks negatively affect food vendors. Inadequate infrastructure and services in food markets pose threats to the health and food safety of the inhabitants since selling food products near uncollected garbage, lack of proper storage facilities, insufficient water and sanitation as well as lack of refrigeration contaminates the food.

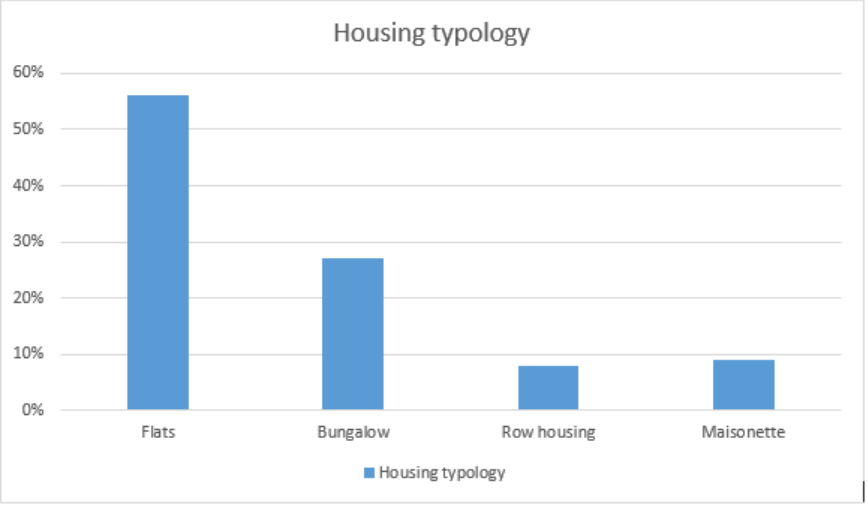
5.7 Impacts of Informal Urban Sprawl on the Provision of Social Infrastructure

5.7.1 Housing

Housing typologies in the Makongeni neighbourhood include flats, bungalows, row housing and maisonettes. Specific housing typologies include; commercial flats, residential flats, mixed-use flats, row housing, maisonette, bungalow, educational facilities, industrial facilities, and health facilities. According to the field study, about 56% of the houses are flats, 27% are

bungalows, 9% are maisonettes, and 8% are row houses. About 81.2% of the residents pay rent, while 18.8% are house owners.

Figure 15: Housing typologies



Source: Field survey, 2021

Plate 13: Housing typologies in Makongeni neighbourhood

Source: Field survey, 2021

The housing demand in the Makongeni neighbourhood exceeds the supply. The total population of the Makongeni neighbourhood is 86,581 persons (KNBS, 2019). The study area has 32, 765 conventional households and 96 group quarters households. The high demand and low supply of housing have led to increased rents in the neighbourhood. The average price of a

1-bedroom apartment is Ksh 14,000 while the average price of buying a house (3-bedroom bungalow) is Ksh 7,000,000. These findings are consistent with Sinha's (2015) claims that the increasing population in sprawling areas creates a demand for housing. Those who cannot afford to pay the high rents in the Makongeni neighbourhood live in informal settlements located in the southern part of the neighbourhood. These settlements are characterized by low-quality housing made of iron sheets. The iron sheets are cheap and easily available to the residents. According to Daef (2002), the retreat by the public sector in developing countries to provide housing leads to an increase in housing costs that makes it difficult for the growing population to pay for minimum housing. Due to the nature of the free housing market, middle-income earners settle outside the city while low-income earners settle in informal settlements. Owing to the character of the unplanned sprawl, the quality of housing deteriorates. People start building shacks and living in houses made of mud bricks and cardboard. Another challenge that affects the housing sector in the neighbourhood is the violation of development control standards. The factors that contribute to defiance of development control guidelines are discussed in section 5.4.5. The violation leads to the construction of non-compliant buildings with small rooms and minimal privacy.

5.7.2 Schools

The neighbourhood has an inadequate number of public schools. Additionally, the average distance to schools in the neighbourhood is higher than the recommended distance, as shown in Table 11. Parents who have enrolled their children in public schools incur high transportation costs. Their children also experience health issues since they sleep for fewer hours and wake up very early to go to school. The majority of the residents have enrolled their students in private schools due to the long distance to public schools and insufficient school supplies in public schools. However, many private schools in the neighbourhood are non-compliant with development control guidelines such as minimum land requirements. As a result, these schools do not provide students with adequate playgrounds.

Table 10: Average distance to schools

Type of school	Public/Private	Approximate distance (km)
Nursery	Public	4.8

	Private	1.4
Primary school	Public	4.8
	Private	1.5
Secondary school	Public	5
	Private	2.3
Tertiary institutions	Private	4.9
	Public	4.7

