IMPLICATIONS OF SMART CITIES ON THE ADJACENT LAND USES: A CASE OF KONZA CITY IN KENYA

BY

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DECLARATION

This research is my original work and has not been presented before for a similar assessment.

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DEDICATION

I dedicate this project to my parents, Mr. Kennedy Kaunda and Mrs. Millicent Atieno Kaunda, for their unending support. Thank you for constantly reminding me that I can achieve anything I dream of and encouraging me to advance my studies. I will forever be grateful for all the sacrifices you made for me to become the person I am today—special dedication to my husband come best friend, Arch. William Mambo Matola, thank you for your love, support, and encouragement. I know I will achieve even greater things with you by my side.

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ABSTRACT

The Smart City era has been ushered in by technological advancements of the 21st century, creating transformative landscapes that integrate technology, infrastructure, and urban planning to enhance the quality of life for residents and promote sustainable development. However, emerging smart cities have failed to integrate with the adjacent land uses, failing to meet the smart city principles. The study aims to investigate the implication of a smart city on the adjoining land uses. The specific objectives of this research are fourfold. First is to assess the effects of Konza City on the adjacent land uses; second is to determine the factors that have contributed to the interrelationship between Konza City and the adjoining land uses; third is to evaluate stakeholder roles, perceptions, and behavior; and fourth is to propose strategies that can be employed to ensure sustainable smart cities and the adjacent land uses. The study focused on the area around Konza City within Konza and Muumandu Sub-locations. The study employed a multi-method approach, combining quantitative and qualitative data collection methods. Quantitative data was collected using a structured questionnaire from 92 households within the study area. Qualitative data was collected through interviews with four key informants, observation, and three focus group discussions with traders and business operators in Malili town. Secondary data was collected from the review of published materials, government reports, and print media. The data was analyzed using SPSS and GIS software (ArcGIS and ArcView). Data collected was presented graphically using tables, bar charts, histograms, pie charts, graphs, spatial maps, and 2D design models. The findings demonstrated that Konza City has significantly influenced the adjacent land use patterns, economic activities, and social dynamics. Konza city has shifted towards more urban and commercial activities. However, challenges such as rising land prices, gentrification, and increased pressure on infrastructure and services have been experienced. These findings highlighted the need for a comprehensive and inclusive approach to smart city planning and development. From the study, it can be concluded that Smart Cities have significant implications on the adjacent land uses, changing the area's character. The area surrounding Konza City has undergone a dynamic shift in land use, from primarily agricultural to commercial and residential, signifying the region's potential for urban growth. The study recommends an integrated spatial planning model that ensures controlled urban development, enhanced accessibility and connectivity with interlinked nodes, improved access to services and facilities, sustainable environmental conservation, and reduced infrastructure strain by promoting other nodes to secondary and tertiary status. This study further recommends a structure plan and zoning guidelines to manage the effects and demands of the adjacent land uses arising from the city.

Key Words: Smart City , Adjacent Land Uses

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LIST OF ABBREVIATIONS AND ACRONYMS

ASALs	Arid and Semi-Arid lands
CSTD	United Nations Commission on Science and Technology for Development
GIS	Geographic Information System
GIT	Geographical information technologies
GPS	Global Positioning System
ICT	Information Communication Technology
KOTDA	Konza Technopolis Development Authority
PLUPA	Physical and Land Use Planning Act
FGD	Focus Group Discussion
NACOSTI	National Commission for Science, Technology and Innovation

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1 INTRODUCTION

1.1 Background to the study

A smart city is an urban area where traditional networks and services become more flexible, efficient, and sustainable using digital information and communication technologies to improve the city's operations for its inhabitants' benefit (Mohanty, Choppali, & Kougianos, 2016). Smart Cities are emerging worldwide as a product of technological advancement, enabling faster communication systems to be incorporated into the fabric of the built environment. From the very initial invention of smartphones, other devices have allowed people to connect with anyone, anywhere and time, for various social and economic benefits. Such ICT-based solutions have also been applied to the planning of cities to meet the multiple priorities in urban sustainability.

ICT-driven approaches to sustainable development have become an emerging trend, suggesting ICT's significant role in making urban environments more sustainable (Habitat 2015). Technology's rapid development, especially Information and Communication Technology in the 1990s, has created a firm foundation for new digital solutions and increased efficiency in tackling complex issues within urban areas (Verburg, Neumann, & Nol, 2011).

Technological advancement has been a critical aspect in the history of urban development. From the Neolithic era, whereby nomadic groups transitioned to agriculture, then later to the Industrial Revolution, which introduced a new combination of transport systems, buildings, and telecommunication networks, there has been a radical transformation of the urban landscape in making cities to become a promise for livable places (McCue, 1994). The Smart City concept is being applied widely with the anticipation that it will solve the complexity and challenges of urban areas while promoting a better quality of life. European cities such as Vienna, Amsterdam, Stockholm, and California in the USA are considered champions for implementing smart cities. Although most smart city initiatives are in highly developed countries like the USA, Korea, and Japan, developing countries, especially in Africa, also focus on integrating this concept into their policies and urban strategies (Alavibelmana & Fazekas, 2018).

Over the past decade, various African countries have been trying to position themselves on the smart cities map, with an extensive list of cities planned and built across the continent. Some

include Hope City in Ghana, Eko Atlantic City in Nigeria, and the Kigali Innovation City in Rwanda. A common aspect in planning such cities is innovative technology that enhances smartness, sustainability, and Eco-friendliness, incorporating mixed land uses and special economic zones.

The smart cities wave in Kenya elicits various spatial forms, locations, and purposes complexities. One of the megaprojects in line with this is the Konza Smart City. It is a flagship project with Kenya's Government Vision 2030, a long-term economic development plan aimed at transforming Kenya into a newly industrializing middle-income country. The City's development strategies focus on economic sectors that advance technology growth in Kenya, hence being dubbed "Africa's Silicon Savannah".

A lot of changes have happened around the smart city. The area was initially very rural and demarcated as part of the Arid and Semi-Arid lands (ASALs) where the main economic activity is pastoralism and thus the ranches were the main source of livelihood. Once the idea of Konza city was born, there was rapid development that was experienced with a lot of subdivisions and land use change, all of these geared to take advantage of the opportunities brought about by Konza City. The adjacent areas have become more urbanized and thus the land use patterns are bound to change due to the increase in population. More land is being converted to residential, commercial, and other forms of urban land use.

Various concerns have been expressed on the implications of the development on the adjacent land uses, particularly issues of social polarization and gentrification. This new smart city's relation to the adjoining land uses is also crucial. This research entailed developing a spatial development framework for symbiotic and sustainable co-existence between smart cities and adjacent land uses.

1.2 Statement of the Research Problem

Smart cities should be inclusive, agile, resilient, and sustainable, able to address the evolving needs and challenges of urbanization. Most aspects relevant to the new urban agenda point out the role and potential of ICT to address challenges and present smart approaches to make cities more livable (Habitat 2015). One aspect of smart cities is how they approach spatial management, particularly in the context of urbanization by promoting compactness through mixed land use,

maximization of land efficiency, and promoting diversified, sustainable, and socially inclusive communities concerning the adjacent areas.

However, smart cities are being planned as technologically self-sufficient islands lacking a well-thought-out concern of their implications on the adjacent land uses in recognition of the pre-existing population and resources (Mondal, 2014). These cities result in new migrants flocking into the area, anticipating economic opportunities. Smart Cities were implemented as a Vision 2030 flagship project to position Kenya on the global map as a leading ICT destination that would expand and leverage Kenya's technology-focused industries (Frischmann 2010). Its vision is to be a sustainable world-class technology hub and a significant economic driver for Kenya. Its central concept is to use technology to address all sectors, such as Housing, water, energy, transportation, health, and the environment.

This research investigates the implications of Konza City to the adjacent land uses. This study provides an understanding of the challenges and opportunities of smart cities in the spatial development of an area. Further, this study recommends physical and land use development for the adjacent areas surrounding smart cities.

1.3 Purpose of the study

The study aimed to assess the implications of smart cities on adjacent land uses.

1.4 Research Questions

1. What are the effects of Konza City on the adjacent land Uses?
2. What factors have contributed to the interrelationship between Konza City and the adjacent land uses?
3. What are stakeholders' roles, perceptions, and behaviour toward Konza City and the adjacent land uses?
4. What strategies can ensure sustainable smart cities and their adjoining land uses?

1.5 Research Objectives

1. To assess the effects of Konza City on the adjacent land uses.
2. To determine the factors contributing to the interrelationship between Konza City and the adjacent land uses.
3. To evaluate stakeholders' roles, perceptions, and behavior towards Konza City and the adjacent land uses.
4. To propose strategies to ensure sustainable smart cities and their adjacent land uses.

1.6 Assumptions of the proposed Study

The study was based on the following assumptions:

i. Smart cities have not generally supported the development of adjacent land uses.

ii. Planning the adjacent land uses will enhance the performance of a smart city.

1.7 Justification and Significance of the Study.

During the 18th annual session of the United Nations Commission on Science and Technology for Development (CSTD), Smart Cities and Infrastructure was selected as one of the priority themes. The new Sustainable Development Goals, the 2030 Agenda for Sustainable Development, the Addis Ababa Action Agenda, and the Paris Agreement under the Framework Convention on Climate Change provide a promising intersection of agendas to address this priority theme. The purpose of building smart cities is to make the lives of the residents more accessible, safer, and inclusive. Applying smart solutions and urban design and planning in the smart city era can prevent crimes (Chiodi, 2016).

The Concept of smart cities is a relatively new one in Kenya. Very few studies have been done linking smart cities to the adjacent areas as most studies have focused on the functionality within the smart cities' boundaries. The implication of Konza's smart city on the development of adjoining land uses has not been adequately documented, justifying the need and significance of this study for the benefit of Kenya and the world.

2 LITERATURE REVIEW

2.1 Overview

This chapter presents a summary of various scholarly studies that have been done previously on smart cities and their implication on the development of adjacent land uses. A brief historical background of the topic of study is done, followed by a conceptual background outlining the existing concepts and constructs of smart cities. A description of common themes and theories is also discussed. A critical analysis of these studies follows this to understand the literature and identify the existing gaps and controversies in the research topic.

2.2 Historical Background to the implication of Smart Cities on the Development of Adjacent Land Uses

The rapid population growth between the 1700s and 1800s in the United States meant that the government had difficulties keeping track of the population and economy as governmental processes like census were conducted by hand (Barrera, 2020). The crisis of government operations was reflected in the census of 1880, which took seven years to complete. Pierce et al, 2013 concluded that cities were growing much faster than the government could measure them, let alone provide services (Pierce, Freed, & Townsend, 2013).

The invention of the International Business Machines (IBM) reduced the tabulation of census data to two years, paving the way for technology in government processes in the USA (Barrera, 2020). Singapore, in 1981, followed suit in setting up the National Computer Board, whose mission was to enhance economic competitiveness and quality of life, country-wide, by exploiting IT.

The expansion of the Internet in the early 1990s influenced the use of ICT to solve urban problems (Hollands, 2008). In this period, IBM exploited its knowledge and experience in technology and pioneered the smarter cities marketing initiatives that facilitated the development of the top-down smart city model. Citizen interest developed and deployed digital-based applications to make cities more liveable (Barrera, 2020). It ensured that governments had access to online data from citizens driving the bottom-up smart city initiatives.

The early smart city initiatives between the 1990s and 2000s gained more attention with the examples of Songdo in South Korea and Masdar City in the United Arab Emirates (Hollands,

2008). They aimed to incorporate advanced technologies and sustainable practices, but only within their boundaries (Hollands, 2008). With this limitation of the application of the smart city aspects, cities such as Songdo, for instance, faced challenges connecting with its larger Incheon metropolitan area. Due to this isolation, Songdo's vision of being an economic hub has not been achieved to date.

After 2010, a shift occurred as smart cities began to recognize the need for regional integration as they realized that the benefits of smart technologies could and should extend beyond city limits (Caragliu, DelBo, & Nijkamp, 2011). This is evident in Barcelona, whose smart city initiatives developed in its surrounding region (Caragliu, DelBo, & Nijkamp, 2011). It benefited neighboring rural areas from improved infrastructure, healthcare, and education (Caragliu, DelBo, & Nijkamp, 2011).

Between 2010 and 2020, smart regions emerged (Allam & Newman, 2018). It further emphasized the need for regional integration, connectivity, and collaboration as isolated smart cities were seen to fail, as is the case with Songdo (Allam & Newman, 2018). This approach recognized economic, social, and environmental challenges (Allam & Newman, 2018).

In China, urban sprawl is the phenomenon that goes together with developing smart cities. Sprawl is featured by the dynamic evolution of urban spatial structure (Hao, Chen, & Min, 2021). It is manifested by geographical space expansion and decreased population density, making the urban structure more decentralized and polycentric (Hao, Chen, & Min, 2021).

2.3 Conceptual Background

2.3.1 The Concept of Smart Cities

Smart cities are defined as effectively integrating the physical, digital, and human systems to deliver a sustainable and inclusive built environment (BSI 2014). It can also be defined as an urban area encompassing the different scales of a city (Street, Plaza, Neighborhood, or the entire city) (Moura, 2019). Such information may include energy, transportation, water supply, waste management, building management, and environmental control. There have been several definitions of the concept of smart cities as presented by Albino et al. (2015) and Dameri (2017) some of which are highlighted as follows:

Table 1 Scholarly Definitions of Smart Cities

Author (Year)	Definition
(Hall et al., 2000)	A city that integrates and monitors the conditions of all its critical infrastructure to maximize its resources, plan preventive maintenance accordingly to maximize its efficiency to the Inhabitants.
(Giffinger, Fertner, Kramar, & Meijers, 2007)	A city performing in a forward-looking way by searching and identifying intelligent solutions to enhance the services provided to the citizens.
(Su, Li, & Fu, 2011)	A product of the digital city combined with the Internet of Things.
(Guan, 2012)	A city prepared to provide a healthy and happy community under challenging global, environmental, economic, and social conditions.
Bakici et al. (2013)	An advanced high-tech city that connects people, information, and various city elements through technology to create a greener and more sustainable city with increased quality of life.

According to this study, a smart city is considered a city that pursues sustainable development through Information and Communication Technology by making the city's components more intelligent, interconnected, and efficient to achieve social, economic, and environmental goals to improve the quality of life of its inhabitants, and the adjoining land uses.

The concept of smart cities entails six main attributes. These include Smart Mobility, Smart Economy, Smart Environment, Smart People, Smart Living, and Smart Governance (Yigitcanlar & Lee, 2014).

2.3.1.1 Smart Mobility.

Smart mobility encompasses intelligent transportation and transport systems. It also incorporates an attribute of transport management, which facilitates the movement of people from one point to another. Intelligent parking solutions are also integrated into the mobility plan of the city (Galati, 2018)

2.3.1.2 Smart Economy

A smart economy is an economy that is based on innovation. (Yigitcanlar & Lee, 2014) Points out that resource efficiency and sustainability are critical in ensuring the success of the economy of smart cities. It adopts innovative new entrepreneurial initiatives to increase productivity and competitiveness to improve the quality of life of its inhabitants.

2.3.1.3 Smart Environment

According to (Moura, 2019), a smart environment includes efficient water and waste management and monitoring environmental indicators to manage any environmental stress. Sustainable urbanization and Urban resilience are critical concepts that are incorporated in a smart environment.

2.3.1.4 Smart People

(Batty, 2012) explained that the hierarchy of social and human capital measures smart people. These include affinity to lifelong learning, creativity, open-mindedness, and participation in public life. Smart city solutions support an accessible and inclusive environment to increase prosperity and innovation within its community.

2.3.1.5 Smart Living

Smart living encompasses all aspects that support a high-quality level of life. Such elements include health conditions, safety, and housing quality. Smart living focuses on improving social and digital inclusion so people can easily access electronic services, connectivity, and various social platforms. Smart living focuses on all age groups and demographics so that people of all ages, young and old, can enjoy increased quality of life through an inclusive strategic approach.

2.3.1.6 Smart Governance.

Smart governance is characterized by the people's participation level in a particular geographical area (Batty, 2012). It includes people's participation in decision-making, transparent governance, and various political strategies that run the day-to-day lives of the city.

2.3.2 The Concept of Land Use

Land has a critical role in human life. It is used for various activities such as settlement areas, agricultural activities, and the setting up of industries. Land use is a permanent human intervention that arises from the fulfillment of the needs of nature. It is an interaction between human beings

and their environment, policies, and human attitudes. It is considered one of the primary drivers of global change with a significant implication of various policy issues (P.H. Verburg, K. Neumann, L. Nol, 2011).

Several factors affect land use, including population growth, income levels, occupation, urban development policies and regulations, business taxes, political power and land use decision-making, pedestrian and vehicular traffic, technology, and time frame from approval of development plans (Mwathi, 2016).

In this study, land use is defined as the various human efforts applied on a particular space to utilize the natural environment to meet various needs in life. It shall be categorized as residential, commercial, educational, industrial, recreational, public purpose, public utilities, urban agriculture, and transport.

2.4 Effects of Smart Cities on the Development of Adjacent Land Uses

A study by Hasanawi and Winarso 2018, titled 'Land-Price Dynamics Surrounding Large-Scale Land Development of Technopolis Gedebage, Bandung', Indonesia, aimed to explain the dynamics of the land price surrounding the large-scale land development. The key objectives were to examine land price changes over the last 16 years with specific characteristics, analyze the effect of large-scale land development on land price, and estimate the contribution of land value (market price) to these characteristics. They employed a descriptive research design, targeting a population of 120 community associations. Purposive sampling was used to obtain data from the community association leaders. Data collection methods included a literature review, observation of the existing land use, and interviewing of land brokers and local communities (Hasanawi & Winarso, 2018).

Hasanawi and Winarso (2018) observed that the recent rise in prices exhibited a consistent trend of being higher in suburban areas compared to the inner city. This phenomenon was primarily attributed to the substantial demand driven by the extensive land development project of Technopolis Gedebage. Moreover, they noted that the escalating land prices were challenging to control, as the market rates experienced rapid growth after the establishment of Gedebage as a technopolis region. The authors concluded that the costs of properties situated near main roads, involved in large-scale development initiatives, and benefiting from robust infrastructure and

tenure security, witnessed a more rapid increase compared to plots that lacked formal sector services in fully serviced subdivisions (Hasanawi & Winarso, 2018). These findings concerning increased gentrification and land prices resonated with the research conducted by Avianto (2017) and Noorloos, Avianto, and Opiyo, both of which focused on Konza Smart City in Kenya.

Hasanawi and Winarso, 2018 conducted their study in Indonesia, whose dynamics are not similar to those in Kenya. The study focuses on assessing the dynamics of land prices around techno-cities, while this study aims to understand the implications of smart cities on adjacent land uses. Their study offers an understanding of the changes in the market price of land around smart cities. The study employed a qualitative research design and failed to analyze these dynamics' quantitative aspects. Data collection did not represent the whole population as the study relied on a purposive sampling design.

Soud K. Al-Thani, Cynthia P. Skelhorn, Alexandre Amato, Muammer Koc, and Sami G. Al-Ghamdi, 2018 conducted a study on "Smart Technology Impact on Neighborhood Form for a Sustainable Doha, Qatar." The main question raised in this study is: considering the existing neighborhoods of Doha, how can smart transportation and communication technologies improve the sustainability and livability of the low-density city? The research objectives include exploring and understanding the impact of smart transportation on cities' urban planning. to emphasize the credibility of a low-density sustainable city with new smart technology and to focus on the polycentric development of neighbourhoods because it is the most appropriate approach for turning Doha into a sustainable, resilient city. The study employed theories on sustainable and livable neighborhoods, neighborhood units, Livable Renovation of Existing Neighbourhoods, and New Urbanism. Theories on smart technology's impact on urban planning were sustainable mobility and communication technology (Al-Thani, Skelhorn, Amato, Koc, & Al-Ghamdi, 2018).

The research adopted a descriptive survey design and employed a purposive sampling strategy. To gather data from key informants, the study utilized the Delphi method. However, it's worth noting that the study did not specify the number of key informants interviewed or the size of the population under investigation. The Delphi method involves convening a panel of subject matter experts who participate in answering both initial and follow-up questions in a sequential manner. These experts are given questionnaires anonymously, with each successive round of questioning

building upon the insights derived from the previous rounds (Al-Thani, Skelhorn, Amato, Koc, & Al-Ghamdi, 2018).