Source: Field survey, 2021

Table 11: Requirements for education facilities

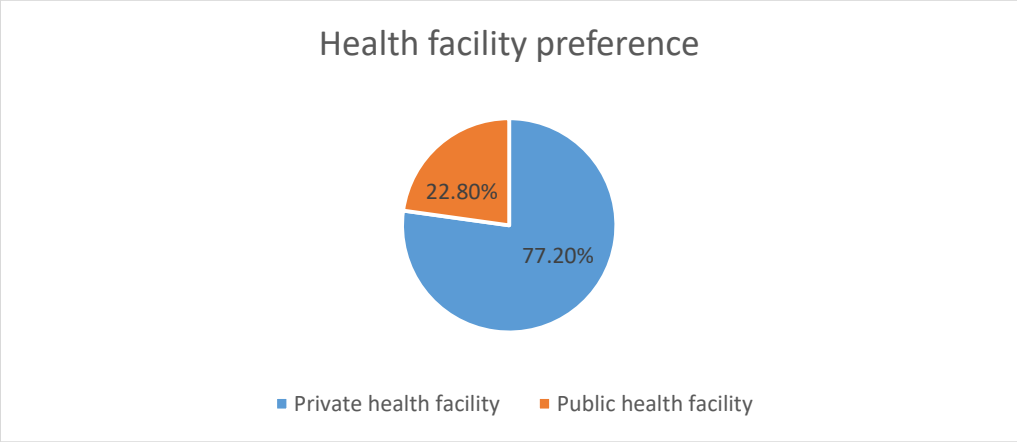
School	Recommended distance	Land requirement
Nursery school	300-500m	0.15-0.25Ha
Primary school	500m-2km	3.9Ha
Secondary school	500m-3km	3.4Ha-4.5Ha

Source: Physical Planning Handbook (2008)

5.7.3 Health Facilities

The field survey identified challenges to public health as; a lack of maternity services at the dispensary, inadequate medical staff, insufficient medicine, and expensive medicine. Due to these challenges, 77.2% prefer to seek medical services at private medical facilities. Others prefer to buy drugs at the chemists without prescriptions.

Figure 16: Health facility preference



Source: Field survey, 2021.

5.7.4 Open Spaces

Makongeni neighbourhood lacks a gazetted open space. However, the residents use the private vacant lots where people rest and engage in recreational activities. These lots are degrading at a high rate due to the open dumping of waste by the inhabitants. In their study on the dynamics of urban sprawl, Sperandelli, Dupas & Dias Pons (2013) explain that informal urban sprawl usually leads to a reduction in green spaces due to increasing population.

5.8 Coping Mechanisms of Makongeni Residents

This section seeks to answer the enquiry '*How do the residents of the Makongeni neighbourhood cope with the deficit of infrastructure?'* The section outlines the strategies that the residents have adopted to cope with the undesirable impacts of informal urban sprawl on the provision of infrastructure.

The first coping mechanism is using *tuktuks* and motorbikes to avoid traffic jams. According to the field survey, 13% of the residents prefer to use motorbikes while 12% use *tuktuks.* These are also smaller modes of traffic that can comfortably fit in the available substandard access roads. According to Onyango (2018), residents of sprawled areas usually devise strategies to curb traffic congestion and poor road conditions. His study on how Kisumu town residents cope with inadequate road infrastructure revealed that people use motorbikes and *tuktuk* to avoid traffic jam in the city. People in the area prefer to use these two forms of public transport to the common public buses to reach their destinations faster.

Plate 14: Residents using tuktuk and motorbikes


Source: Field survey, 2021

The residents of the Makongeni neighbourhood also buy water to cope with frequent water rationing. The water vendors in the area sell at Ksh 20-50 per 20-litre can. Other residents harvest rainwater or use water from boreholes.

Plate 15: Water vendor

Source: Field survey, 2021.

According to the field survey, the residents dig pit latrines and use septic tanks to dispose of their liquid wastes since the sewerage reticulation does not cover all households in the neighbourhood. The septic tanks and pit latrines increase the risk of borehole water contamination in the area. Senn (2020) affirms that shallow water wells get polluted by onsite

sanitation systems in sprawling areas. Another coping mechanism adopted by Makongeni residents is the open burning of solid wastes. According to the field survey, approximately 9% of the residents openly burn their solid wastes. These residents claimed that they prefer to burn their waste since the county government takes too long to collect garbage, which accumulates and becomes a nuisance. Others claimed that they prefer to burn their waste since they do not have money to pay for garbage collection services. To cope with the challenges facing the Makongeni food market, residents have adopted various strategies. For instance, some vendors use their flashlights in the evening due to insufficient lighting in the market, and others place their products on the floor due to insufficient stalls. This creates a hygiene problem. Due to inadequate parking in the market, vendors, suppliers and buyers park along the roads. This trend creates traffic jams along the collector roads near the market. Some vendors also close their businesses early due to insecurity at night. Owing to the challenge of a lack of refrigeration facilities, vendors leave their produce in cotton sacks overnight to prevent the produce from decaying fast.

The field survey revealed that the compliance level with development control standards in the Makongeni neighbourhood is approximately 62.8%. This means that about 37.2% of the buildings are non-compliant with development control regulations. To cope with the situation, the residents settle in houses that lack access to adequate amenities such as water supply, sanitation and waste collection services. The middle-income earners are likely to settle in multi-story buildings while low-income earners live in informal settlements. Businesses in the area also operate from substandard buildings and shacks.

Plate 16: Substandard business shacks

Source: Field survey, 2021

Makongeni neighbourhood has inadequate schools and health facilities. Therefore, the residents enrol their children in private schools and seek medical facilities from private health centres and clinics. The New Humanitarian (2008) affirms that quality healthcare is a luxury that exceeds the reach of the residents of sprawled areas. When residents get sick, they buy medicine from local shops, often without a prescription from qualified health professionals. Sometimes, the medicine is too expensive, and the locals are forced to do without them.

Since the Makongeni neighbourhood lacks a gazetted open space, residents use the vacant private lots for recreational purposes. Plate 18 shows children playing in a vacant private lot. These lots are degrading due to littering by the residents.

Plate 17: Children playing in a vacant private lot

Source: Field survey

5.9 Interventions that will address Urban Sprawl and Enhance Provision of Social and Physical Infrastructure

This section seeks to address the question '*Which planning interventions will mitigate informal urban sprawl and the deficit in the infrastructure provision in the Makongeni neighbourhood*?' The section outlines the suggestions from the research on interventions that will address informal urban sprawl and enhance the provision of infrastructure.

Table 12: Suggestions on Potential Intervention Measures

Problem	Intervention Measures
Ineffective planning	Nationalization of development rights
	Adopt policies on the compulsory acquisition of land
	Adopt policies on the transfer of development rights
	Adopt Smart Growth strategies
Ineffective implementation of existing plans	Improve departmental coordination
	Improve technical know-how (Employ more planners)
	Improve financing of CIPs
Inadequate enforcement of development control regulations	Provision of more resources; funding and vehicles
	Enactment of anti-corruption measures
	Digitization of old records
Non-Compliance with development control	Creation of public awareness programs
	Regular inspections and supervision
	Lowering statutory and professional fees
	Strict enforcement of the regulations

Inadequate provision of physical infrastructure	Expansion of Garissa road
	The pavement of access roads
	The pavement of the bus park
	Provision of parking
	Expansion of water supply and sewerage systems
	Reparation of old pipes
	Provision of permanent stalls, additional flood lights and raising of the perimeter wall in the food market
	Regular collection of solid wastes
Inadequate provision of Social infrastructure	Provision of a green park
	Regular monitoring of housing quality
	Provision of incentives to owners to lower rents
	Provision of books and school supplies
	Provision of more affordable drugs, maternity services, and adequate staffing in the dispensary

Source: Field Survey, 2021

The suggested solution for solving the problem of inadequate planning is the nationalization of development rights, where property developers maintain the right to develop their property, but the state decides what will constitute the development in a land use plan. Another intervention for solving the problem of inadequate planning in Thika municipality is

adopting policies on the compulsory acquisition of land and transfer of development rights to facilitate infrastructure provision. Strategies for enhancing the implementation of plans are; improving departmental coordination; improving the technical know-how of the planning department by employing more planners, and improving the financing of CIPs. Solutions for solving the problem of inadequate enforcement of development control regulations were; the provision of more resources, including funding and vehicles; enactment of anti-corruption measures, and digitization of old records. Additional resources will help the development control officers to carry out regular inspections and improve their efficiency in development control. Anti-corruption measures such as jail terms for rogue officers will reduce the development of non-compliant buildings in the neighbourhood.

Digitization of old records will help the development control office to keep track of development trends in the area. The propositions for improving compliance with development control regulations include; the creation of public awareness programs; regular inspections and supervisions; lowering statutory and professional fees, and strict enforcement of the regulations. Sensitization of the public on development control standards will improve the public's level of awareness and curb non-compliance. Regular inspections and supervision by the development control officers will ensure that new and old developments adhere to the standards. Lowering statutory and professional fees will encourage more developers to consult qualified professionals during the development process. Strict enforcement of the regulations will ensure that ignorant developers will face stiff penalties.

Interventions for enhancing the provision of physical infrastructure in the neighbourhood include; the expansion of Garissa road to accommodate the increasing number of vehicles; pavement of access roads to improve mobility during rainy seasons; pavement of the bus park to improve mobility and efficiency of transport services; provision of more parking spaces to prevent encroachment of road reserves and road-user conflicts; expansion of water supply and sewerage systems to accommodate the increasing population; reparation of old water supply and sewerage pipes; and regular collection of solid wastes. Suggestions to improve the food market are; providing permanent stalls, providing more sanitation facilities, adding flood lights, and raising the perimeter wall in the food market to improve security.

Strategies for enhancing the provision of social infrastructure in the neighbourhood are; regular monitoring of housing quality; provision of incentives to house owners to lower rents; provision of books and school supplies; provision of more affordable drugs, maternity services, and adequate staffing in the dispensary; and the provision of a green park in the neighbourhood.

CHAPTER SIX: SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The main purpose of this research was to explore and generate more knowledge on the concept of informal urban sprawl by examining the causes, impacts on the provision of infrastructure, and coping mechanisms of the urban community in Makongeni neighbourhood. This chapter presents the summary of the findings and recommendations made by the researcher on the intervention measures for curbing informal urban sprawl and enhancing the provision of infrastructure.

6.2 Summary of Findings

The objectives of this study were to; ascertain the factors that contribute to the occurrence of informal urban sprawl in Thika municipality; to assess the impacts of informal urban sprawl on the provision of infrastructure in Makongeni neighbourhood; to determine how Makongeni neighbourhood residents cope with the deficit of infrastructure, and to propose planning interventions that will mitigate informal urban sprawl and the deficit of infrastructure in Makongeni neighbourhood.