The findings from the Delphi Group highlighted their preference for a multi-centered urban structure when pursuing sustainability objectives. This group affirmed the notion that focusing on neighborhoods serves as a promising starting point for enhancing sustainability and livability. Additionally, they recognized that smart principles could mitigate urban fragmentation, thanks to their self-sufficiency. The research's overarching conclusion underscores the potential of technology to bolster neighborhood autonomy, particularly in the realms of energy, waste management, and transportation. Furthermore, it advocates for the foundation of smart cities on principles of polycentricity rather than mono-centricity (Al-Thani, Skelhorn, Amato, Koc, & Al-Ghamdi, 2018).

The study by Al-thani et al. (2018) fails to analyze the quantitative factors and impacts of smart technology on transportation and communication on the sustainability and livability of low-density cities in Doha, Qatar. The study provides no given sample of the key informants that were interviewed. The study employed the Delphi data collection method, which is based on assembling a group of subject matter experts. It is not representative of the general population.

Jessie Alda conducted a "Case Study of the Performance of Export Processing Zones Garment Firms in Mauritius and Kenya in the Dawn of Agoa Phase IV" in 2008. The main research question was, "How have the Export Processing Zones in Kenya and Mauritius benefited each country's industrial development?"

This study aimed to investigate whether the presence of Export Processing Zones in Kenya and Mauritius has benefited each country's industrial development. The study had three objectives, which were to discuss the challenges to the Export Processing Zones in Kenya and Mauritius in the dawn of AGOA Phase IV, to examine how the presence of the Export Processing Zones in Kenya and Mauritius has been beneficial to the industrial development each country's garment firms and to explore the performance of EPZ garment firms in Kenya and Mauritius, measured in export performance in U.S. dollars from 1999 - 2005. Alda (2008) employed qualitative research design through a case study approach. The target population was the Kenyan Export Processing Zones Authority and the Mauritius Central Statistics Office. The researcher used a purposive sampling design and collected data through a literature review and key informant interviews. The

study concluded that there is a positive relationship between industrial development and Export Processing Zones in Kenya and Mauritius (Alda, 2008).

The study by Alda(2008) focused on establishing the economic and social impacts of Export Processing Zones from a national perspective. This study fails to assess the implications of Export Processing Zones on adjacent land uses. It relies on qualitative data collection methods and case study analysis to compare EPZs of Kenya and Mauritius.

Dicky Avianto, 2017 conducted a study in Kenya. The study was entitled "Konza Techno City and Its Impact on the Surrounding Local Communities". Its purpose was to investigate the impact of Konza Techno City (KTC) and its buffer zone as a New Planned City project on the local community surrounding the project site. The study's research questions included: what did the planning process and implementation of Konza Techno City look like? To what extent did the Malili and Old Konza local communities get involved in the planning process and implementation of Konza Techno City? How does the Konza Techno City buffer zone change the land tenure and land use plan in Malili and Old Konza? How does implementing Konza Techno City and land use change in the buffer zone potentially affect the livelihood of local people in Malili and Old Konza? (Avianto, 2017)

Avianto's study was anchored on theories such as the Ladder of Citizen Participation, Garden City Theory, Communicative Planning Theory, New Planned City, stakeholder engagement and Power Relations. The study employed an explanatory research design, which is qualitative. The study relied on a multistage sampling design involving random and snowball sampling of key informants. Data collection methods included key informant interviews and questionnaires. (Avianto, 2017)

He found that there is an increase in informal commercial activity and development. The surroundings of Konza Techno-city were also found to receive small improvements, such as better access to electricity and an improved water supply. He finally states that the surrounding is highly susceptible to future gentrification due to these improvements to Konza and its environs that attract people (Avianto, 2017). This study agrees with the study by Hasanawi and Winarso, 2018 in Indonesia, where smart cities have fueled the gentrification of areas around upcoming smart cities.

Avianto's study fails to analyze the implications of Konza on spatial aspects of the surrounding Malili Town. It explored the level of involvement of the local communities in planning and implementing Konza Techno-City. It also analyzed the impacts of the city on the livelihoods of local communities. The study employed a non-random sampling technique, snowballing, to interview key informants.

A study conducted in Konza Techno City, Kenya, by Femke Van Noorloos, Diky Avianto, and Romanus Otieno Opiyo in 2019 was titled "New Master-Planned Cities and Local Land Rights: The Case of Konza Techno City, Kenya." Its purpose was to assess African new cities' impacts on people's land access and livelihood. The study employed a descriptive survey design and a purposive sampling design through key informant interviews (Noorloos, Avianto, & Opiyo, 2019).

The research revealed that a buffer zone was established to deter the unregulated growth of informal developments around the project, as these developments had the potential to be visually unattractive and deter potential investors. Following the announcement of Konza Techno City in 2012, growth accelerated significantly, leading to further subdivision and sale of land. This rapid urbanization resulted in the construction of additional semi-permanent structures within the buffer zones. The introduction of extra infrastructure and buffer zones was found to contribute to population displacements, while new land-use and zoning regulations introduced livelihood insecurities. The study also identified that the fence surrounding Konza Techno City acted as a barrier, preventing local pastoralists from traditionally grazing their cattle in the area. Additionally, it was observed that Malili experienced substantial land speculation, as land prices saw a significant increase since 2006–2007 (Noorloos, Avianto, & Opiyo, 2019). Hasanawi and Winarso (2018) also believe that new techno-cities spur increased land rates and gentrification.

The study by Noorloos, Avianto, and Opiyo in 2019 focuses on the impacts of Konza Techno City on people's access to land and livelihoods, while this study focuses on the implications of smart cities on adjacent land uses.

2.5 Roles, perceptions, and behaviours of stakeholders towards Konza City and the adjacent land uses

According to Hasanawi and Winarso (2018), the infrastructure projects developed in Technopolis Gedebage, Bandung, Indonesia, such as the KM 149 toll gate plan and the TOD terminal, were predominantly utilized by the developer rather than benefiting the community. They suggest that the private sector should be responsible for constructing private facilities and implementing a zoning bonus mechanism, with a particular focus on the neighboring areas. It is also recommended that the Technopolis Gedebage community plays a more significant role in determining the direction of regional development, as indigenous people are marginalized by being coerced into selling their land with the expectation of fetching high prices. This situation prevents them from directly experiencing the future development impacts of Technopolis Gedebage. To mitigate price hikes and enhance the accessibility of affordable land for housing for low-income individuals, the government should explore strategies for increasing the supply of informal-sector plots (Hasanawi & Winarso, 2018).

Hasanawi and Winarso (2018) discovered that the escalating land prices were challenging to manage, primarily due to the rapid rise in market rates following the designation of Gedebage as a technopolis area. However, they contend that this situation could indirectly impose a burden on lower-middle-class communities, leading to their displacement from their land. This displacement would significantly affect their diminishing income, as it would result in the loss of vital livelihood resources, such as farming and agriculture (Hasanawi & Winarso, 2018).

Tom Erik Julsrud & Tanu Priya Uteng, 2015, undertook a study titled “Technopolis, shared resources or controlled mobility? A net-based Delphi-study to explore visions of future urban daily mobility in Norway”. The purpose of this study was to contribute to building a stratified understanding of the scenarios we might be looking at with respect to future daily mobility. The research objective was to develop a set of scenarios describing public transport users in central urban areas in Norway in 2050.

They employed a descriptive research design and a purposive sampling design to obtain data from transportation planners and experts. Data collection methods involved a literature review and online, real-time Delphi survey (Julsrud & Uteng, 2015). Julsrud and Teng (2015) found that among younger men and individuals in urban areas, there is a reduced reliance on car travel, while

women and those residing in less densely populated regions tend to use cars for transportation more frequently. They suggest that future urban mobility may witness changes and shifts in preferences (Julsrud & Uteng, 2015).

In the study by Al-Thani, Skelhorn, Amato, Koc, and Al-Ghamdi (2018), it was observed that technology plays a significant role in providing information, engaging with users, enhancing quality of life, and promoting sustainable behavior. Technology can also facilitate neighborhood independence, which, in turn, fosters sustainability in terms of energy, waste management, and transportation, thereby fostering a sense of belonging within the community (Al-Thani, Skelhorn, Amato, Koc, & Al-Ghamdi, 2018).

Alda (2008) uncovered a positive correlation between Export Processing Zones (EPZs) and industrial development in Mauritius and Kenya. However, the research also noted that while EPZs initially create a substantial number of jobs within a country, these jobs often lack quality and cost-effectiveness. The diversification of the Mauritian EPZ program has been identified as a crucial economic benefit to the Mauritian economy (Alda, 2008).

Avianto (2017) highlighted the low level of community involvement and the dominant top-down approach in the planning process for Konza Techno-city, which makes the impact of the city on the local surrounding communities almost inevitable. The study concludes that Konza Techno City had minimal immediate effects on the local communities during its early implementation phase. However, the anticipated long-term impacts, including congestion and rapid development in the surrounding areas or buffer zones, may restrict access to land for pastoralist communities. The employment opportunities in Konza Techno City are primarily geared toward high-skill labor, which may pose challenges for local communities with limited education and access to educational resources in the current neighborhoods of Malili and Old Konza (Avianto, 2017).

Noorloos, Avianto, and Opiyo's 2017 study found that the announcement of Konza Techno City and the associated expectations attracted a significant influx of newcomers from across Kenya seeking job opportunities and improved infrastructure, with hopes of benefiting from rising land prices. The introduction of extra infrastructure and buffer zones was found to contribute to displacements, while new land-use and zoning regulations led to livelihood insecurity. Residents expressed concerns about meeting modern building standards and the potential risk of their homes being demolished or purchased by high-income individuals and well-off investors who can meet

the development criteria. As a result, many structures in Malili remained semi-permanent. The study also identified that the fence surrounding Konza Techno City acted as a barrier, preventing local pastoralists from traditionally grazing their cattle in the area.

Furthermore, the research revealed that the city's lack of expertise resulted in multiple changes to the project and a failure to submit and obtain approval for public planning and environmental licensing documents. Citizen participation was found to be limited to the "informing" level, often seen as tokenistic rather than genuinely participatory. The study concluded that new cities are introduced into existing environments with pre-existing activities, human populations, and livelihoods, which begin to evolve and change as soon as the concept of a new city is developed (Noorloos, Avianto, & Opiyo, 2019).

2.6 Strategies for sustainable smart cities and the development of adjacent land uses.

Hasanawi and Winarso (2018) propose that the Indonesian government should undertake comprehensive data collection, including historical land price trends, and conduct a thorough analysis of the target development areas before formulating plans. This approach would ensure that the development of these regions benefits the community rather than solely serving the interests of developers. They emphasize the importance of constructing public infrastructure. To mitigate the negative effects of private sector activities, they suggest implementing a mechanism, like a zoning bonus, in the vicinity of the Semanggi ring toll road in Jakarta. Furthermore, they recommend that the private sector should not only be responsible for developing private facilities but should also consider implementing a zoning bonus system with a focus on the neighboring areas.

The study underscores the need for active participation from the Technopolis Gedebage community in shaping the direction of regional development. Indigenous people have been marginalized by being compelled to sell their land with expectations of high selling prices, thus preventing them from directly experiencing the future impacts of Technopolis Gedebage development. To alleviate rising land prices and enhance access to affordable housing for low-income individuals, the government should explore strategies for increasing the availability of informal-sector land plots.(Hasanawi & Winarso, 2018).

Julsurd and Uteng (2015) suggest that scenario planning should be employed to manage controlled mobility and shared mobility within emerging Technopolis areas. They argue that the traditional transport modeling exercises fail to capture the complexities of travel behavior and predict future scenarios accurately. Therefore, they advocate for further research to fully comprehend the interactions between a 'Controlled Mobility' future, the emergence of 'Technopolis,' and the concept of 'Shared Mobility.'

In their 2018 study in Qatar, Al-Thani, Skelhorn, Amato, Koc, and Al-Ghamdi recommend a shift in city planning approaches. They propose that city planning should no longer be exclusively top-down but should incorporate both bottom-up and top-down procedures. This contrasts with the recommendation by Julsrud and Uteng in 2015, who endorsed a relatively top-down approach through scenario planning for techno-cities. However, Avianto (2017) and Noorloos et al. (2019) support the integration of both top-down and bottom-up approaches in planning techno-cities.

Alda's case study analysis of Kenya and Mauritius suggests the need for increased local ownership of Kenyan EPZ firms. He emphasizes that ownership of Kenya's EPZ enterprises should account for 53.5%.

In his study, Avianto recommends that new planned cities should not neglect local needs and livelihood conditions during the planning process, as these cities are not isolated entities. He proposes an integrated planning process that involves local communities to achieve inclusivity as outlined in Sustainable Development Goal number 11. Avianto further recommends making Konza Smart City's plan more inclusive across different segments of society. This can be achieved by revising the Buffer Zone plan to integrate local communities in the surrounding area, considering their socio-economic conditions. Additionally, he advocates for increased transparency and communication about the plan and its implementation to the surrounding communities through frequent two-way public meetings. These recommendations align with the views of Al-Thani et al. (2018) and Noorloos et al. (2019), who also emphasize that planning techno-cities should involve both bottom-up and top-down approaches to ensure community involvement and benefits.

2.7 Research gaps and inconsistencies

Studies on the implications of smart cities have failed to analyze the quantitative implications of smart cities on the adjacent land uses. Only two studies have been conducted in Kenya, both of which have focused on the social and economic impacts of Konza Smart City.

The studies reviewed have failed to capture the impacts of smart cities on adjacent land uses. In light of this, the proposed research aims at bridging this knowledge gap.

2.8 Legal, Policy and Institutional Framework

2.8.1 Legal Framework

a) The Constitution of Kenya, 2010

The Constitution serves as the ultimate legal authority in the country, establishing the fundamental principles for Kenya's well-being. Article 60 of the Kenyan Constitution focuses on the sustainable and effective management of land resources, as well as ensuring fair access to land. It explicitly stipulates that land in Kenya must be utilized, held, and administered fairly, efficiently, productively, and in an environmentally sustainable manner. Article 67 assigns the National Land Commission the responsibility of supervising and overseeing land use planning across the entire nation.

In Chapter eleven, specifically Article 174, the Constitution outlines the objectives of government devolution, which include granting people the authority to self-govern and encouraging their active participation in decision-making processes concerning the state's powers and their own interests. Article 184 emphasizes the need for national legislation to facilitate citizen involvement in the governance of urban areas and cities.

b) The Physical and Land Use Planning Act No. 13 of 2019

The Physical and Land Use Planning Act of 2019 addresses the need for comprehensive land planning throughout Kenya, including the essential requirement to plan the region encompassing the smart city and its surrounding areas. The legislation defines a local physical and land use development plan as a plan intended for a specific area within a city, municipality, town, market center, or urban center. These plans are formulated by county governments and provide clear guidance on the procedures to be followed during development processes.

The Act confers upon County Governments the authority to regulate land use and development activities within their respective jurisdictions to ensure orderly and appropriate development within those areas. It explicitly states that no development may proceed within the jurisdiction of any local authority without obtaining the necessary development permission. As a result, any developer seeking such permission must complete a PPA1 form as specified in the Fourth Schedule. Section 33(1) empowers County Governments to evaluate and either grant or decline development permission as per the form prescribed in the Fourth Schedule, with the requirement to provide reasons for any refusal. Consequently, county governments are responsible for the oversight of development activities within their jurisdiction.

Section 52 of the Act defines special planning areas, which are areas characterized by unique development potential, natural resources, or environmental challenges. These areas may be deemed suitable for intensive and specialized development activities, which could have significant effects extending beyond the immediate locality. The section further mandates County Governments to establish regulations to facilitate public participation when designating an area as a special planning area.

Furthermore, Section 29 of the Physical and Land Use Planning Act outlines the possibility for two or more counties to collaborate on an inter-county physical and land use development plan through mutual agreement or in cases of compelling necessity. This provision is particularly relevant to the scenario of Konza City and its adjacent areas, as they encompass sections of Machakos, Makueni, and Kajiado Counties.

c) The County Government Act No. 17 of 2012

This legislation is enacted to implement the provisions of Chapter Eleven of the Constitution, which delineate the powers, functions, and responsibilities of county governments for the delivery of services and related matters. The Act bestows upon County Governments the overarching authority concerning planning and development control within their respective areas of jurisdiction. Consequently, all requests for development must undergo evaluation and approval by the designated departments established by the County Government to oversee planning.

Within the framework of this Act, the County Government's responsibilities and roles in development planning and land use planning encompass the formulation of municipal or urban area plans, which serve to facilitate and regulate development activities within their jurisdiction. Section 11 specifies that every city and municipality must establish land use plans, building plans, and zoning plans, which serve as the instruments for facilitating and regulating development processes.

d) Urban Areas and cities Act No. 13 of 2011

This legislation establishes management boards for cities and municipalities, tasked with overseeing and regulating developments within their respective jurisdictions. Their primary responsibility is to ensure the enforcement and adherence to policies set forth by both the national and county governments. Sections 36(1), 37, and 38 in Part V of the Act stipulate that every city and municipality established under this legislation must operate within a framework of integrated development planning. This approach is aimed at contributing to the protection and promotion of the fundamental rights and freedoms outlined in Chapter Four of the Constitution and working towards the gradual realization of the socioeconomic rights of the local population.

Section 11 outlines the principles governing governance and management, emphasizing the importance of involving residents actively in city management affairs. In line with the provisions of Section 11, Section 22 promotes public engagement through citizen forums established within cities.

e) Environmental Management and Coordination Act (EMCA), 2012 amendment

The Environmental Management and Coordination Act (EMCA) of 2012 establishes the legal and institutional structure for the management of the Kenyan environment, with a primary objective of safeguarding the well-being of the public. According to this act, an environmental impact assessment is a methodical evaluation conducted to ascertain whether a program, activity, or project is likely to result in any harmful effects on the environment. Section 58, subsection 1 of EMCA mandates the conduct of an environmental impact assessment study for all development projects. This requirement is in place to ensure that appropriate mitigation measures are implemented to avert potential hazards.

2.8.2 Policy Framework

a) Sustainable Development Goals 2015

This global appeal for action encompasses a collection of 17 Sustainable Development Goals (SDGs) aimed at combating inequality, addressing injustice, eliminating poverty, and addressing climate change by the year 2030. The evaluation and comprehension of development within Konza's smart city and its surrounding areas were conducted within this framework to promote fair and sustainable progress and land administration. Key SDG objectives relevant to the planning process encompass the eradication of poverty, the promotion of health and well-being, ensuring access to safe and affordable drinking water and sanitation, and making investments in infrastructure and innovation. These aspects are fundamental drivers of economic growth and overall development, among other associated goals.

b) National Land Policy 2009

Throughout human history, land has played a significant role in society. However, key challenges Throughout the course of human history, land has consistently held a pivotal role in shaping societies. However, Kenya faces substantial challenges in ensuring the optimal and sustainable utilization of land. The prudent management of natural resources, with land being a significant component, is predicated on the fundamental principle that establishing an equitable and sustainable relationship between humans and natural resources is imperative for the stability and advancement of the land sector in a nation's development. In line with the provisions of the Constitution of Kenya from 2010, the National Land Commission is entrusted with the responsibility of executing efficient, equitable, and sustainable land administration and management across the entire nation.

One of the primary hindrances to the growth of smart cities in Kenya is the absence of effective connectivity between these cities and their neighbouring areas. This deficiency is exacerbated by a lack of comprehensive land use planning in the regions adjacent to the smart cities, resulting in incompatible land uses. Addressing this challenge demands a particular emphasis on inclusivity to foster sustainable growth.

c) Kenya’s Vision 2030

Vision 2030 serves as Kenya's long-term development roadmap, founded on the principles of sustainable development with the objective of achieving a fair and unified society experiencing equal social progress within a clean and secure environment. This vision aims to sustain economic growth, establish a people-centric, results-driven, and accountable nation, and ultimately transform Kenya into a globally competitive and affluent nation with an enhanced quality of life by the year 2030. Within the framework of Kenya's Vision 2030, there exists a desire for Kenya to evolve into a middle-income nation that rapidly industrializes and competes on the global stage. To facilitate this process, it is imperative to have an effective industrial policy framework in place. Furthermore, the constitutional structure places a renewed emphasis on economic performance within the national and devolved governance framework. Consequently, comprehending the ramifications of smart city development on adjacent land usage is essential to realizing this vision.