6.2.1 Why Informal Urban Sprawl Occurs in Thika Municipality

Makongeni neighbourhood is one of the fastest-growing residential neighbourhoods in Thika Municipality. The rate of urban expansion in the municipality in the last 34 years is 0.91%, and the type of sprawl in the area is multi-directional. This study used Landsat image classification to map the land cover changes in the Makongeni neighbourhood from 1988 to 2021. The built-up area in the neighbourhood increased from 0.92 square kilometres in 1988 to 5.26 square kilometres in 2021. The area covered by vegetation decreased from 7.02 Sq. Km to 1.19 Sq. Km during the same period. The key drivers of informal urban sprawl in the area are; ineffective planning, ineffective implementation of plans, inadequate enforcement of development control standards, defiance of development control standards, and existence of traditional land tenure systems that bypassed planning processes.

The escalation of informal sprawl in the municipality indicates that planning did not adequately address the pre-existing informal urban sprawl in the region, and the duality of planning exacerbates the situation. Ineffective implementation of urban plans in Thika municipality also increases informal sprawl in the area. Factors that affect plan implementation

in the study area are; little coordination between county departments, particularly in planning and budget implementation facets, limited technical know-how, and political interference. The field survey also revealed that inadequate enforcement of development control standards leads to uncoordinated urban growth in the Makongeni neighbourhood. Non-compliance to development control standards also leads to informal urban sprawl in the study area. The general compliance level to development control regulations in the study area is approximately 62.8%. Factors that contribute to the defiance of development control principles include; the desire to maximize profits (29%), high statutory and professional fees (25%), corruption (20%), inadequate public awareness (12%), ignorance (8%), and insufficient inspections and supervisions (6%). The traditional land tenure system that bypassed planning also leads to informal urban sprawl in the area.

6.2.2 Impacts of informal urban sprawl on the provision of infrastructure in the Makongeni neighbourhood

Informal urban sprawl in the Makongeni neighbourhood has devastating effects on the provision of infrastructure. The access roads are generally in poor condition due to low maintenance. The access roads are also narrow and hardly motorable during the rainy seasons. Informal urban sprawl in the area has led to road-user conflicts and congestion on the roads. The residents experience longer commuting times during the rush hour. Public transport vehicles cause road-user conflicts as they pick up and drop off at undesignated areas along Garissa roads. The infringement of the road reserves by hawkers and parked vehicles also leads to congestion in the planning area. Obstruction of stormwater drainage systems in the area causes flooding on the roads during the rainy season.

The field study revealed that only 70% of the residents have piped water. Others harvest rainwater, dig boreholes, or buy water from vendors. The main challenge facing water supply in the neighbourhood is water rationing. Informal urban sprawl also affects solid waste management. The main challenge facing solid waste management in the Makongeni neighbourhood is the open dumping of waste. Residents openly dump waste due to insufficient waste collection bins in the neighbourhood. Additionally, the county government does not have sufficient garbage trucks to collect the waste. Therefore, the solid wastes in designated collection points such as near the food market sit for too long before collection. This trend has led to bad

odour and loss of aesthetic value. The main challenge facing the provision of sewerage systems in the neighbourhood is the overloading of sewer pipes due to the increased population. The field survey revealed the challenges facing the food market as; congestion, hygiene problems due to delays in garbage collections; blocked drainage system; lack of refrigeration facilities; insufficient permanent stalls; lack of parking for vendors, suppliers and buyers; insufficient lighting; inadequate sanitation facilities; and security problems at night. Impacts of informal sprawl on the provision of social infrastructure include; low-quality housing, insufficient public education and health facilities, and degradation of open spaces.

6.2.3 Coping Strategies

The coping strategies that the residents have adopted to manage the undesirable impacts of informal urban sprawl on the provision of infrastructure are; using tuk-tuk and motorbikes to avoid traffic jams; buying water from vendors during rationing; digging boreholes or harvesting rainwater; using pit latrines due to insufficient sewer lines; burning solid wastes; using playgrounds as open spaces; and seeking private educational and medical services.

6.2.4 Possible Intervention Measures

A strategy for solving the problem of ineffective planning is the nationalization of development rights, where property developers maintain the right to develop their property, but the state decides what will constitute the development in a land use plan. Another strategy for solving the problem of ineffective planning in Thika municipality is by including policies for the compulsory land acquisition and transfer of development rights to facilitate infrastructure provision. Strategies for enhancing the implementation of plans are; improving departmental coordination; improving the technical know-how of the planning department by employing more planners, and improving the financing of CIPs. Solutions for solving the problem of inadequate enforcement of development control regulations were; the provision of more resources, including funding and vehicles; enactment of anti-corruption measures, and digitization of old records. The propositions for improving compliance with development control regulations include; the creation of public awareness programs; regular inspections and supervisions; lowering statutory and professional fees, and strict enforcement of the regulations. Interventions for enhancing the provision of physical infrastructure in the neighbourhood include; the expansion of Garissa road to accommodate the increasing number of vehicles; pavement of access roads to improve

mobility during rainy seasons; pavement of the bus park to improve mobility and efficiency of transport services; provision of more parking spaces to prevent encroachment of road reserves and road-user conflicts; expansion of water supply and sewerage systems to accommodate the increasing population; reparation of old water supply and sewerage pipes; and regular collection of solid wastes. Suggestions to enhance the provision of social infrastructure in the neighbourhood were; regular monitoring of housing quality; provision of incentives to house owners to lower rents; provision of books and school supplies; provision of more affordable drugs, maternity services, and adequate staffing in the dispensary; and the provision of a green park in the neighbourhood.