The development of smart cities in Kenya is a significant stride towards realizing the Vision 2030 objectives. However, it is imperative to address the adverse impacts of these smart cities on the surrounding lands. The overarching goal of Kenya Vision 2030 is to create a globally competitive and prosperous nation with an elevated quality of life by 2030. Konza Technopolis, as a flagship project under Vision 2030, aligns with the vision's objectives through several key avenues. These include enhancing the country's human capital, particularly in Science, Technology, Engineering, and Mathematics (STEM); diversifying the Kenyan economy by fostering an innovation ecosystem for nurturing technology businesses; boosting investments in research and development (R&D) by attracting R&D centres and technology companies; and generating technological solutions for urban development challenges. Konza Technopolis is envisioned as a sustainable, world-class technology hub that will significantly contribute to Kenya's economic development, hosting cutting-edge facilities to support innovations from conception to commercialization.

2.8.2 Institutional Framework

a) The State Corporations Act Cap. 446 (2012 revision)

The legislation bestows authority upon the Konza Technopolis Development Authority Order of 2012, which establishes the Konza Technopolis Development Authority as the entity responsible for overseeing Konza Smart City. This authority is tasked with the responsibilities of city

development, the oversight and management of authorized activities in the region, and the coordination with the governing bodies of Machakos and Makueni Counties to ensure that developments in the surrounding buffer zone conform to the prescribed area standards, among other duties.

2.9 Case Studies

2.9.1 Singapore

Singapore, officially known as the Republic of Singapore, is an independent island city-state located in maritime Southeast Asia. Since gaining its independence from Malaysia in 1965, Singapore has experienced rapid growth in various domains, including social, economic, and political aspects.

Singapore has made remarkable progress on its path toward sustainability. More than five decades ago, Singapore faced challenges such as pollution, inadequate sanitation, and high unemployment. This small island city-state, devoid of natural resources and faced with an uncertain future after its separation from Malaysia, has undergone a remarkable transformation. Singapore's visionary leaders believed in pursuing economic development without compromising the environment or social inclusivity. With this vision, strong political leadership, and collaborative efforts by various stakeholders, Singapore evolved from mudflats into a clean and environmentally friendly modern metropolis (Smart Nation and Digital Government Office, 2018).

The Master Plan for the Republic of Singapore was initially formulated between 1952 and 1955, receiving government approval in August 1958. Subsequently, it has undergone ten revisions with various amendments. In the current planning framework, the Concept Plan outlines the long-term land use strategies for Singapore, subject to regular reviews. The Concept Plan's objectives are translated into detailed land use plans for different planning areas, shaping the Master Plan. The most recent Master Plan, developed in 2019, incorporates amendments and updates based on relevant feedback received during public exhibitions.

Singapore's journey toward becoming a smart city involves the integration of technology for payment, information access, and government services, resulting in a seamless user experience (Lee, Kwon, Cho, Kim, & Lee, 2016). The city also prioritizes inclusivity, particularly for its elderly population, addressing issues such as loneliness and home or street accidents. This is

achieved through the creation of smart homes equipped with carpet sensors that alert family members in case of a fall (Lee, Kwon, Cho, Kim, & Lee, 2016). Singapore's urban planning promotes the use of autonomous vehicles, with wide sidewalks accommodating options like golf carts. Public transport and active modes of transportation are given more space in road design, with repurposed road lanes improving the pedestrian and public transport experience. For instance, Bencoolen Street serves as an example of a Transit Priority Corridor (TPC). The city also plans to enhance its walkways and outdoor areas, maintaining the existing low-rise streetscape while providing guidance for private redevelopment (Lee, Kwon, Cho, Kim, & Lee, 2016).

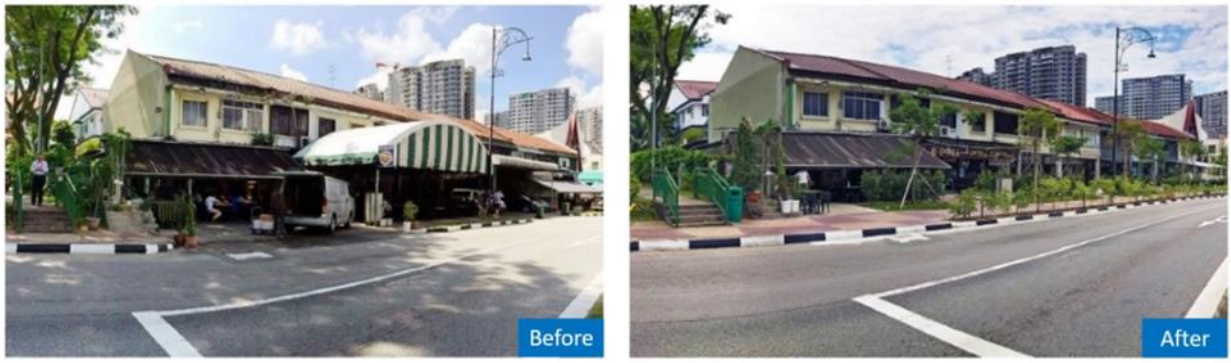


Figure 1 Emphasis on NMT in Singapore

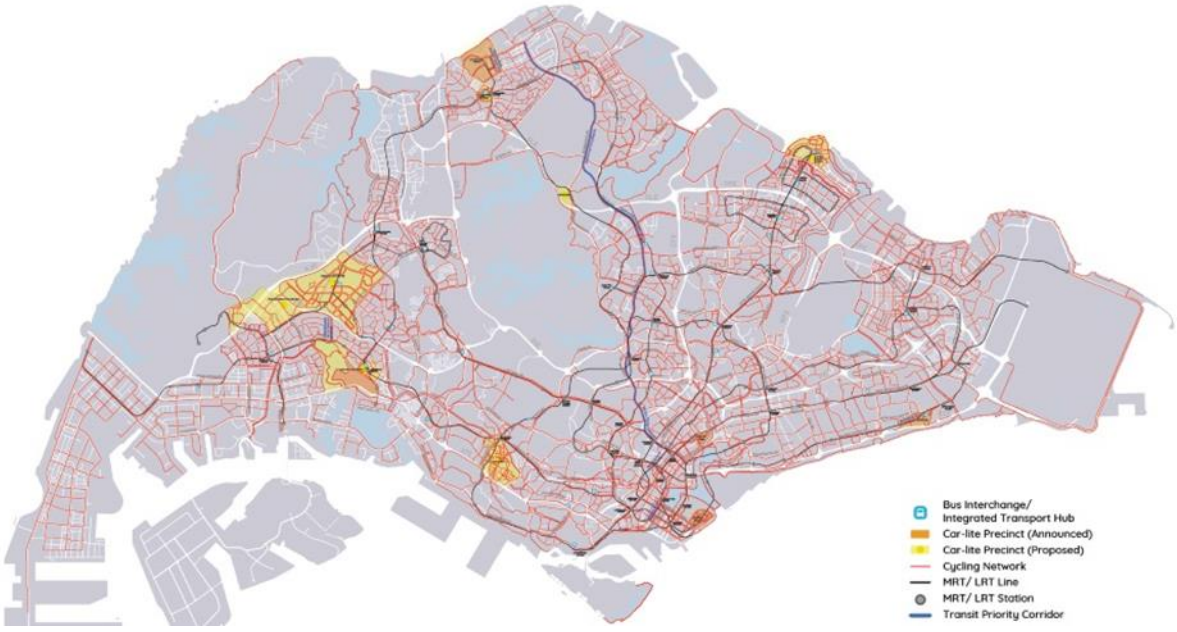


Figure 2 Transportation networks in Singapore

Singapore's status as a smart city is maintained through a collaborative effort between the public and private sectors. While many smart solutions are conceived in the private sector, they are implemented and enforced by the public sector (Lee, Kwon, Cho, Kim, & Lee, 2016). The government actively engages with communities to preserve the unique characteristics of local identity areas by establishing design guidelines for both existing and new developments while safeguarding essential elements. Furthermore, these local identity areas undergo revitalization through the introduction of new public spaces, enhanced streetscapes, and the careful addition of new residences and amenities. Singapore's government collaborates closely with communities to ensure the preservation of the distinct attributes of local identity areas. This involves the establishment of design guidelines for both existing and new developments, as well as the protection of essential features. In addition to this, these local identity areas are revitalized through the introduction of new public spaces, the enhancement of streetscapes, and the thoughtful integration of new homes and facilities. For example, in the case of the Dakota Crescent Estate, new residences and amenities will rejuvenate the area while preserving the beloved playground and the surrounding six blocks.

Figure 3 Playgrounds around residential blocks of Singapore

The vibrancy of a locality increases when local communities, business operators, and property owners take a more active role in shaping their neighbourhoods. They are in the best position to put into action ideas and solutions that align with their requirements. As a result, the neighbourhood reaps the rewards of these enhancements. The Singaporean government

collaborates closely with residents through initiatives like the Streets for People program and the Lively Places Program, aiming to enhance the appeal of streets and public spaces for both visitors and businesses.

Figure 4 showing residents taking ownership of neighbourhoods

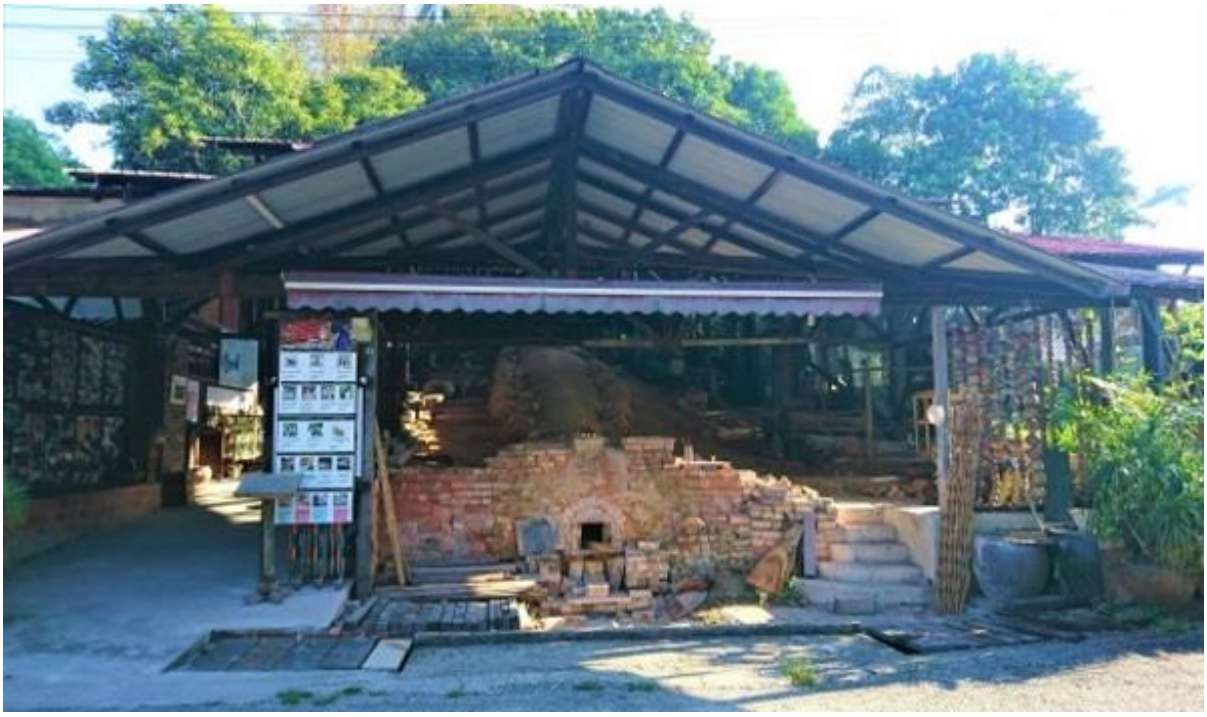


Figure 5 The Dragon Kiln in Singapore

The Dragon Kiln, a unique local cultural feature, is retained within a lush park setting amidst JTC’s industrial estate.

Figure 6 showing Toa Payoh town

Toa Payoh town showcases new housing options, upgraded public areas, enhanced connectivity, and opportunities to explore the town's rich heritage as part of the Housing and Development Board's 'Remaking Our Heartlands' (ROH) initiative.

In 2018, Singapore earned the title of the world's most intelligent city during the 2018 Smart City World Congress for its innovative use of technology to enhance the quality of life for its residents. It prides itself on being a live-able and sustainable urban centre, characterized by clean air and a wholesome environment, a resilient and diversified water supply, and the presence of splendid green spaces (Government of Singapore, 2018).

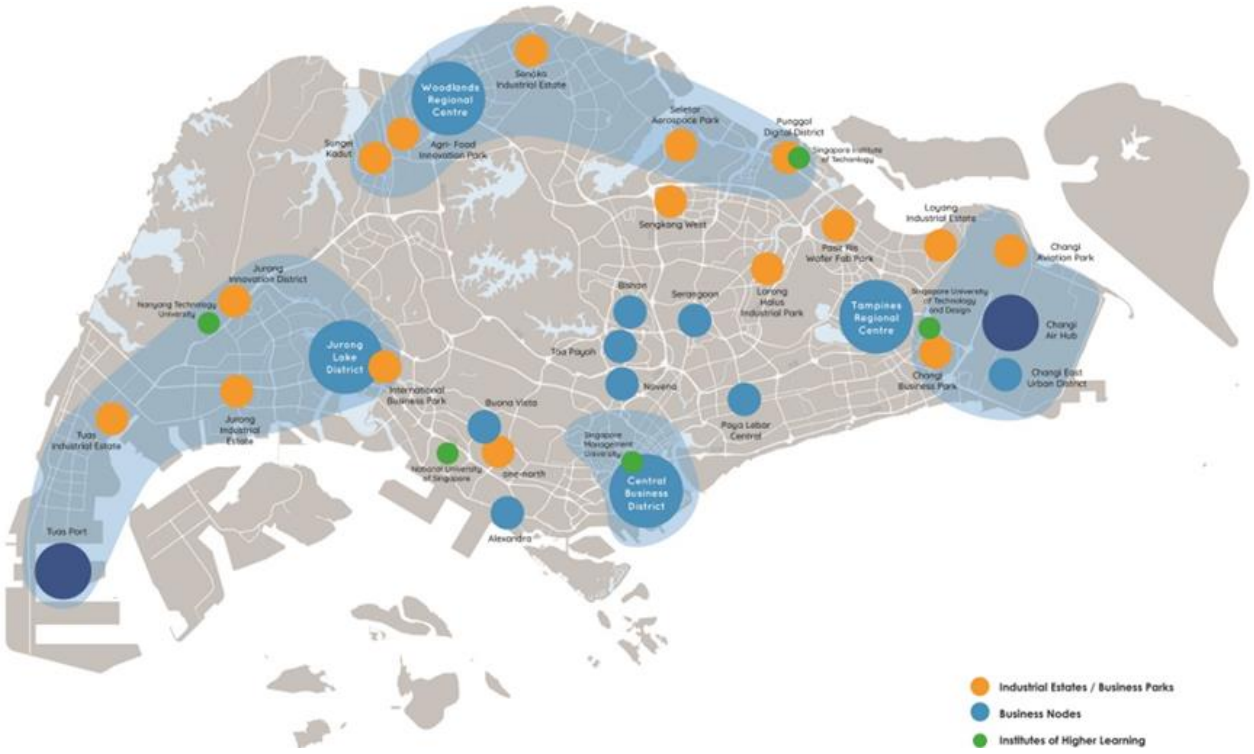


Figure 7 Singapore's industrial, business, and institutional nodes

It, however, has an unfair advantage over other cities due to its city-state nature. Given its scale, it is easier for Singapore to embrace elements of a smart city (Lee, Kwon, Cho, Kim, & Lee, 2016). Singapore's approach to sustainable development is guided by three key principles an integrated approach and long-term strategic planning, investments in innovative solutions and forging partnerships (Lee, Kwon, Cho, Kim, & Lee, 2016).

The lessons that can be learnt from Singapore is that there is definitely a need for stakeholder engagement in developing a smart city. It is also evident that a smart city must initially solve pre-existing issues and challenges of the host community before imposing its utopian ideologies. Singapore, perhaps due to its nation-city state, managed to impose smart city elements through out the nation, hance ensuring its sustainability, a key factor that must be considered in all smart cities especially Konza City.

2.9.2 Kigali, Rwanda

In response to the escalating challenges posed by rapid urbanization and the vision of revolutionizing the development of the continent using digital technology and ICT, a range of African governments, private enterprises, and global organizations collaborated to establish the Smart Africa Alliance. During the Transform Africa 2017 event in Kigali, the Rwandan Government, in conjunction with the Alliance, made a commitment to transition Kigali into a smart city. The objective was to unlock the potential of its residents and enhance public services and businesses through innovative approaches. The ultimate goal was to create a model for urban innovation that could be replicated in other African cities, enabling them to harness the benefits of rapid urbanization rates (Inmarsat, 2023).

Figure 8 Kigali Cityscape

SOURCE: (Rich, Westerberg, & Torne, 2017)

In Kigali, the capital city of Rwanda, both leaders and residents harness data, information, and knowledge to collaboratively shape a resilient and sustainable future. Their vision for achieving smart city status revolves around inclusive data-driven management and planning, the efficient development of community-based infrastructure and services, and the promotion of localized and shared innovation and economic growth (Rich, Westerberg, & Torne, 2017).

The impact of Smart City Kigali extends beyond the city and national borders, as it aims to attract talent from across the entire African continent for educational purposes. Rwanda's

position as a leader in technological advancement provides Kigali with an advantage in realizing the components of a smart city. Notably, Kigali's approach differs from that of Konza, as the Rwandan government focuses on implementing smart city elements within an existing city rather than constructing a smart city from the ground up, as is the case with Konza (Rich, Westerberg, & Torne, 2017).

Kigali's masterplan is intricately interconnected with the daily management practices of local authorities, as well as with strategic, long-term policy development, rather than existing as a standalone document. It originates at the national level, where the plan outlines initiatives aligned with the goals of the Republic of Rwanda's National Urbanization Policy, then progressively narrows down to specific regional and municipal-scale initiatives. This approach underscores the critical aspect of Kigali Smart City being part of a broader urban landscape rather than an isolated entity (Rich, Westerberg, & Torne, 2017). The strategies that Kigali Smart City incorporates in realizing its vision is as illustrated in figures 9 and 10.

Figure 9 Strategies 1- 5 to realize the vison of Kigali Smart City

SOURCE: (Rich, Westerberg, & Torne, 2017)

Figure 10 Strategies 6-10 to realize the vison of Kigali Smart City

SOURCE: (Rich, Westerberg, & Torne, 2017)

Kigali Smart City's action plan is anchored on three pillars that are further divided into nine building blocks for initiatives. The pillars are smart governance, smart and efficient services and utilities and localized innovation for social and economic development. Table 1 further breaks down these pillars into building blocks and their respective initiatives. These initiatives are further anchored on associated case studies that have inspired Rwanda-specific projects.

Table 2 Pillars, building blocks ad initiatives of Kigali Smart City

PILLARS	**BUILDING BLOCKS**	**INITIATIVES**
1. *Smart Governance*	Data-led urban planning and management.	i. Integrated GIS-base urban management platforms. ii. Cross-ministry financial and project management platform. iii. Multi-stakeholder safer cities programme.
	Smart policies and regulations.	i. Dynamic data-supported urban master planning. ii. Enabling environments for urban technology testing.
	Public engagement and open data.	i. Data strategies including open data, privacy and cyber-security. ii. Accessible internet zones in strategic and residential areas. iii. Digital citizen engagement tools accessible to all. iv. Urban Data accessible to all.
2. *Smart and efficient services and utilities*	Efficient, demand - based services.	i. Regulatory frameworks for virtual power plants and other demand-based management solutions. ii. Smart data-led 'door-to-door' mobility solutions. iii. Digital service points for rural settlements. iv. Smart urban agriculture projects.

	Sustainable and resilient resource management.	i. Sensor-based environmental data. ii. Green and smart building labs. iii. Smart, sustainable and shared neighbourhood pilot projects.
3. *Localized innovation for social and economic development*	Localized and challenge-based financial opportunities.	i. Promote local digital business platforms. ii. Create collaborative community co-working and digital excellence centers. iii. Establish collaborative urban innovation acceleration labs with academy, community and industry.
	Digital transformation of financial services.	i. Introduce personalized e-finance platforms for all lifetime services. ii. Electronic due-diligence and business loan systems for SMEs.

SOURCE: (Rich, Westerberg, & Torne, 2017)

2.10 Analytical Framework

The planning profession needs theory to inform practice (Friedmann 1979). Theory provides justifications for decisions, offers guidance on possibilities, and facilitates ethical behavior. Theory attempts to extract rules to describe, explain, and predict the world. Researchers draw interpretations of the past, present, and potential futures to develop theory. By and large, though, theory is seen as a product of the times embedded within a particular social context (Grant 2009). In this section, several theoretical debates have been addressed which align with the study's objectives, with the focus being sustainable smart cities. The main issue is the rigid and non-inclusive design overlooking the development of adjacent land uses.

2.10.1 Theoretical Framework

The study is anchored on four theories which include Garden City Theory, Theory of Smart Cities, Participatory Planning Theory and the Concentric Zone Theory.

The Garden City Theory.

The Garden City Theory is one of the urban planning theories initiated by Ebenezer Howard in 1898 due to the rapid migration to cities due to the Industrial Revolution leading to environmental degradation and capitalism. Various planning principles embedded in the garden city theory aim to combine the benefits of the urban and rural environments while addressing both disadvantages. The study by Avianto in Konza, Kenya, employed the Garden City Theory. He viewed it as a solution for overcrowded and polluted cities in Europe due to the industrialization of the city itself as well as to address the lack of housing in urban areas after the Second World War (Avianto, 2017).

In the "Three Magnets Diagram," Ebenezer Howard identified favorable components of urban and rural lifestyles and combined them into a third alternative called the Town-Country magnet (Mirkov 2007). It means that all city life benefits, including higher chances of employment, better amenities, and infrastructure, can be enjoyed while preserving the healthy, natural environment of country life. The Garden City Theory also advocates for collective land ownership, ensuring the whole community benefits from the development. There is also an aspect of growth control, which is made possible by a permanent greenbelt around the city. The cities continue to grow beyond a certain level of, after which another city is established, while the green belts surrounding the cities are still conserved.

Land use zoning is a critical aspect of this theory, using streets and avenues to separate the various zones to enhance environmental quality (Nabila 2021). This theory applies to smart cities and the development of adjacent land uses. It establishes access to inclusive spaces while appreciating the characteristics of the rural areas, which could even encourage people to migrate spontaneously, thus promoting decentralization.

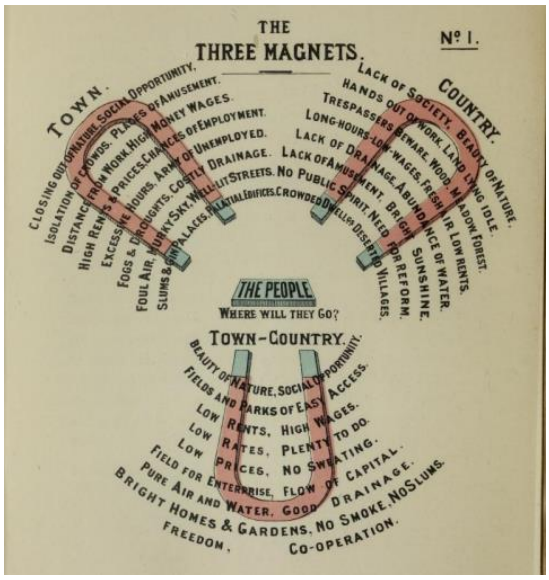


Figure 11 The Three Magnets Diagram Source: Nabila (2021)

There are aspects of social control over land, where a smart city is especially established in a previously rural area. It is prudent that whoever controls the city land should plan the spatial function development. This control should have a public body responsible for the welfare of the whole (Mumford 2006). Mumford (1986) also supported the concept of garden cities precisely because of the decentralization of space and local government.

According to Jenks et al. (1996), much attention recently has focused on the relationship between various urban forms and sustainability, with the idea that the emergence of these smart cities will cause an implication on the adjacent land uses. The Garden City Theory was of great application to these dynamics.

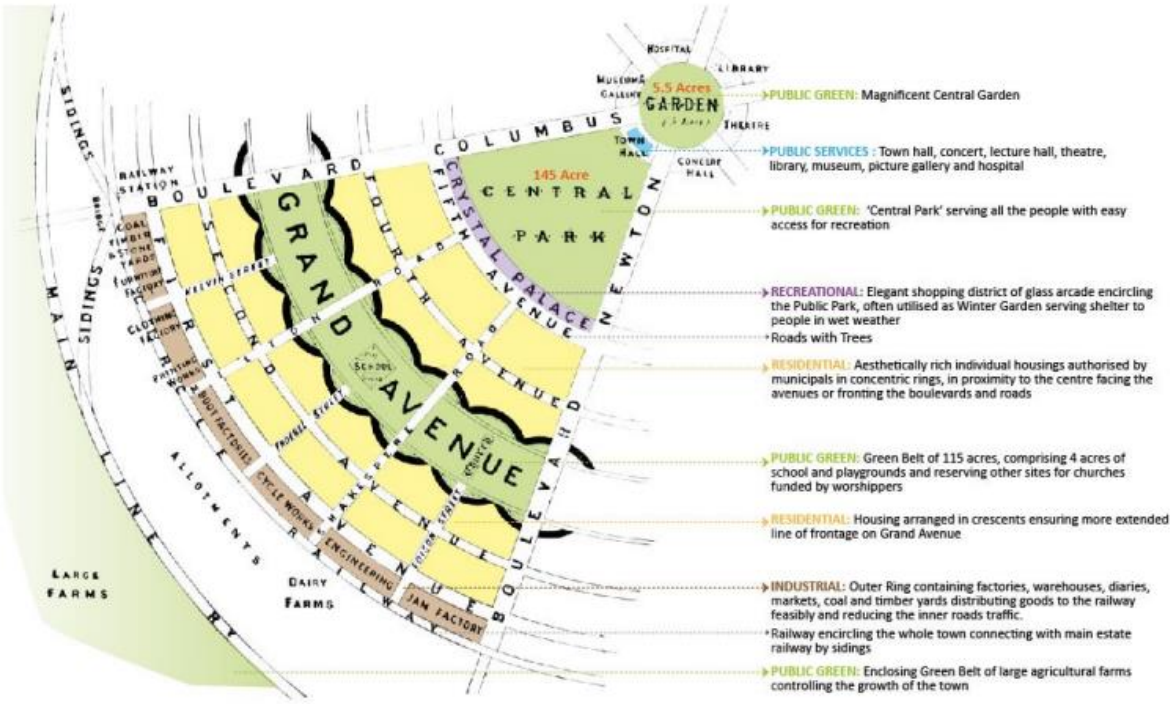


Figure 12:Zoning in the garden City Theory, Source Nabila (2021)

The Smart City Theory.

The concept of a smart city elucidates how information technology significantly influences societal norms to enable sustainable development. Its roots may be traced back to the late 1990s Smart Growth movement, as advocated by Bollier (1998), which promoted novel policies for urban planning. Notably, Portland, Oregon, stands as a well-known exemplar of Smart Growth, as discussed by Caldwell (2002).

Starting around 2005, many technology companies have embraced this term to denote the application of intricate information systems for integrating various aspects of urban infrastructure and services. These encompass areas such as buildings, transportation, electrical and water distribution, and public safety. Over time, the concept has expanded to encompass virtually any technology-based innovation in city planning, development, and operation. Nevertheless, the metaphor of the city as a complex system is particularly insightful when linked to the development of information systems. The increasing intricacy of hardware and software within information systems has led to the formation of communities focused on this evolution (Bollier, 1998; Caldwell, 2002). The Smart City Theory advocates for a linkage in the form of an Urban

Information Model to structure and classify the linkages between the cities to the adjacent as a network flow.

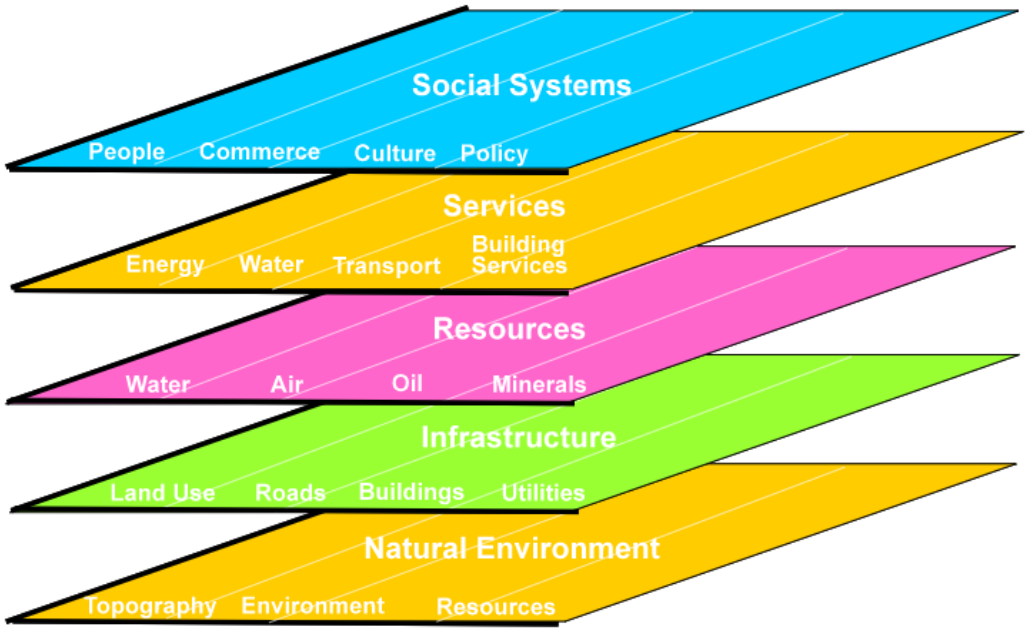


Figure 13 an illustration of an Urban Information Model

Participatory Planning Theory

According to the World Bank, community participation is described as a process by which various stakeholders exert influence and jointly share control over development initiatives, as well as the decisions and resources that impact them. This concept emphasizes the inclusion of all stakeholders and aims to provide a voice for marginalized groups in the development processes (Avianto, 2017). It ensures that people feel a sense of ownership throughout the project's lifecycle, spanning from the conceptualization of the plan to its implementation and monitoring.

Avianto applies Habermas' Communicative Action Rationality as a procedural planning theory, with the goal of incorporating a wide spectrum of opinions to enrich discussions and negotiations, which form the core of the planning process. Participation is, therefore, an integral component of the planning procedure. Avianto emphasizes that planning occurs after engaging with the public and relevant stakeholders. Julsurd and Uteng (2015) argue that the Habermasian Communicative Theory supports the use of Delphi studies for data collection. This approach ensures that consensus

and mutual understanding are achieved when direct communication is fostered over time (Julsrud & Uteng, 2015).

Concentric Zone Theory

Introduced by Burgess in 1925, this theory posits that the urban growth and structure can be best comprehended in terms of concentric circles (Splansky, 1966). Each ring is characterized by distinct forms and qualities of land use, and these "development contours" may be altered by geographical features like rivers, mountains, and lakes.

Burgess proposed the presence of five concentric zones around the city's core. The first zone, also known as the Central Business District, is primarily focused on commercial, social, and transportation land uses. The second zone comprises the factory area, housing industrial activities. The third zone represents a transition area encircled by aging residential buildings in a state of deterioration. The fourth ring is the working-class zone, where industrial workers, having moved beyond the transition zone, seek proximity to their workplaces. The fifth zone, often referred to as the commuters' zone or the suburbs, consists of areas where the population typically commutes from to the city center (Splansky, 1966).

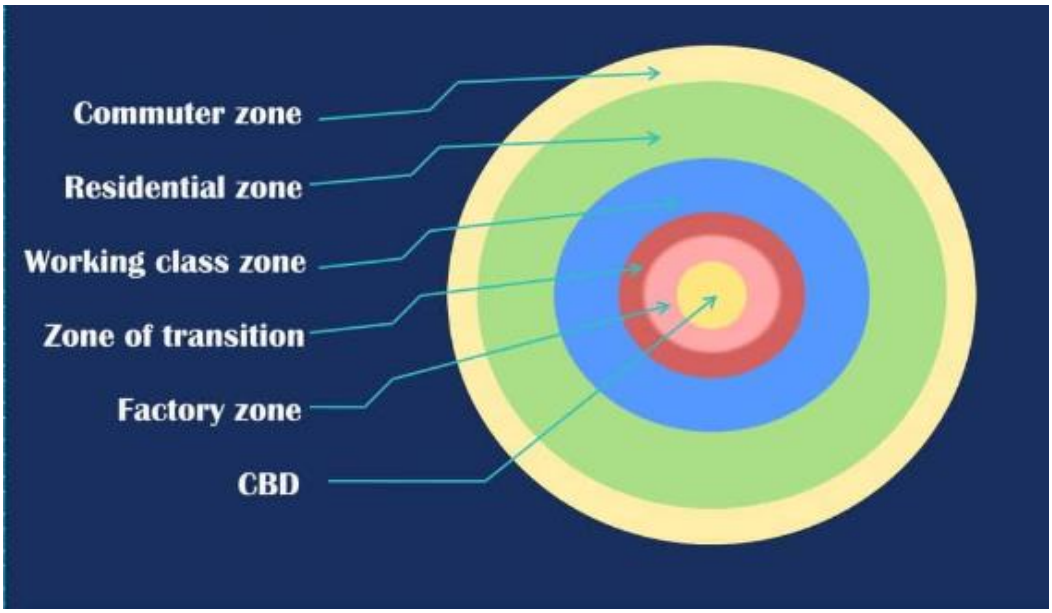


Figure 14 Concentric Zone Model

Source (Nickerson, 2023):

Burgess relied on this model to illustrate the clear divisions in socioeconomic status within and immediately outside Chicago. This model draws criticism as its applicability is only to cities in the United States. European cities such as Paris house the wealthy in the inner city while the urban poor live in its suburban areas. The theory further suffers in light of gentrification. The urban poor are bought out of their homes by the rich. (Nickerson, 2023)

From this model, we understand the spatial organization of cities. The contours of development, although not always complete circles, are crucial in planning smart cities. A smart city will also be subject to rings of development beginning at its core moving outward into its adjacent neighbourhoods (Nickerson, 2023).

2.10.2 Conceptual Framework

The framework includes land use and smart city-related factors. Smart cities are independent variables, while land uses are dependent variables. The intervening variables include population growth, urbanization, politics, and shifts in market demand. Land as a fixed asset is the anchor for developing infrastructure and natural resources. Land use changes can be triggered by any development, impacting social well-being. Smart life, smart people, smart mobility, and smart environment are all impacted by smart cities. By providing non-motorized transportation options, sustainable transportation systems, and environmental safety, smart cities hope to enhance not just the well-being of their citizens but also their economy by facilitating the digital interchange of goods and services.

Changes in population trends could potentially impact land usage indirectly. When there is a need for more room for habitation, the land cover changes. Agricultural land is transformed into built-up areas that include housing and transportation. However, an increase in population could lead to a change in the market. The creation of smart cities may be facilitated by the demand for goods and services, promoting economic expansion. Politicians have sway over decisions on what should be done, where, and by whom. The project succeeds if they lend their support, and vice versa. Policies control activity in space, which impacts development and land usage. Sustainability should be given top priority when developing smart cities and controlling the usage of land.

The following conceptual framework has been derived from a literature review. It has integrated the causes, effects, mitigation, and the desirable outcome of the research study.

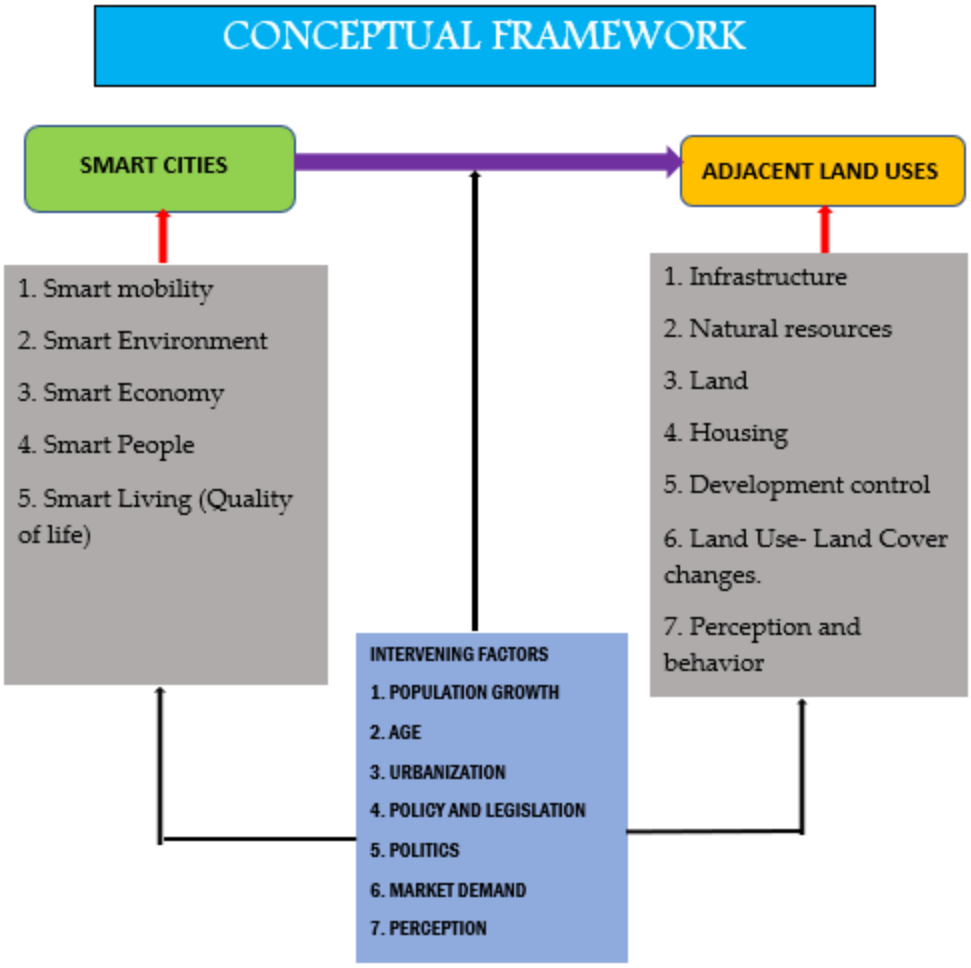


Figure 15: Conceptual Framework (Source), Author 2022

2.11 Chapter summary

The chapter highlights the history of this interaction and the conceptual definitions of elements of smart cities and land use. The chapter provides an in depth understanding of other smart cities in the world and in Africa and how those cities have managed to capture the key elements of a smart city. Theoretical concepts that underpin this study are also reviewed. This chapter provides a detailed understanding of the nexus between smart cities and adjacent land uses from a global perspective up to the local level, highlighting the knowledge gaps from various studies. It culminates in discussing the laws and policies underpinning planning and managing smart cities and land use planning in Kenya.

3.0 RESEARCH METHODOLOGY

3.1 Overview

The chapter describes the research design, population and sampling, objective-based data collection methods, data analysis and presentation techniques. The chapter further describes the reliability, validity, and ethical considerations applied during the study. Several factors were considered for the proposed research design. These include the availability of resources, the type of information desired, and the fact that the independent variable cannot be manipulated.

3.2 Research Design

This research project comprised three distinct phases: the conceptual phase, the narrative phase, and the interpretive phase.

In the conceptual stage, the research problem, questions, and objectives were developed in the form of a proposal. This phase involved comprehensive literature reviews, enabling the researcher to gain familiarity with policies, theories, and concepts related to smart cities and the development of neighboring land uses.