6.3. Conclusion

This study concludes that informal urban sprawl in the Makongeni neighbourhood has been increasing at a fast rate over the past four decades. This trend is expected to continue due to high population and economic growth. Uncontrolled developments have had adverse effects on the provision of infrastructure in the neighbourhood. For instance, congestion on roads, odour due to open dumping of wastes, inadequate water supply, insufficient sewer networks, inadequate public education and health services, substandard housing, and loss of aesthetic value. As a result, they have affected the quality of life. Inadequate planning, insufficient implementation of existing plans, inadequate enforcement of development control codes of practice and defiance of the development control guidelines are the leading causes of the sprawl. Adopting Smart Growth strategies in planning and strict execution of development control regulations can curb the undesirable effects of sprawl on the provision of infrastructure. Additionally, enacting anti-corruption measures in development control will solve the corruption problem. Sufficient funding of institutions that provide physical and structural infrastructure, such as Thiwasco, will enhance the provision of the infrastructure in the neighbourhood.

6.4 Recommendations

6.4.1 Policy Recommendations

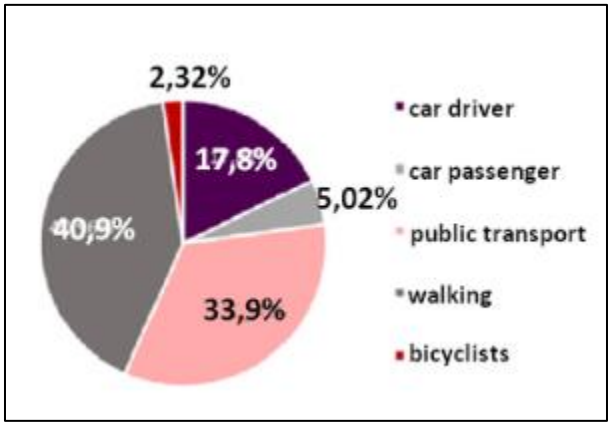
a. Harmonizing the rural-urban ‘divide’ by subjecting the two spaces to planning.
b. Nationalizing development rights to allow the national and county governments to limit the types of development in specific areas through planning.

c. Adopting policies of Compulsory acquisition of land and Transfer of Development Rights into the planning process to curb unplanned settlements and enhance infrastructure provision.
d. Use of innovative land financing mechanisms such as Land Value Capture to develop infrastructure in the neighbourhood.
e. Creation of an autonomous development control oversight association to solve corruption issues by undertaking systematic audits of prevailing developments and the development control administrators mandated to approve developments in the Makongeni neighbourhood. The association would ensure that all developments undergo regular inspections to enhance compliance. The association would also impose strict penalties on corrupt developers or development control officers.
f. Establishment of a neighbourhood association to increase awareness of development control regulations through regular workshops. The association can also assist the development control officials in enforcing the standards in the neighbourhood.
g. The county government should provide the sub-county planning office with adequate resources and vehicles to facilitate adequate development control exercises. The sub-county planning vehicles require more vehicles and funds to facilitate efficient development control exercises.
h. The sub-county planning office should adopt the smart growth concept to prevent further informal urban sprawl and strain on the provision of infrastructure. The smart growth concept constitutes sustainable utilization of existing resources, channelling development to areas that have the prevailing physical infrastructure, and building on existing urban assets to advance urban development and redevelopment. As a result, less land is utilized for the housing, roads and commercial buildings. Smart growth encourages mixed-use zoning, high-density development, reduced reliance on private cars, preservation of open spaces, and revitalization of older infrastructure.

6.4.2 Urban Design Recommendations

a. Upgrading of Garissa road using modal split to A2 level to accommodate all road users, including non-motorized transport.

Figure 17: Recommended modal split



Source: Ungvarai, 2019

b. Expansion of the Garissa road storm water drainage to 1-1.5 m to facilitate surface run-off and prevent flooding during the rainy season.
c. Provision of stormwater drainage in the collector and access roads in the neighbourhood to prevent flooding.
d. Provision of adequate parking facilities to prevent congestion caused by those who park on the roadsides.
e. The pavement of the Bus Park and the provision of shades to improve the transport services.
f. Provision of affordable housing (In line with Agenda 4). The adoption of the smart growth concept will encourage high-density development and provide more housing.
g. Construction of a level 3 hospital to serve the growing population and ensure that the residents receive sufficient public health services.
h. Construction of an additional public primary school, secondary school, special school and a youth polytechnic. The schools will ensure that all residents access public education services.
i. Provision of stalls, adequate sanitation facilities, refrigeration facilities, parking, and another floodlight in the food market. The perimeter wall of the market should also be increased to enhance security.
j. THIWASCO should expand the water supply system to accommodate the growing population and replace the overloaded sewerage pipes and expand the sewerage network.

k. Provision of more garbage bins around the neighbourhood and garbage trucks to make the solid waste collection more efficient
l. Establishment of a waste segregation system in garbage collection points. Waste segregation involves categorizing the waste to be collected into three different categories, that is organic, inorganic (recyclable) and hazardous. After waste segregation at the point of collection, the waste should be incinerated to enhance garbage management.
m. Provision of a green park in the southern part of the neighbourhood.

6.4.3 Areas for further research

This study suggests further research on:

1. The economic benefits and costs of informal urban sprawl.

2. The suitability of development control standards in secondary cities in Kenya.

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Appendix 1: Data Needs Matrix

Objective	Data Needs	Method of data collection	Sources of data	Data collection instruments	Method of data analysis	Presentation technique
To ascertain the factors that lead to informal urban sprawl occur in Thika municipality	Rate of urban spatial expansion	Literature review Mapping	Existing records Landsat images	Document review GIS software	Thematic analysis	Maps Report
	Drivers of informal urban sprawl	Literature reviews Interviews	Existing records Residents	Document review Household questionnaires	Thematic analysis Frequencies	Chart Report
To establish the impacts of informal urban sprawl on provision of infrastructure	Sufficiency and quality of roads, water supply, sewerage systems, solid waste management infrastructure, food market infrastructure, schools, hospitals, open spaces and housing	Observation Interviews Photography Document review	Residents Key informants	Observation checklists Household questionnaire KIG	Frequencies, Cross tabulations Thematic analysis	Tables Charts Photographs Maps Report
To determine how the residents of the neighbourhood cope with	Strategies that residents have adopted cope without adequate infrastructure	Observation Questionnaires	Residents	Household questionnaire	Frequencies, Thematic analysis	Photographs Charts Report

the deficit of infrastructure						
To establish planning interventions that will mitigate informal urban sprawl and the deficit in the infrastructure provision in the neighbourhood	Approaches to improve planning and development control Strategies to improve the quantity and quality of infrastructure	Interviews Document review	Key informants Residents Existing records	KIG Household questionnaire	Thematic analysis	Report

Appendix II: Household Questionnaire

UNIVERSITY OF NAIROBI

SCHOOL OF THE BUILT ENVIRONMENT

DEPARTMENT OF URBAN AND REGIONAL PLANNING

HOUSEHOLD QUESTIONNAIRE

Declaration: As part fulfilment for award of a degree of Master of Arts in planning at the Department of Urban and Regional Planning a student is required to conduct a research and write a thesis on planning issues and as such, I Frida Muriithi Reg. No. B63/12042/2018 is conducting a research on informal urban sprawl and its effects on the provision of infrastructure in Makongeni Neighborhood, Thika municipality. This is therefore to confirm that the data being collected is purely for research purposes and will be treated with strict confidence. Your co-operation is highly appreciated.

Questionnaire Identification Information:

Questionnaire No:

Name of interviewer:

Date:

Section I. Background Information

1. Name of respondent (optional)……
    a. Age…….
    b. Gender. Male…… Female…….

c. Occupation…….

d. Approximate monthly income…….

Section II. Drivers of Informal Urban Sprawl

2. Were you born in Makongeni neighbourhood? Yes ( ) No ( )
3. If No, Name the county/area you lived in before moving to Makongeni neighbourhood….....
4. Which year did you migrate to the neighbourhood?.....
5. Name the reasons for migrating to Makongeni neighbourhood.

   ……..

Section III. Land acquisition and Utilization

6. Do you own the land you live on? Yes ( ) No ( )
7. What is the size of the land in acres?.....
8. If yes to question 1, how did you acquire the land?

Method of land acquisition	Tick appropriately
Inheritance	
Lease	
Purchase	
Allocation by government	
Any other (specify)	

9. Which year did you acquire the land? .....
10. Did you subdivide the land? A. Yes……. B. No……..
11. If yes, how did you use the resultant plots?

    A. Sold…….. B. Developed ……. C. Other (Specify)……..

12. What ownership documents do you possess for the land?

Ownership document	Tick appropriately
Title deed	
Lease agreement	
Temporary occupation license	
Letter of allotment	

Share certificate	
Any other (specify)	
None	

13. If none, why do you not have any ownership documents?

……..

Section IV: Housing

14. Type of house (s) the household lives in. (Filled by observation)

House type	Tick where appropriate
Maisonette	
Bungalow	
Row housing	
Flats	
Other (Specify)	

15. Roof, floor and wall materials of the house. (Filled by observation)

Roof material	Tick	Wall material	Tick	Floor material	Tick
Iron sheets		Cement blocks		Cement	
Concrete		Bricks		Tiles	
Tiles		Stones		Wooden	
Asbestos		Mud and poles		Mud	
Grass		Timber		Other (Specity)	
Other (specify)		Iron sheets			
		Other (specify)			

16. Do you own the house you live in? Yes ( ) No ( )

If yes, complete the section below.

a) In which year was the house constructed?.....

b) Do you have approved plan (s)? Yes ( ) No ( )

c) How long did take to have your plans approved?