The narrative phase encompassed the planning of the study. During this stage, the researcher defined the specific area of focus and the scope of field surveys and observations. The research methods and techniques for collecting, analyzing, and presenting data were meticulously designed.

The interpretive phase of the research began after data collection, cleaning, analysis, and synthesis were completed. At this point, the researcher engaged in a systematic interpretation of the data, aiming to make sense of it and address the research questions.

This study employed a mixed research approach, combining both qualitative and quantitative methods to evaluate the implications of Konza smart city on the development of adjacent land uses. Both quantitative and qualitative data analysis techniques were applied in the study.

3.3 Population and Sampling

3.3.1 Target Population

The total population where the sample was drawn is 9,979, which constitutes the total population of the two sublocations where the study is located and the 2768 households in the area as per the census data 2019.

3.3.2 Accessible Population

The accessible population included individual households, business-people, key informants (Physical Planner from Konza Technopolis Development Authority, County Planner and Surveyor Machakos County, County Surveyor Makueni), and business people comprising of young and middle-aged men and women available during the study.

3.3.3 Sampling Frame

The parcel numbers formed the sampling frame for the household survey. For the business questionnaire, the parcel numbers for the shops were used as the sampling frame.

3.3.4 Sample Size

Household Questionnaire

The study aimed to determine the sample size required to estimate the proportion of households with specific characteristics in the Konza and Muumandu Sublocations. The significance of having an acceptable sample size to avoid bias or impulses is pivotal when conducting research.

It's important to note that the proportion of the research population that gets sampled is as important as the absolute size of the sample relative to the population's complexity, the researcher's aims, and the types of statistical analysis that were carried out. (Taherdoost, 2016).

While a larger sample size can reduce the liability of prejudiced findings, it's essential to balance the benefits of a larger sample size against the resources available to the researcher. It's essential to avoid the point of dwindling returns, where the benefits of adding the sample size become negligible. Gill et al. (2010) emphasize the need for balance in determining the sample size, as adding the sample size beyond a certain point may not result in significant advancements in accuracy and may increase the cost and time needed for data collection and analysis.

The population's complexity is also a factor to consider when determining the sample size. A more complex population may bear a larger sample size to achieve acceptable representation. The points of the researcher and the types of statistical analysis that were carried out can also impact the needed sample size. For illustration, a larger sample size may be necessary if the research aims to describe minor differences between groups or estimate rare events. In this research, the factors considered in the sample size determine the complexity of the research area and available resources for the study but also maintain the highest level of information accuracy and precision. The population in the area is homogeneous; therefore, having the Finite Population Correction Factor formula was ideal for sample size determination.

To calculate the sample size, the parameters used were a confidence level of 95% and a margin of error of 10%. The sample provides 95% confidence that the proportion of households with the characteristic falls within a range of plus or minus 5% of the estimate obtained from the sample.

To determine the sample size for the households, the following formula was applied

$$4 \quad n = N \times \frac{\frac{Z^2 \times p \times (1-p)}{e^2}}{N-1+\frac{(Z^2 \times p \times (1-p)}{e^2}}$$

Where:

n = desired sample size

N = Population size,

Z = Critical value of the normal distribution at the required confidence level e.g. 95% or 1.96 z-score

P = Sample proportion,

e = tolerable margin of error

Therefore

n = desired sample size

N = 2082

Z = 1.96

P = 0.5

e = 0.1

$$n = 2082 \times \frac{\frac{1.96^2 \times 0.5 \times (1 - 0.5)}{0.1^2}}{2082 - 1 + \frac{(1.96^2 \times 0.5 \times (1 - 0.5)}{0.1^2}}$$

n = 91.84732

n = 92

The sample size obtained was divided proportionately between the two sublocations in the research area. For the Konza Sublocation, the total households in the study area are estimated to be 687, which is the total number recorded from the population and housing census report 2019. For Muumandu, the research used 67% of the total household number from the 2019 census, corresponding to the percentage of land that the sublocation occupies that falls within the site area.

Based on the calculations, a sample size of 92 households was obtained. It implies that the household questionnaires were administered in 92 households in the study area with the characteristic of interest that is accurate to within plus or minus 10%, with a 95% confidence level. Therefore, Konza, with 687 households, had 33 households interviewed, while Muumandu, with 1395, had 59 households interviewed.

Commercial Questionnaire

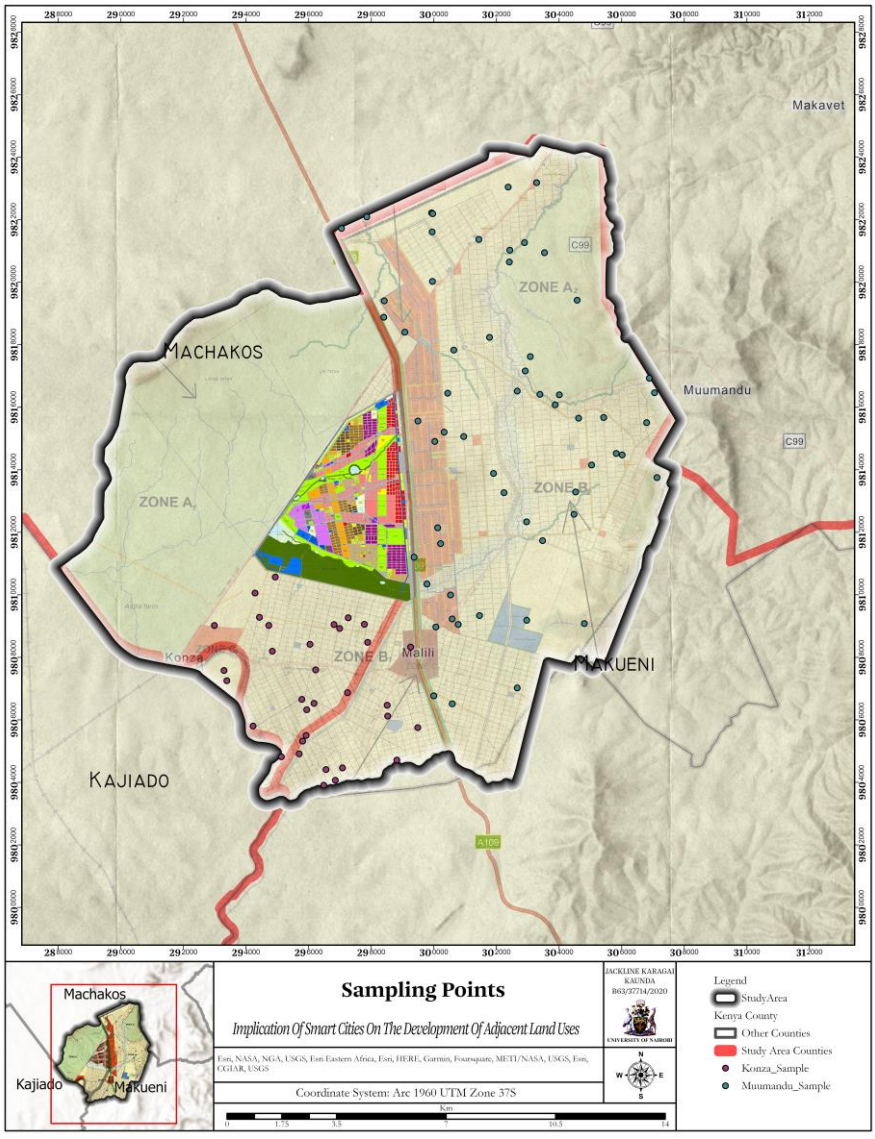
According to Gay (1981), as cited in Murigu (2005), determining an applicable sample size depends on various factors such as the number of variables, research design, data analysis system, and accessible population size. A sample size of 30 or more is recommended for correlation studies, while 10 of the accessible population is sufficient for descriptive analyses. Experimental studies bear at least 30 cases per group. Roscoe (1975), on the other hand, proposes that sample sizes between 30 and 500 are applicable for most research studies.

The selection of an applicable sample size depends on different factors that may differ between studies. For illustration, the complexity of the research questions and the type of data analysis system to be used can impact the needed sample size. In addition, it's essential to consider the feasibility and cost-effectiveness of carrying a larger sample size, as this may not always be doable

or practical. In the case of the commercial questionnaire, descriptive analyses were needed; therefore, a sample of 10 as prescribed by Gay (1981) or 30 as inferred by Roscoe (1975) were deemed sufficient. However, to ensure the validity and reliability of data, the 30 by Roscoe was used as the sample size for the business/commercial questionnaire.

3.3.5 Sampling techniques

The study employed a multistage sampling technique.



i. Purposive sampling was applied to identify the study site.

Konza City is the only smart city in Kenya and thus the areas adjacent to it were purposively selected to form the study area as they are directly impacted by the smart city. To delaminate the realm of influence a radius of 8 km was chosen in line with the concentric zone theory. The study area predominantly covers Machakos and Makueni counties. Kajiado county was excluded from the study purposively with an assumption that the growth will follow the already established towns in Makueni (Malili) and Machakos (Konza Ranch) before any effect is felt in Kajiado.

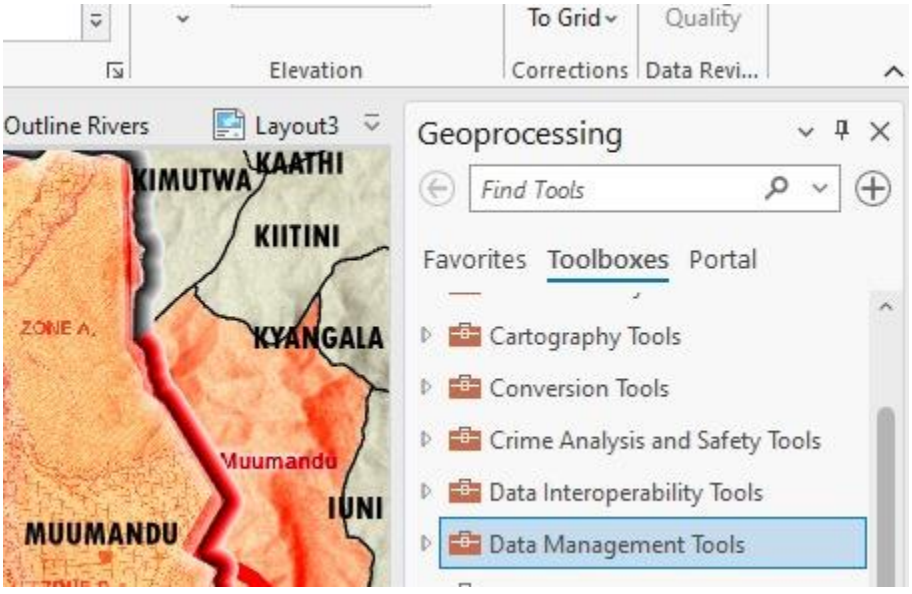
The next consideration was the A104 road from Nairobi to Mombasa which was purposively selected as a landmark that influences development next to the city.

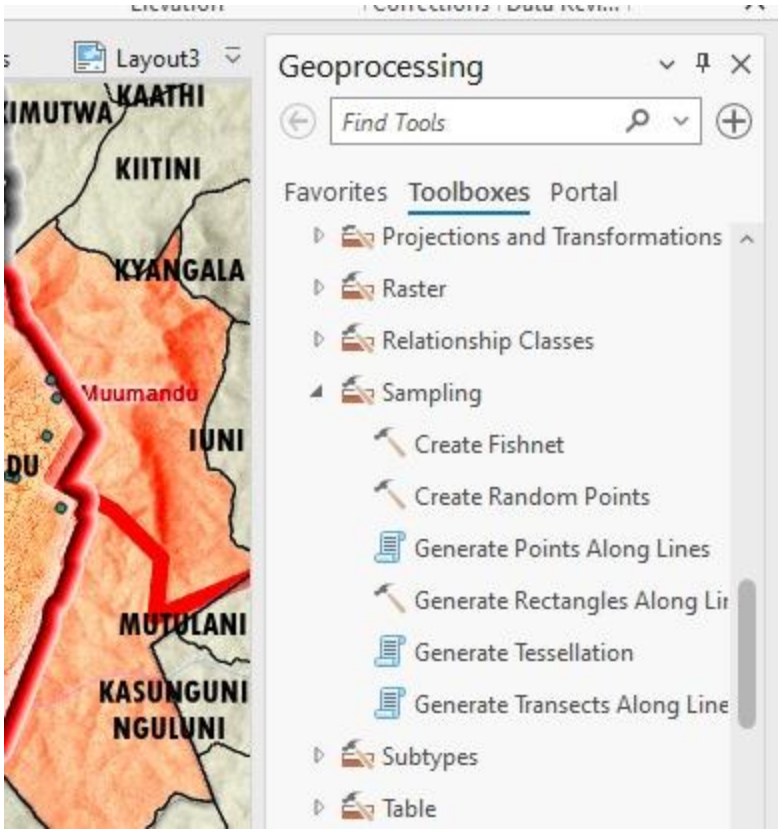
ii. **Purposive sampling of key informants.**

The key informants were deemed to be people with specific skills and authority. They included a Physical Planner from Konza Technopolis Development Authority, a County Planner and Surveyor from Machakos County, and County Surveyor Makueni county.

iii. Simple Random sampling in the selection of households and businesses.

To ensure that each member of the target population had an equal independent chance of being included in the sample, simple random sampling was used. Through GIS, the entire study area was mapped out showing the built-up areas and households randomly selected from the various sections to form part of the sample.

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Muumandu
IUNI
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KASUNGUNI
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Favorites
Toolboxes
Portal
Projections and Transformations
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Create Random Points
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Subtypes
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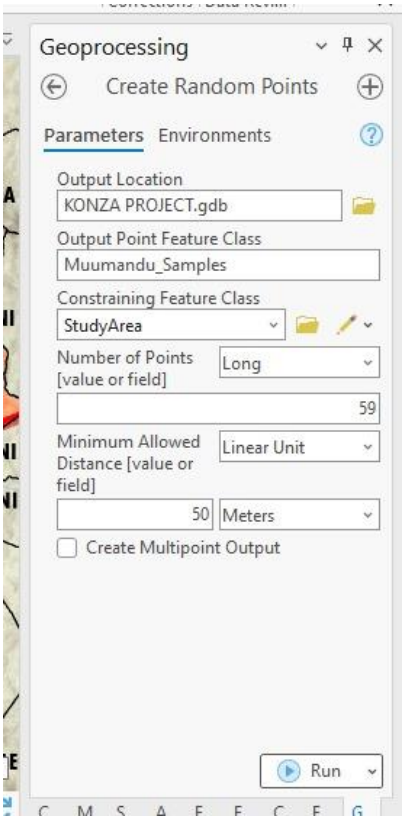
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Output Point Feature Class
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Constraining Feature Class
StudyArea
Number of Points [value or field]
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59
Minimum Allowed Distance [value or field]
Linear Unit
50
Meters
Create Multipoint Output
Run

iv. Quota sampling of Focus Groups.

Quota sampling was used in the selection of participants for the focus group discussion. The researcher assigned quotas to several groups of people in order to create sub-groups of individuals which represent characteristics of the target population holistically. These characteristics included gender, age, sex, type of business and location.

3.3.6 Unit of analysis and observation

The unit of analysis in this study is Konza City and its impact on the adjacent land uses. On the other hand, the unit of observation is the specific land uses, infrastructure and utility, institutions and population dynamics.

3.4 Reliability and Validity

Five questionnaires were administered during the pilot survey to test the completeness and accuracy of the data instruments. The research assistants were trained on the research instruments before the commencement of data collection. The inter-rater- technique of reliability was employed to measure agreement from respondents. Content Validity was applied in measuring the degree to which data collected using questionnaires represented smart cities and land uses.

3.5 Data collection methods

Data was gathered from a variety of sources using diverse techniques and multiple data collectors, encompassing both quantitative and qualitative approaches. This approach enabled triangulation, ultimately enhancing the credibility and reliability of the research findings. The data sources consisted of primary and secondary materials, while the methods employed encompassed document analysis, case study assessments, one-on-one and group interviews, round table discussions, observational data, oral history, and the administration of survey instruments.

3.5.5 Document Analysis

It was applied as quantitative and qualitative research through a systematic procedure to analyze documentary evidence and answer specific research questions. The researcher applied the Archival method and techniques of content analysis in triangulation to expand on findings along with other data sources.

3.5.6 Household questionnaire survey

Household questionnaire surveys were prepared and administered to household respondents to gain more information about the study area of Konza.

3.5.7 Business questionnaire survey

A business questionnaire survey was prepared and administered.

3.5.8 Key informant interview administration

The Interview method was preferred to gather information from the key respondents to enable a comprehensive gathering of information. The interview questions were prepared prior to undertaking the exercise.

3.5.9 Focused Group Discussion

Focused Group Discussion was also applied as a method of data collection to gather information from people within the study area with similar backgrounds and interests. The focus group discussion was held, capturing the concerns and aspirations of the residents in the Malili market and Konza Old Town.

3.5.10 Observation

To ensure comprehensive data collection through observation, an observation checklist was created. This checklist comprises essential and pertinent elements within the study area, thereby ensuring the capture of all required information.

3.5.11 Objective-Based Data Collection Methods

Research Objective	Data Collection Methods	Analysis Method
To assess the effects of Konza City on the adjacent land uses.	Administering of questionnaires, Interviews Observation.	-Time series analysis - Descriptive and
To determine the factors contributing to the interrelationship between Konza City and the adjacent land uses?	Administering of questionnaires, Interviews Observation Focused group discussions.	Descriptive and inferential Analysis.
To evaluate stakeholders' roles, perceptions and behavior towards Konza City and the adjacent land uses.	Administering of questionnaires, Interviews Observation Focused group discussions.	Descriptive and inferential Analysis.
To propose strategies that can be employed to ensure sustainable smart cities and the adjacent land uses.	Administering of questionnaires, Interviews Observation.	Content analysis in analyzing best practices.

3.6 Data analysis and presentation

A diverse set of approaches were employed to analyze the accumulated data. Statistical software tools such as SPSS were utilized to generate frequency distributions and central tendency measures. Additionally, document analysis, as well as the scrutiny of maps and photographs, were carried out. Qualitative data was subjected to analysis through both case-specific examination and cross-case analysis, depending on the specific variable under consideration.

The research findings were reported descriptively in a comprehensive thesis report, and they were visually represented through the use of tables, bar charts, histograms, pie charts, graphs, spatial maps, and 2D design models.

3.7 Ethical considerations

This study ensured that honesty and integrity was upheld during the data collection process and in the reporting of the findings. All respondents who gave their input during the administering of the various research instruments gave their consent. The researcher obtained a research permit from NACOSTI before undertaking this research. Confidentiality of the respondents was considered and anonymity especially in the provision of sensitive information. In accordance to respect for intellectual property, all sources of information used in this research have been cited.

3.8 Data needs Matrix

Research Objective	Data sources	Data Needs	Data Collection Methods	Analysis Method	Analysis Tools	Presentation Method	Outputs
To assess the effects of Konza City on the adjacent land uses.	Primary data sources: interviews, observation and instruments administration. Secondary data sources: Books, journals.	Social-economic and environmental effects of Cities on adjacent land uses	Administering of questionnaires, Interviews Observation.	-Time series analysis - Descriptive and inferential analysis	Arc GIS Excel SPSS	Charts Graphs Tables Maps	Reports Maps

To determine the factors that have contributed to the interrelationship between Konza City and the adjacent land uses?	Primary data sources: interviews, observation and instruments administration. Secondary data sources: Books, journals.	Drivers influencing the interrelationships of Cities and adjacent land uses	Administering of questionnaires, Interviews Observation Focused group discussions.	Descriptive and inferential Analysis.	Excel SPSS	Charts Graphs Tables Maps	Report
To evaluate the roles, perceptions and behavior of stakeholders towards Konza City and the	Primary data sources: interviews, observation and instruments administration.	Cultures, perceptions and behavior of stakeholders in Cities and adjacent land uses	Administering of questionnaires, Interviews Observation Focused group discussions.	Descriptive and inferential Analysis.	Excel SPSS	Charts Graphs Tables Maps	Report

adjacent land uses.	Secondary data sources: Books, journals.						
To propose strategies that can be employed to ensure sustainable smart cities and the adjacent land uses.	Assessment of findings on secondary sources, books i.e., journals and drawing conclusions	Strategies on promoting sustainable cities and compatibility of adjacent land uses.	Administering of questionnaires, Interviews Observation.	Content analysis in analyzing best practices.		Maps	Report on development control which will give dimension on smart cities. Recommendations on the best land use practices and sustainable cities.