(i) Less than a month ☐

(ii) 1 -3 Months ☐

(iii)More than three months ☐

d) What challenges did you face when going through the approval process?

……

……

……

e) Number of floors of the building ……..

f) Number of units…….

g) Estimated project cost (Ksh)…….

h) Estimated returns/selling price …….

i) Source of finance

(i) Mortgage ☐

(ii) Savings ☐

(iii)Others (specify) ☐

If no to question 4,

a) Who owns the house……

b) How much rent do you pay per month in Ksh ……...

c) Why do you prefer staying in this area?

……

……

Section V: Roads

17. Which means of transport do you use most? (Tick the correct)

Means of transport	Tick appropriately
Private vehicle	
Public transport (matatu/buses)	

Motorbike	
Bicycle	
Any other	

18. What is your monthly expenditure on transport? Ksh……..
19. Type of road leading to the property (Filled by observation)
    Tarmac ( ) Murram ( ) Earth road ( )
20. In your own opinion, are the road surface conditions in the neighbourhood good, fair or bad? Good ( ) Fair ( ) Bad ( )
21. How long do you take to reach your place of work? (Hours)……..
22. What is the approximate distance to your work place?.....
23. What transport challenges do you face?

……..

……..

……..

24. What are your suggested solutions to these challenges?

……..

……..

……..

Section VI. Water supply

25. Where do you get water for household use?

Source	Tick	Water provider
Piped water		
Borehole/well		
Rain water harvesting		
Water vendors		
Any other (specify)		

26. Is the water supplied consistent? Yes ( ) No ( )
27. If no, how many days in a week do you access water?..... days
28. How many litres of water do you use per day? ……
29. How do you safeguard against water shortage in your home?.....
    …….
30. What is the quality of water you receive in terms of odor and color?
    Good ( ). Bad ( )
31. In the past one year, has any of your family members suffered from a waterborne disease? Yes ( ) No ( )
    If yes, which disease?.....

Section VII. Liquid and Solid Waste Management

32. How do you dispose liquid waste?

Method of disposal	Tick where appropriate
Sewer	
Pit latrine	
Septic tank	
Open drain	
Soak pit	
Other (specify)	

33. Who provides the liquid waste disposal services? (public/private)

……..

34. How do you dispose solid waste?

Method of disposal	Tick where appropriate
Burn	
Bury	
Recycle	
Garbage collection services	

35. Which types of solid waste do you recycle?

……..

……..

36. Who collects the solid wastes for recycling? Where are these materials taken to?

……..

……..

37. Who provides the garbage collection services?

……..

38. How much monthly fees do you pay for garbage collection?

……..

39. How frequently is the garbage collected?

……..

40. What are the challenges you face in disposing waste?

a) Liquid waste

……..

……..

……..

b) Solid waste

……..

……..

……..

Section VIII: Education

41. What is the approximate distance to the nearest schools? (in km).

Type of school	Public/Private	Approximate distance (km)
Nursery	Public	
	Private	
Primary school	Public	
	Private	
Secondary school	Public	
	Private	
Tertiary institutions	Private	
	Public	

42. What challenges do you face regarding the education institutions?

……..

……..

……..

43. What are your suggested solutions for these challenges?

……..

……..

……..

Section IX: Health facilities

44. What type of health facility do you and your family go to? Specify

a) Public health facility……..

b) Private health facility…….

45. What is the approximate distance to the nearest health facility? (in km) ……..

46. What challenges do you face regarding the health facilities?

Challenge	Tick the appropriate challenge
Long distance	
Inadequate drugs	

Inadequate staff	
Inadequate facilities	
High cost	
Others (Specify)	

47. What proposed solutions would you suggest for better health provision from, or access to public health facilities? ……..

…….

…….

…….

Appendix III: Developers Questionnaire

UNIVERSITY OF NAIROBI

SCHOOL OF THE BUILT ENVIRONMENT

DEPARTMENT OF URBAN AND REGIONAL PLANNING

DEVELOPERS QUESTIONNAIRE

Declaration: As part fulfilment for award of a degree of Master of Arts in planning at the Department of Urban and Regional Planning a student is required to conduct a research and write a thesis on planning issues and as such, I Frida Muriithi Reg. No. B63/12042/2018 is conducting a research on informal urban sprawl and its effects on the provision of infrastructure in Makongeni Neighborhood, Thika municipality. This is therefore to confirm that the data being collected is purely for research purposes and will be treated with strict confidence. Your co-operation is highly appreciated.

Questionnaire Identification Information:

Questionnaire No:

Name of interviewer:

Date:

Section 1: Background Information

1. (a) Name of Respondent(optional)…….....

(b) Age of respondent……

(c) Gender of respondent: (i) Male …….. (ii) Female…….

(d) Level of education of respondent (i) Informal education…… (ii)No formal education……. (iii) Pre-primary……. (iv) Primary……. (v) Secondary ……. (vi) Tertiary…….

2. What is your occupation? .....

Section II. Development

3. What is the nature of your development?
   a. Type of development? (i) Commercial flat …. (ii) Residential flat…….. (iii) Mixed use flat …… (iv) Row housing…….. (v) Maisonette……. (vi) Bungalow…….. (vii) Educational facility……..(viii) Health facility……(ix) Other (specify)……
   b. Number of floors/levels?.....
4. What is the size of your land in acres? .....
5. What is the approximate cost of your development?.....
6. What is the source of capital for undertaking your development?
   (i) Own savings ……. (ii) Cooperative loan…… (iii) Bank loan ……..
   (iv) Other (specify)……..
7. What is the average monthly income from your development? Ksh ……

Section 111. Development Control

8. Do you have any plan for your development? Yes….. No ……
   If yes, which one?.....

   If no, what guides your development? ……..

9. Which professionals were involved in the preparation of the development application/proposal and the cost of the development application/proposal for each professional?

Professional	Component	Cost

10. Do you have development approvals for your development? Yes…….. No…….

    If yes, which ones?

    ……

    ……

    ……

    If no, why?

    ……

    ……

11. When did you get the development application approvals?.....
12. What was the total time taken to process your development applications?.....
13. Which institutions/government departments were involved in the development application approval process and the cost of approval at each institution?

Institution/Government department	Component	Cost

14. Which development control regulations do you know?

    ……

    ……

    ……...

15. Which challenges did you face while getting the development approvals named above?

……

……

16. In your opinion, what are the causes of non-compliance to development control regulations? ……..

……..

……

17. In your own opinion, what measures should be implemented to enhance compliance with development control regulations in Kitengela town?.....

……

Appendix IV: Interview Schedule for Director of Physical Planning

UNIVERSITY OF NAIROBI

SCHOOL OF THE BUILT ENVIRONMENT

DEPARTMENT OF URBAN AND REGIONAL PLANNING

Declaration: This information is confidential and will only be used for academic purposes.

Date:

INTERVIEW SCHEDULE FOR DIRECTOR OF PHYSICAL PLANNING

1. What are the challenges facing planning in Thika municipality?

   ……
   ……
   ……
   ……

2. What are the challenges facing implementation of the existing plans?

   ……
   ……
   ……
   ……

3. What do you think should be done to adequately address informal urban sprawl in Thika municipality?

   ……
   ……
   ……

Appendix V: Interview Schedule for Development Control Officers

UNIVERSITY OF NAIROBI

SCHOOL OF THE BUILT ENVIRONMENT

DEPARTMENT OF URBAN AND REGIONAL PLANNING

Declaration: This information is confidential and will only be used for academic purposes.

Date:

INTERVIEW SCHEDULE FOR DEVELOPMENT CONTROL OFFICERS

1. What is the general level of compliance to development control regulations in Makongeni neighbourhood?

   ……

   ……...

2. What do you (as a department) do to ensure compliance to development control regulations in the neighbourhood?

   ……

   ……

3. At what point do you intervene? Is it during groundbreaking, during construction or after completion and why?

   ……

   ……

4. How can you rate the success of the department in ensuring effective development control regulations compliance within the county? (Please provide statistics on the interventions from the last two years).

   ……

   ……

5. What do you consider to be your main challenges in effecting development control in the neighbourhood?

   ……

   ……

   ……

6. What do you think should be done to improve compliance to development control regulations in the neighbourhood?

   ……

   ……

Appendix V: Observation Checklist

OBSERVATION CHECKLIST

THE EFFECTS OF INFORMAL URBAN SPRAWL ON THE PROVISION OF INFRASTRUCTURE: A CASE STUDY OF MAKONGENI NEIGHBOURHOOD, THIKA MUNICIPALITY, KIAMBU COUNTY, KENYA.

Date…….

Types of land uses present……

Thematic Area	Required Data
Housing	Housing densities (High, Medium & Low) Character of housing; a. Type (Bungalow, manyatta, maisonettes, apartments & others) b. State materials used c. Orientation (North-South or East-West) Condition (Poor or good): Number of buiding per acre Emerging Issues (to be noted in the books provided)
Utility Infrastructure	Water Infrastructure a. Water supply method b. Treatment c. Storage d. Intake e. Source f. Capacity g. Emerging Issues Waste Management

	a. How liquid waste is managed b. Solid waste; Type of waste generated Logistics network c. Emerging Issues
Transport Infrastructure	Roads a. Map and label road networks b. State surface conditions c. Describe function (highway, arterial, primary, secondary & access) d. Indicate if there are road furniture (street lights, traffic lights, bumps etc.) e. State the road and its condition (Poor/Good) f. Size of access road g. Emerging Issues Termini facilities a. Look for the bus stops, bus parks, railway station, boda-boda shades and tuktuk stops in the area b. Comment on land size for the facility (Adequate/Inadequate) c. State the facility available and its condition (Poor/Good) d. Emerging Issues
Community Infrastructure	Health Establish if there are adequate health facilities Schools

	Establish if there are adequate ECD, Primary, Secondary, Tertiary, Colleges & Universities Availability of open Spaces Availability of Market infrastructure e.g. Stalls Waste collection points (Availability)
Type of development Commercial flat Residential flat Mixed use flat Row housing Maisonette Bungalow Educational facility Health facility	Level of Compliance to Development Control Standards Minimum land size Maximum ground coverage Plot ratio Setback Maximum number of floors Parking