4.0 STUDY AREA

4.1 Introduction

This chapter offers an introduction to the project's geographical context. It places the study in its specific territorial context by outlining and defining the boundaries of the area under investigation. It comprises four primary components: an explanation of why the project area was chosen, the methodology employed to define the project area's boundaries, and a comprehensive profile or depiction of the project area's attributes, overall structural conditions, characteristics, features, and dynamics that are relevant and, to some extent, provide insights into the research objectives.

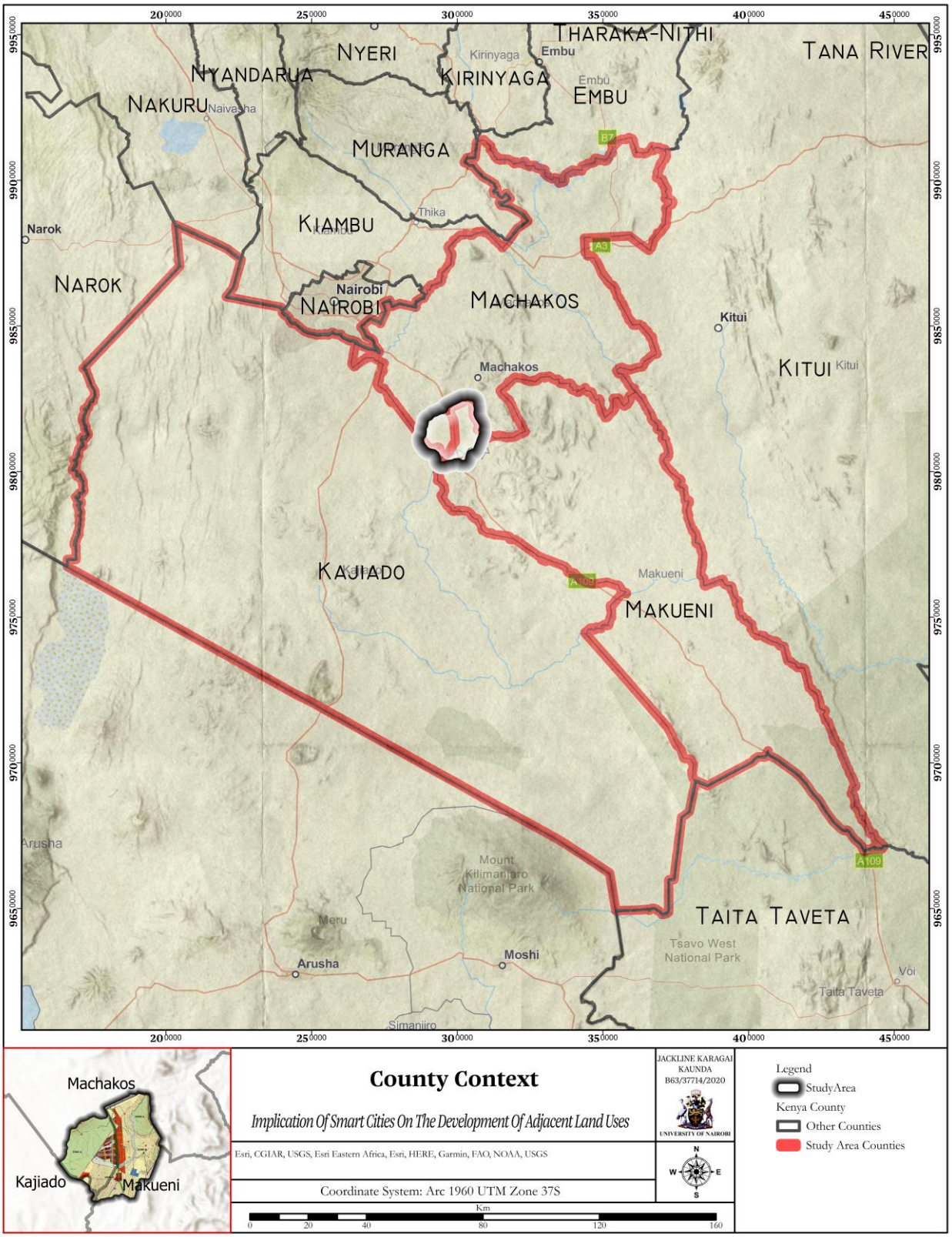
4.2 Regional Identity

Konza Smart City is a significant technology hub that the Kenyan government plans to construct, situated 64 kilometers to the south of Nairobi along the route to the port city of Mombasa. Konza's vision involves creating a mixed-use, high-density, and pedestrian-friendly city designed to accommodate a wide array of programs and districts.

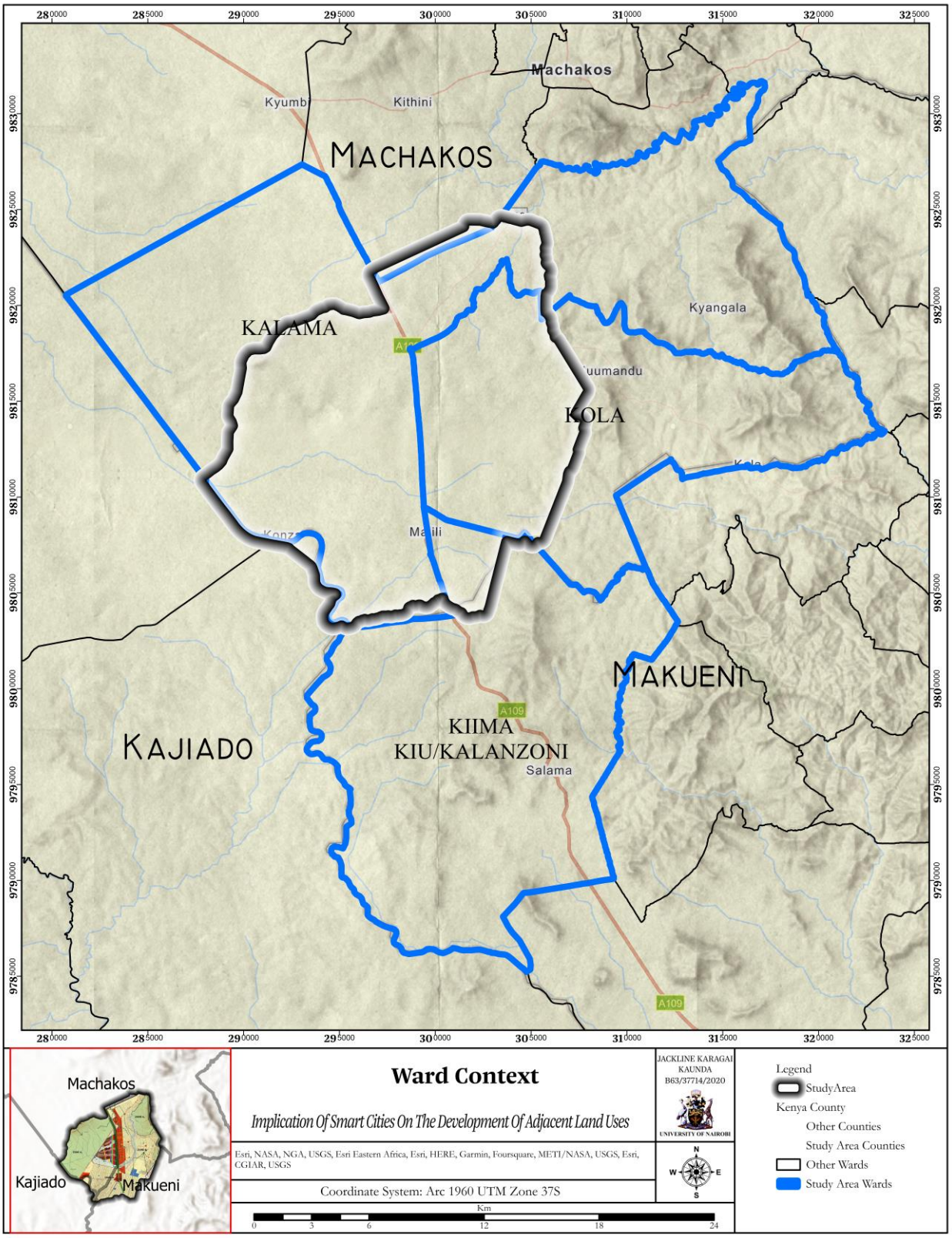
The master plan for Konza follows a "stitch" framework, which comprises a mixed-use "bar" extending from east to west along the Mombasa Highway. This bar is intersected by several program "bands" running from north to south. These bands encompass a university, residential areas, science and technology zones, and office districts. The intersections of these bars and bands create dynamic connections where special programs and higher population densities are concentrated. These intersections serve as focal points, fostering the development of neighborhoods with distinctive characteristics. The stitch master plan also incorporates a network of neighborhood parks scattered throughout the city, each with varying orientations. Most of these parks are linked to the green boulevard, a 60-meter-wide green space, as well as the public transit corridor.

GEOGRAPHICAL LOCATION, NATIONAL, REGIONAL AND LOCAL CONTEXT (MAPS)

Map 1 Map of Kenya showing the national context of the study area

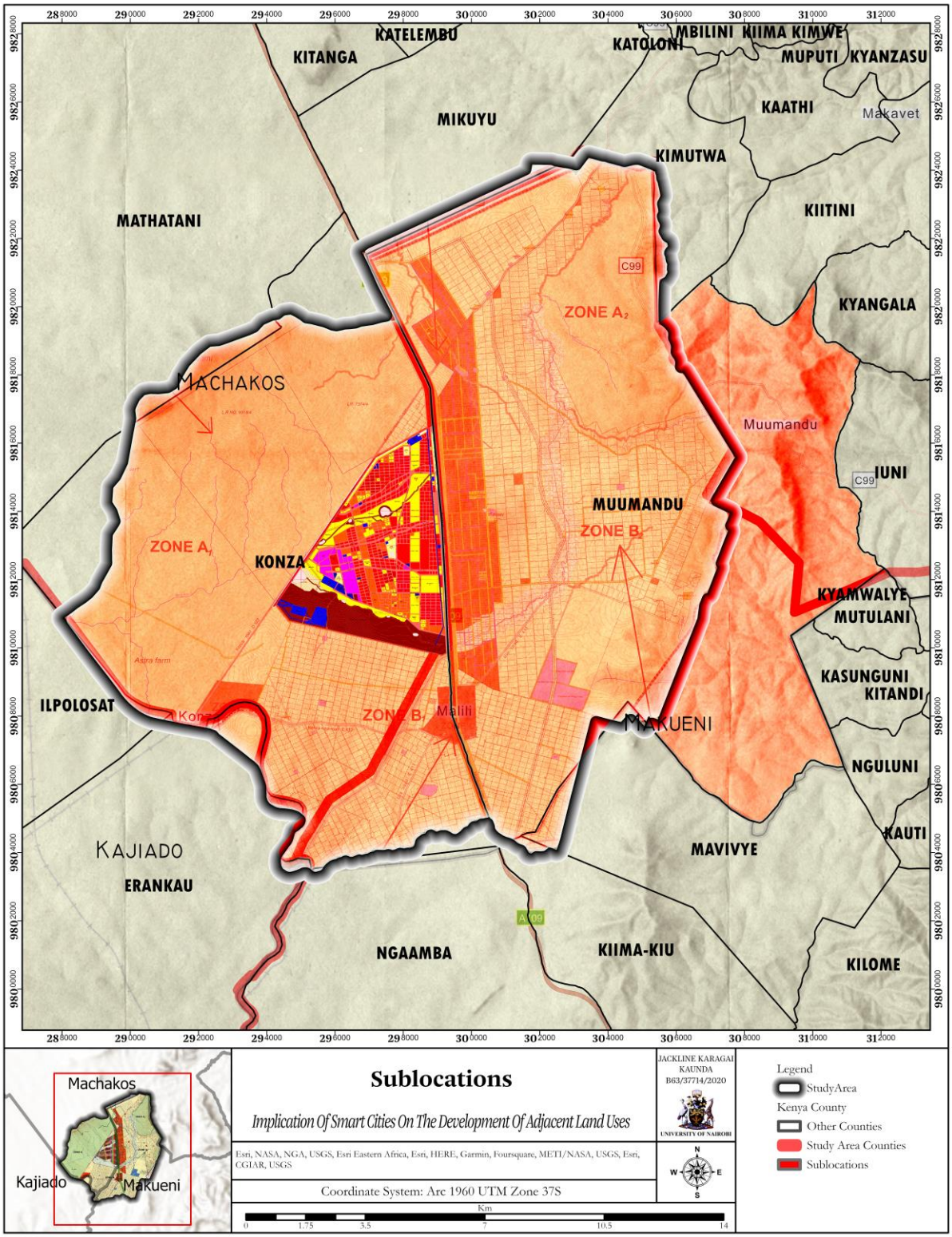


Map 2 Map showing the County Context of the study area.

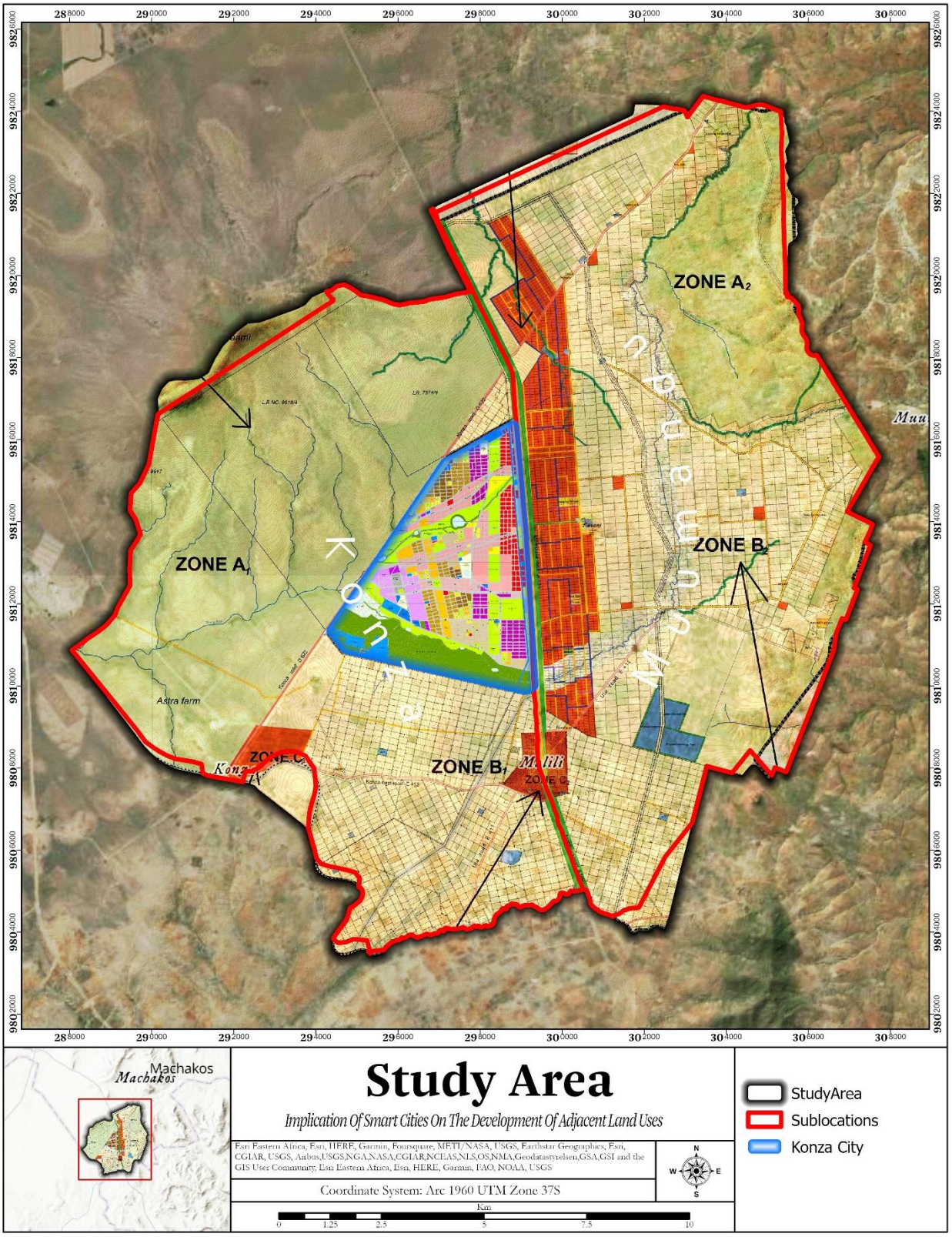


Map 3 Map showing Ward Context of the study area

Source: Compiled from SOK, 2023



Map 4: Map showing sublocation context of the study area



Map 5 Map of the Study Area,

Source: Compiled from SOK RIMs, 2023

4.3 Historical Background

In 2008, the Kenyan Government made a global declaration of its intention to establish Konza Technology City, a smart city commonly referred to as Silicon Savannah. This project was set to be a pivotal component of Kenya Vision 2030, an ambitious national initiative aimed at modernizing the country. In 2009, the Konza Technopolis project was initiated, involving the acquisition of a 5,000-acre plot of land at Malili Ranch, situated 60 kilometers southeast of Nairobi along the Mombasa-Nairobi A109 road. Originally, the launch of this African smart city was scheduled for 2020. Nevertheless, it faced various disruptions due to administrative and economic challenges, which deterred startups considering Kenya as their base.

Just when it appeared that the project might be shelved, in February 2021, the announcement came that 40% of Konza Smart City, as it was later named, had been sold to investors, and the construction of some of its primary structures had been completed.

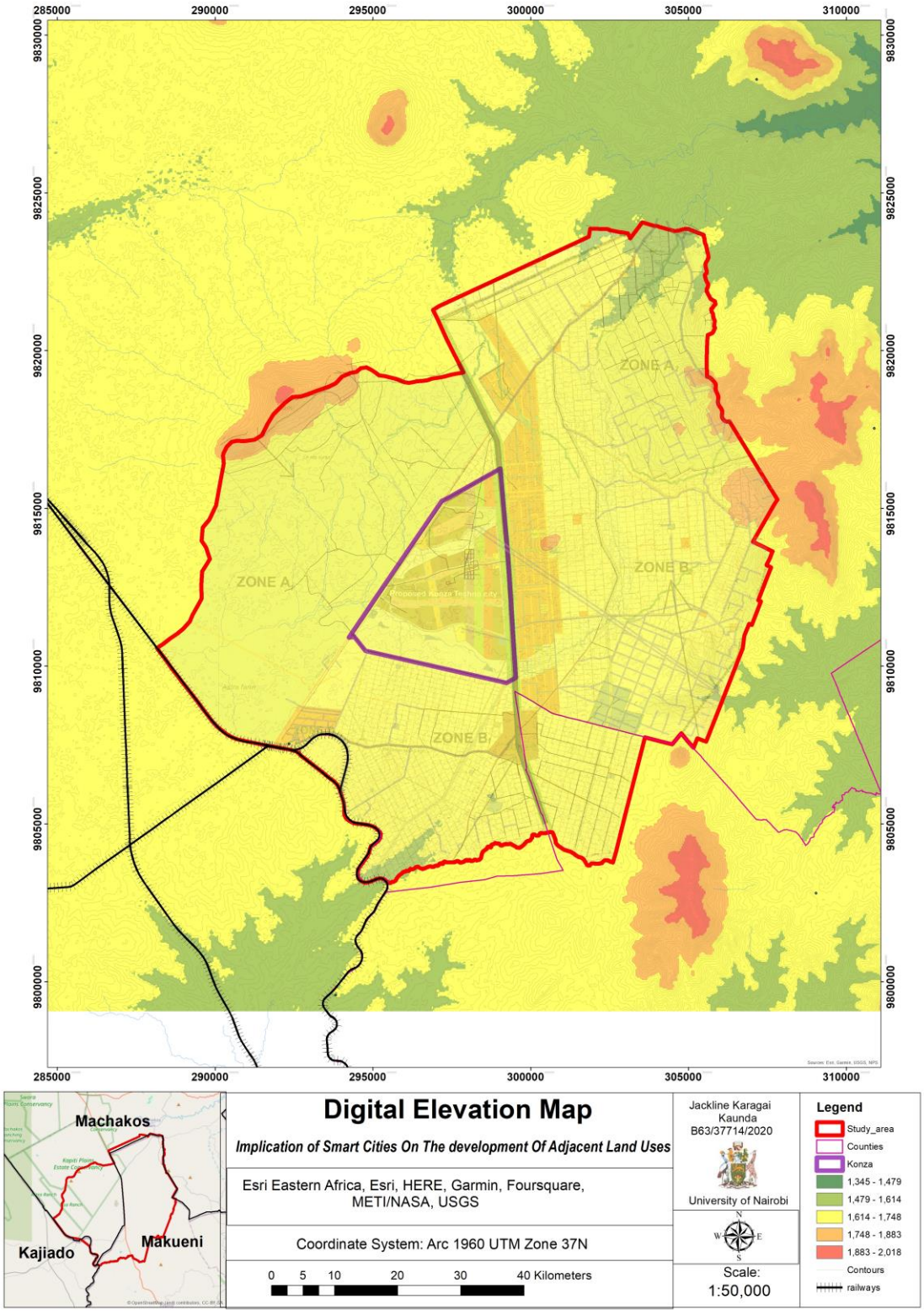
4.4 Physiographic and Natural Conditions

4.4.1 Topography

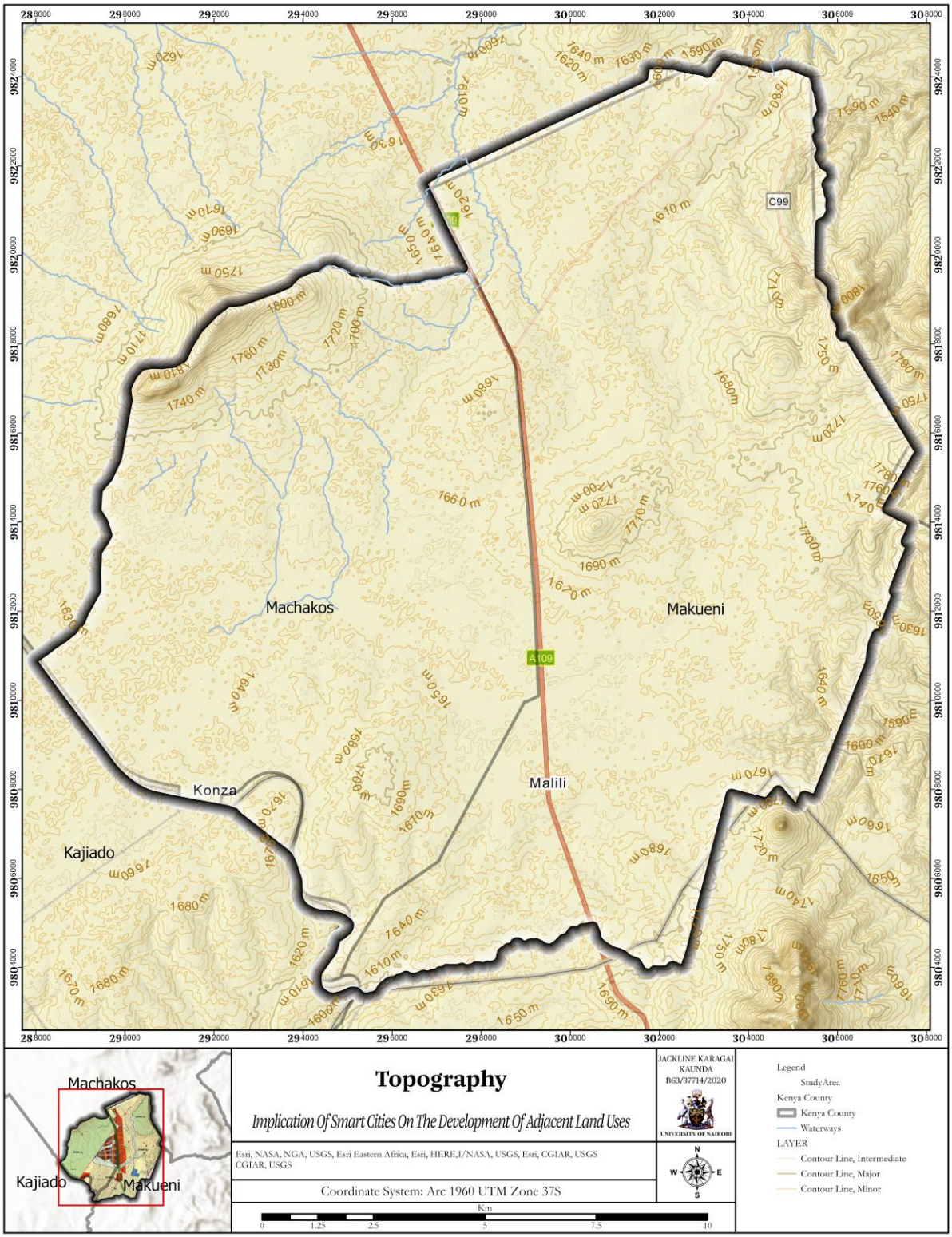
The topography of the study area is generally flat, undulating in the southwesterly direction. The general slope percentage is less than 10% in some central, northern, and southern areas, where it rises to 20%, draining southwards to Stony Athi River. The 5,000 acres' elevation height ranges from 1543 – 1690 m above sea level. Konza Technopolis base consists of metamorphic, igneous, and sedimentary rocks. Ferromagnesian gneiss is the dominant soil group. Hilly areas consist of quartz-rich granitoid, typically black cotton soils characterized by poor drainage, low fertility, black cracking, and swelling firm clay soils.

The Digital Elevation Model (DEM) has been provided to aid in the assessment of the suitability of the sites for different uses. The elevation data has been used to analyze the flooding potential of the sites to adopt interventions on drainage options. It will significantly guide land use planning. The DEM also supports planning for earth works within site, with an ability to compute for cut and fill for site construction and planning for engineering works.

The Stoney Athi, Kimutwa and Mukuyuni seasonal rivers cut through the Southern and to the North of Phase 1. All the rivers drain to the western part of Phase 1. This has now informed the construction of the storm water drains to that general direction.



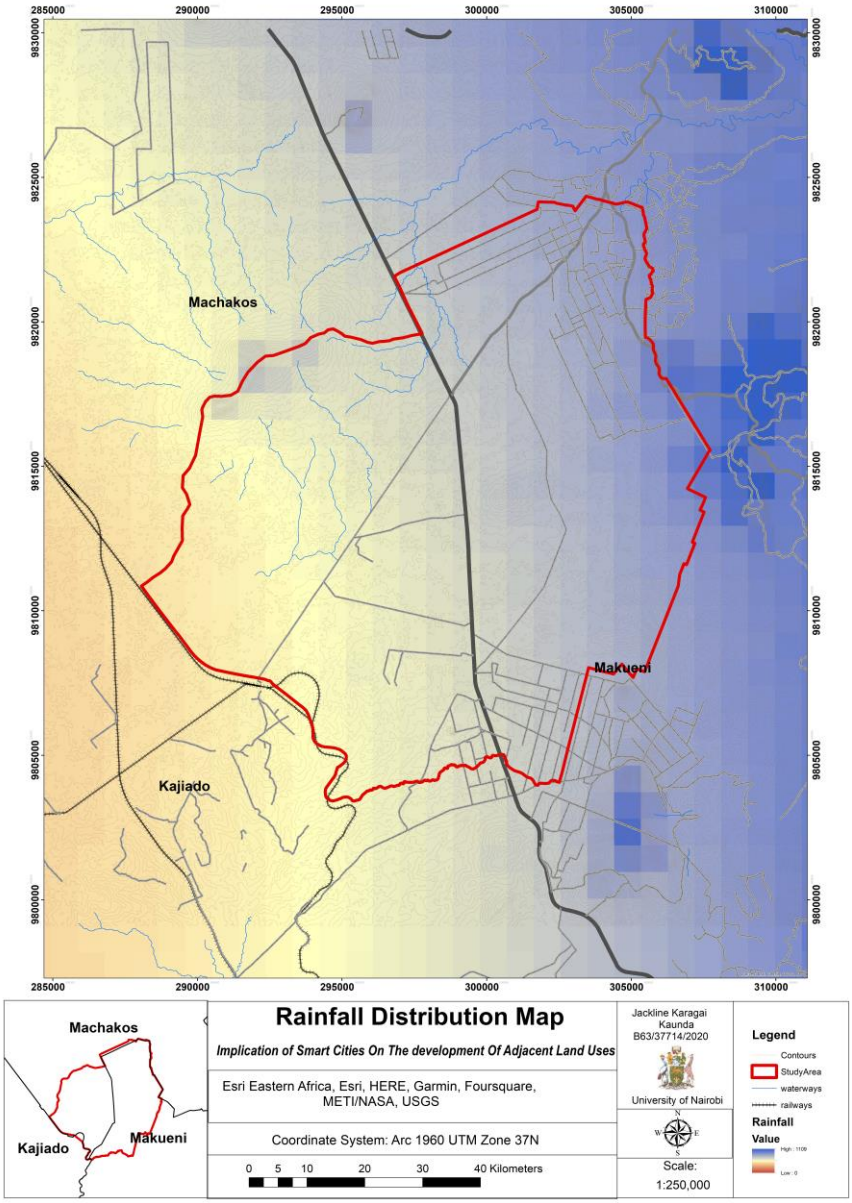
Map 6 Digital Elevation Map of the Study Area



Map 7 showing topography of the study area.

4.4.2 Climate

The research area is situated at an elevation ranging from 600 to 1900 meters above sea level. Precipitation occurs in two distinct seasons, with long rains typically falling from March to May, and short rains occurring from October to December. The total annual rainfall in the region varies from 150mm to 600mm, classifying it as part of the Arid and Semi-Arid Lands. In between the rainy seasons, the area encounters intermittent dry spells in January/February and from July to September. Generally, the study area is characterized by hot and dry conditions, with average temperatures around 22 degrees Celsius. These climatic characteristics are conducive for urban development.



Map 8 showing rainfall distribution of the study area, Source; Author

The fact that the region falls under the category of Arid and Semi-Arid Lands, ranching is a very viable means of livelihood in the area. With the increase of population due to Konza City, smart methods of food production should therefore be considered to be able to cater for the needs of the people.

4.4.3 Vegetation

The research area is predominantly covered by savanna woodland featuring woody plant elements and occasional low Acacia drepanolobium trees. Among the prevalent grass species are Pennisetum mezianum, Bothriochloa insculpta, Themeda triandra, and Digitaria macroblepharon.

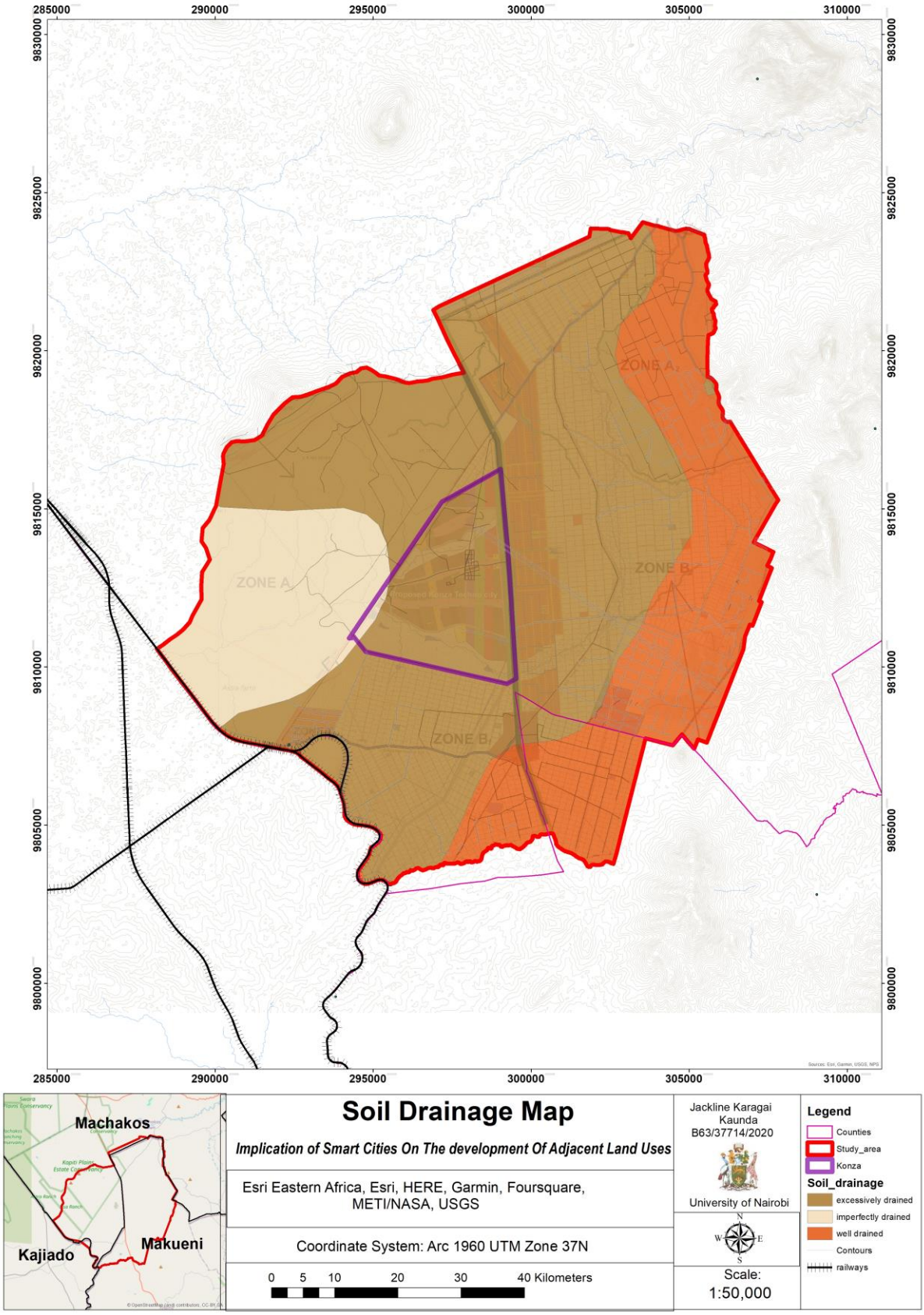
The natural vegetation in this area includes Themeda triandra, which is a tufted perennial grass species favored by grazers, as well as Hyparrhenia rufa, and wooded grassland areas characterized by Themeda in association with Balanites and Themeda in combination with Acacia. It was observed that some of these vegetation is being cut down to pave way for building developments as a result of influx of people attracted to the area by Konza City.

Figure 16: Photos showing the vegetation within the study area

4.4.4 Soils.

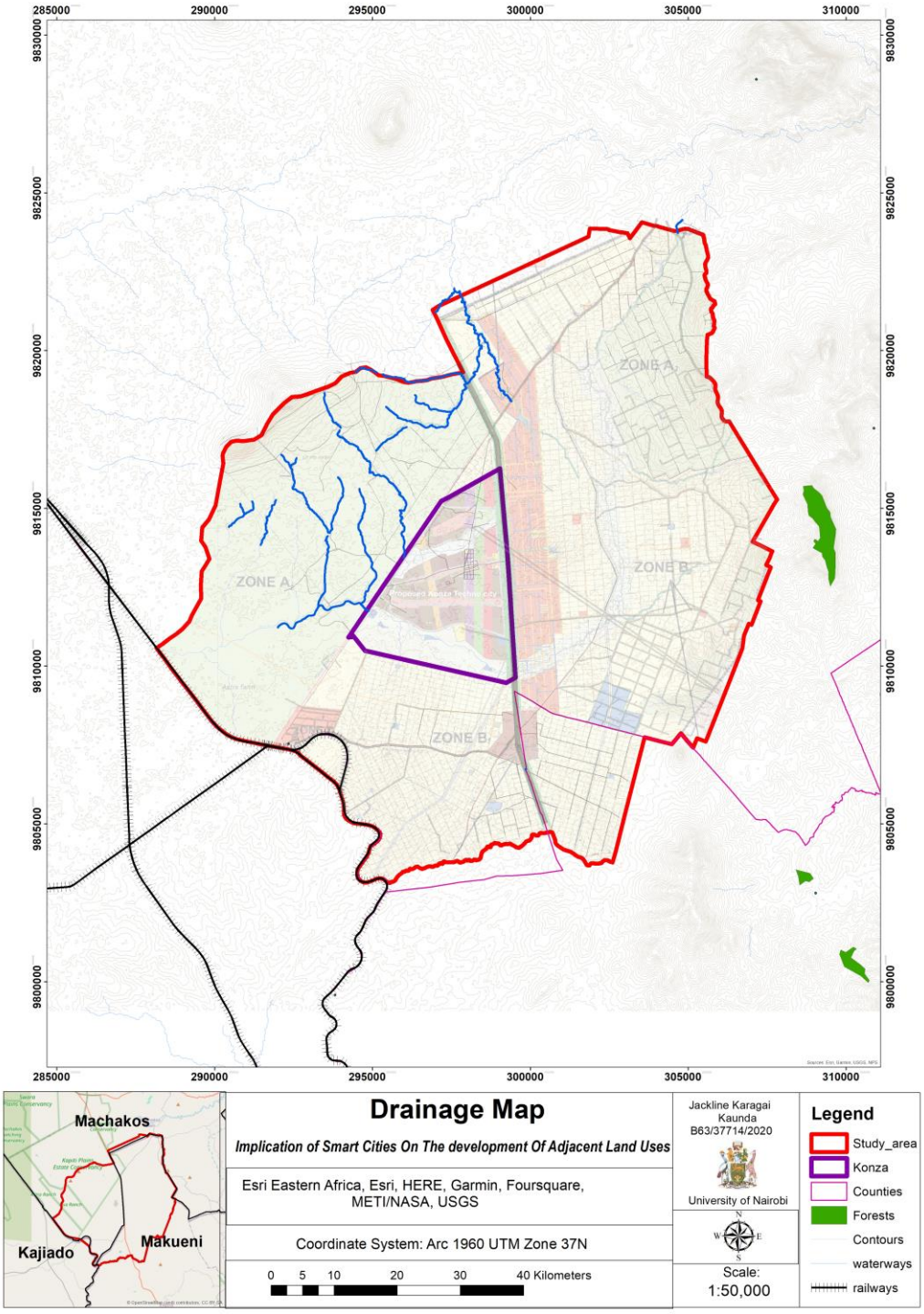
The study area predominantly consists of poorly drained soils. The area's eastern region, which covers 20% of the study area, is covered by well-drained soil. In building sustainable cities, it is necessary to conduct a geotechnical survey to determine stable grounds before conducting any developments. The soil quality will also be critical in determining areas suitable for urban agriculture.

Figure 17: Photos showing the predominant soil types within the area.



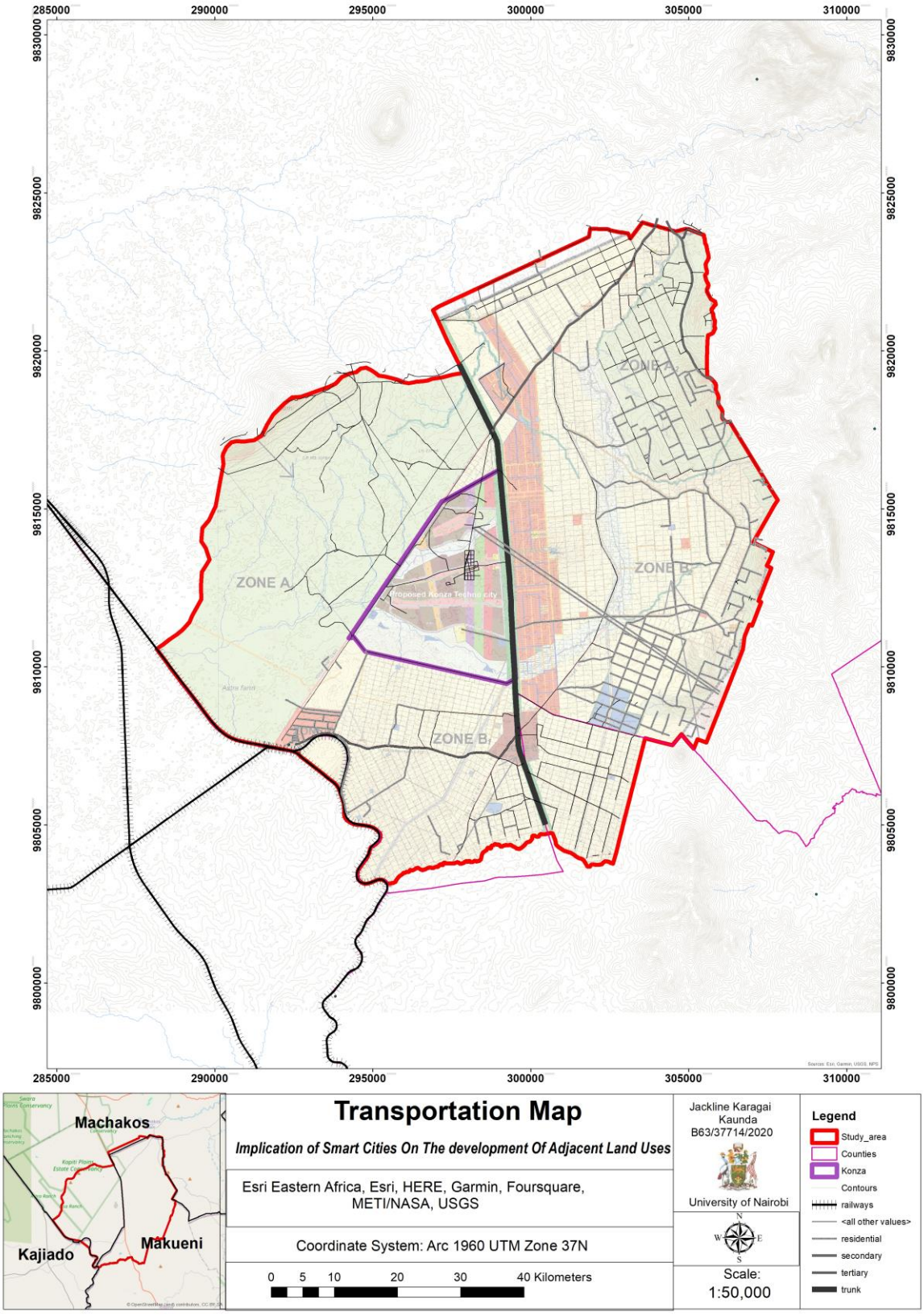
Map 9 Soil drainage map

4.4.5 Drainage and Hydrology



Map 10 showing drainage.

4.4.6 Transport Network

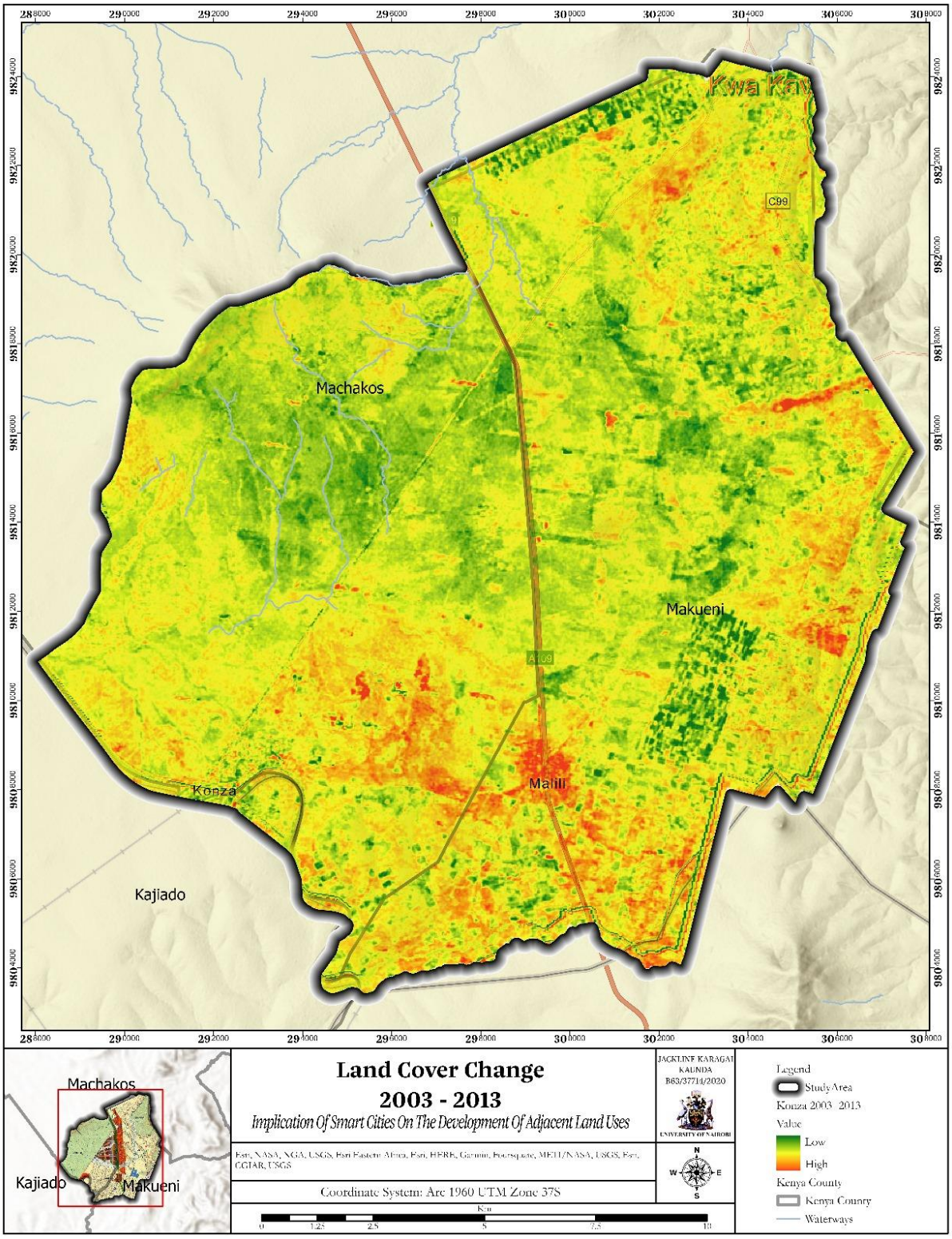


Map 11 showing transportation map

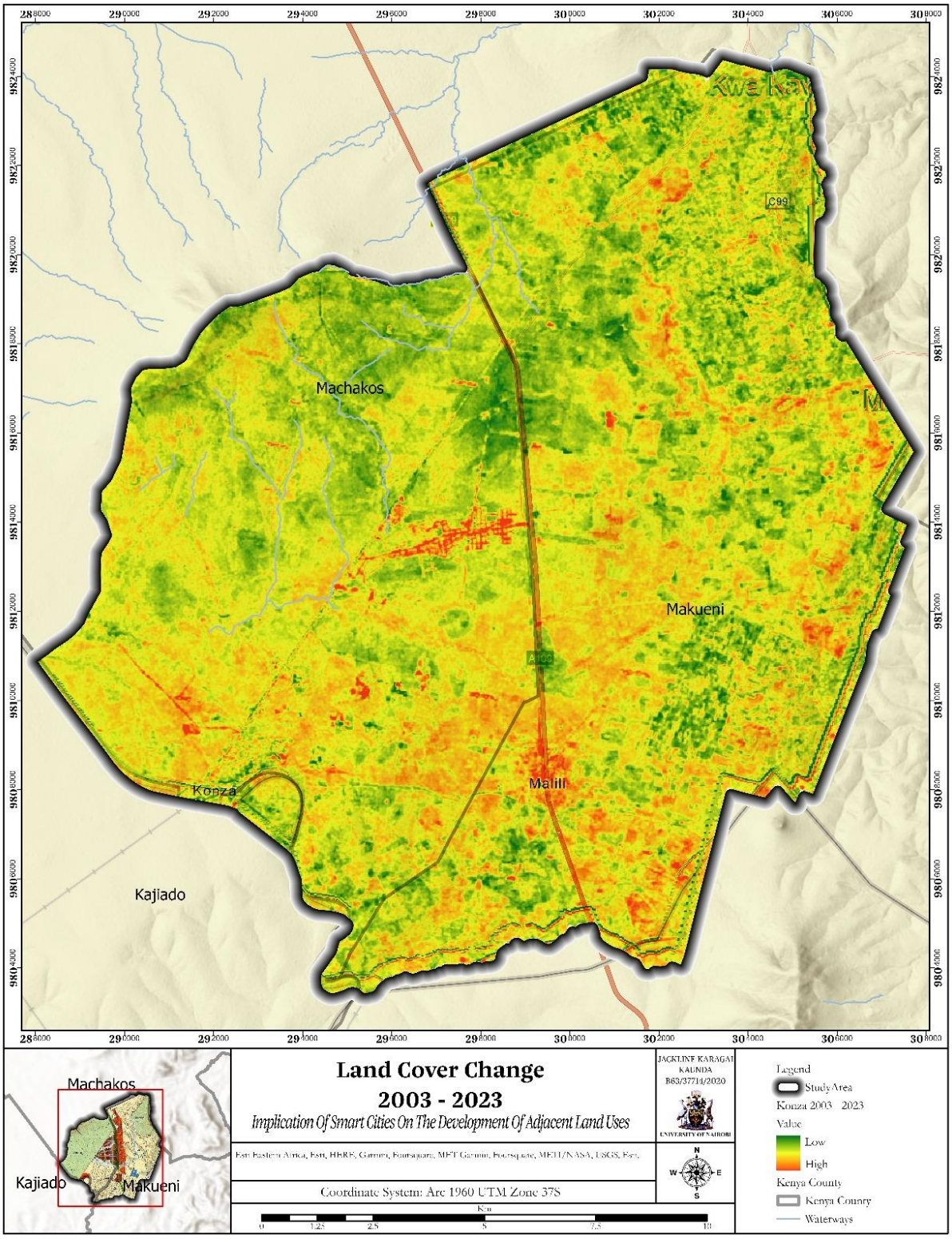
The main highway traversing the area is the A 104 road from Nairobi to Mombasa. Access to Konza city is directly from the main highway. There are several tertiary and secondary roads though most of them are marram class C roads. Most development has occurred along the class A 104 road near the area of Konza City. There is need to improve the transport network to enable better access to infrastructure and other services. There is also a standard gauge railway passing through the study area to Athi River.

4.4.7 Land Cover change Analysis.

Prior to the development of Konza City, the land Cover on the adjacent area was quite low. High concentration was experienced at Malili town. Between the period of 2013 and 2023 after which Konza city came in place, the land cover has increased to high in most parts of the study area. Malili town has also grown significantly as shown in the land cover change map.

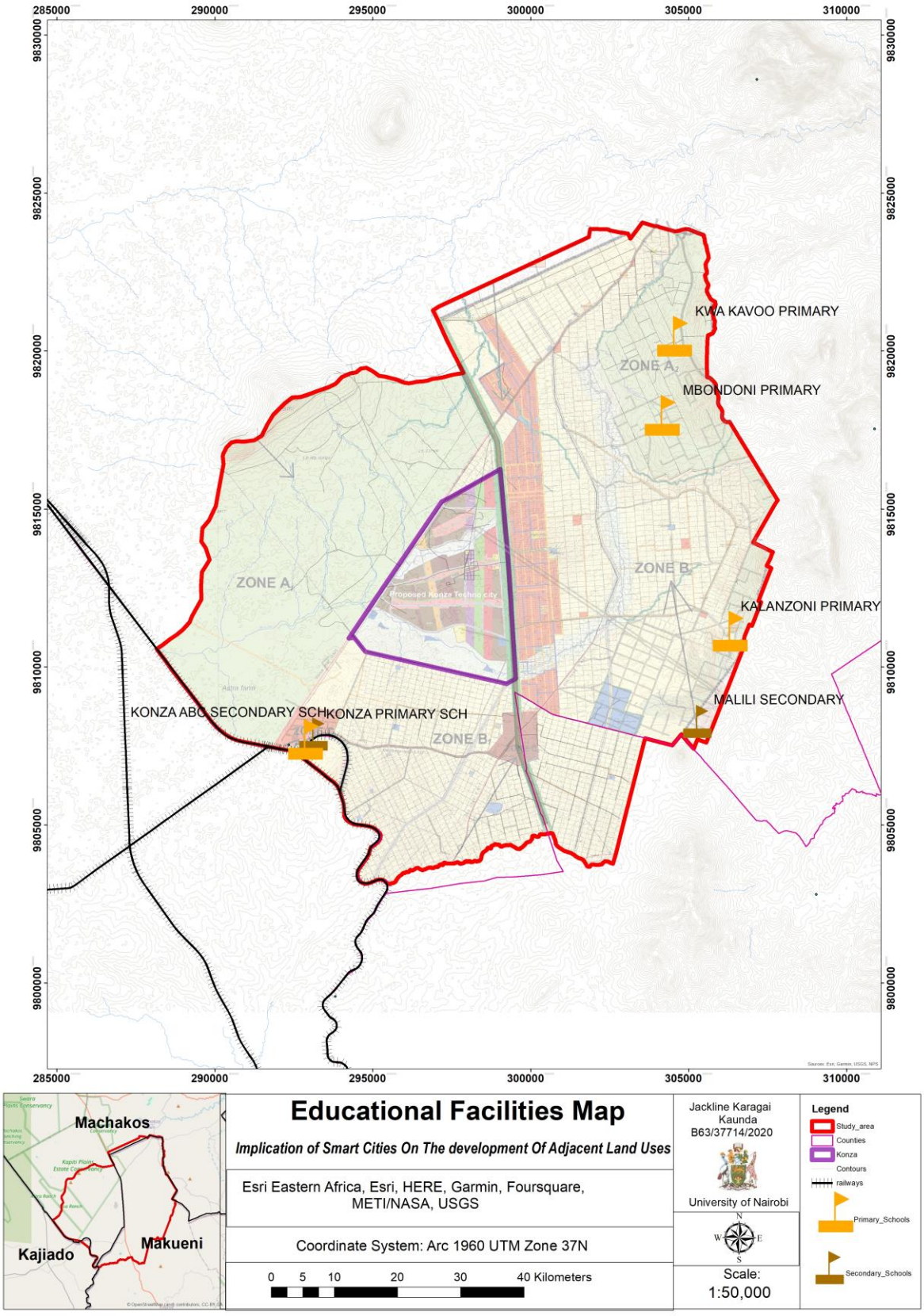


Map 12 land cover changes between 2003 and 2013



Map 13 land cover changes between 2003 and 2023

4.4.8 Education Facilities.



Map 14 showing educational facilities

The area has 4 Primary schools and 2 secondary schools. The schools are well distributed within the region. However, the physical conditions need to be improved in line with the technological advancement of the smart city abating to it.

4.4.9 Wildlife

The western side of the study area has many wildlife species, including Gazelles, Zebra, Warthog, Wild dogs, Hyenas, Wildebeest, Elands, and other mammalian species, and diverse birdlife. These are mainly found in the open grasslands.

Figure 18: Photo showing wildlife passing through the study area

4.4.10 Urbanization Trends

The urbanization trend revolves around creating an "innovation ecosystem" and "Silicon Savannah" in support of three clusters of industrial activity illustrated in the Figure below.

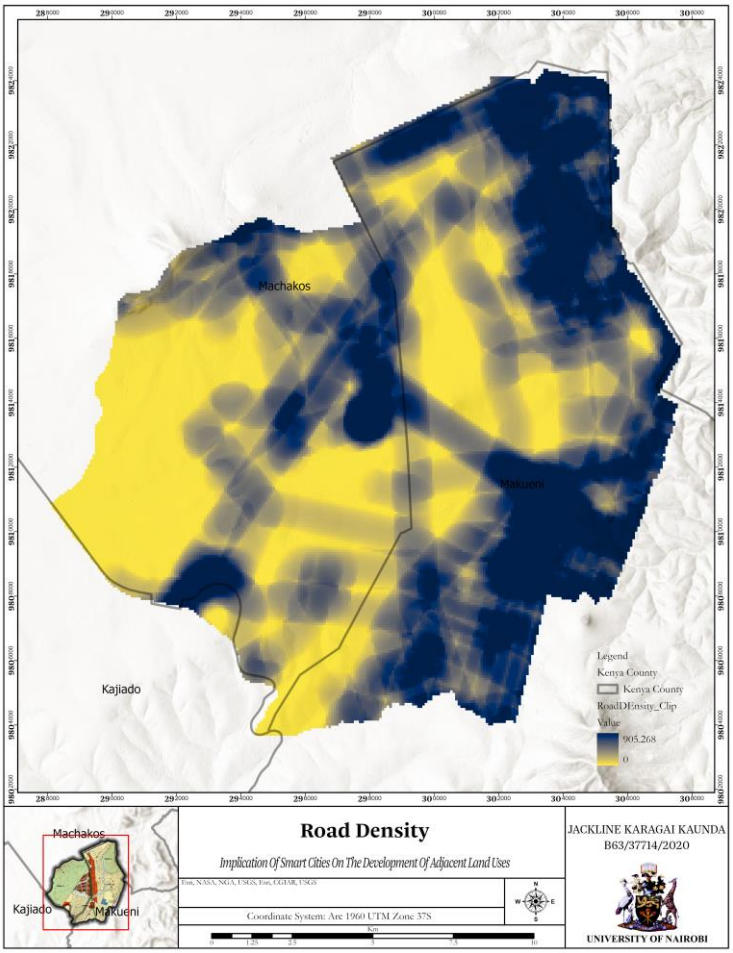
Source: SSS/GEES

By the year 2030, there is an expectation that the smart city will play a pivotal role in supporting Kenya's economic diversification, promoting industrial advancement, and attracting substantial foreign direct investment (FDI). The vision includes the generation of employment opportunities for more than 17,000 individuals, becoming a residence for 200,000 residents, and establishing a sustainable and efficiently managed world-class infrastructure.

The qualitative analysis emphasized the assessment of the city's feasibility and its potential to catalyze the expansion of other economies into emerging industrial sectors.

4.4.11 Road Density.

The road density maps depict a high concentration of roads and paths on the eastern side of the study area. It can be attributed to the increased subdivisions in the area and the fact that the western part of the study area is mainly comprised of ranches and conservancies.



Map 15 showing Road Density Map within the study area

4.5 Population and Demography

The study area encompasses two sublocations, namely Konza and Muumandu. According to the 2019 Kenya Population and Housing Census report, Konza Sublocation is situated in Machakos County and is home to a population of 2,017 individuals. Out of this total population, 1,166 are males, while 851 are females. Konza Sublocation comprises 687 households, with an average household size of 4.5 persons. It's noteworthy that the population of Konza Sublocation has grown by 62.2% since the previous census conducted in 2009.

Similarly, Muumandu Sublocation, located in Makueni County, had a total population of 6,151 people according to the 2019 Kenya Population and Housing Census report. Among this population, 2,950 are males, and 3,201 are females. Muumandu Sublocation consists of 1,395 households, with an average household size of 4.4 individuals. The population of Muumandu Sublocation has increased by 63.5% since the previous census conducted in 2009.

The census data also furnishes demographic insights into the populations of Konza and Muumandu Sublocations. For instance, the age distribution of the population in Konza Sublocation reveals that 54.8% fall within the age range of 15 to 64 years. Children under the age of 14 constitute 39.8% of the population, while those aged 65 and above make up only 5.3% of the population.

Similarly, the age composition of the population in Muumandu Sublocation indicates that 54.9% of the population falls within the age bracket of 15 to 64 years. The population of children under the age of 14 accounts for 41.1% of the total population, whereas those aged 65 and above represent a minor portion at 4.1% of the population.

Projections suggest that the population of the study area is expected to reach 11,024 from its current 9,979. Furthermore, there are expected changes in the age group composition, with the age group between 20 and 35 experiencing the most significant increase. This shift in age group composition is primarily attributed to the migration of people from other areas who have chosen to settle in Konza. The accompanying graph illustrates these changes in age group composition influenced by migration to the area.

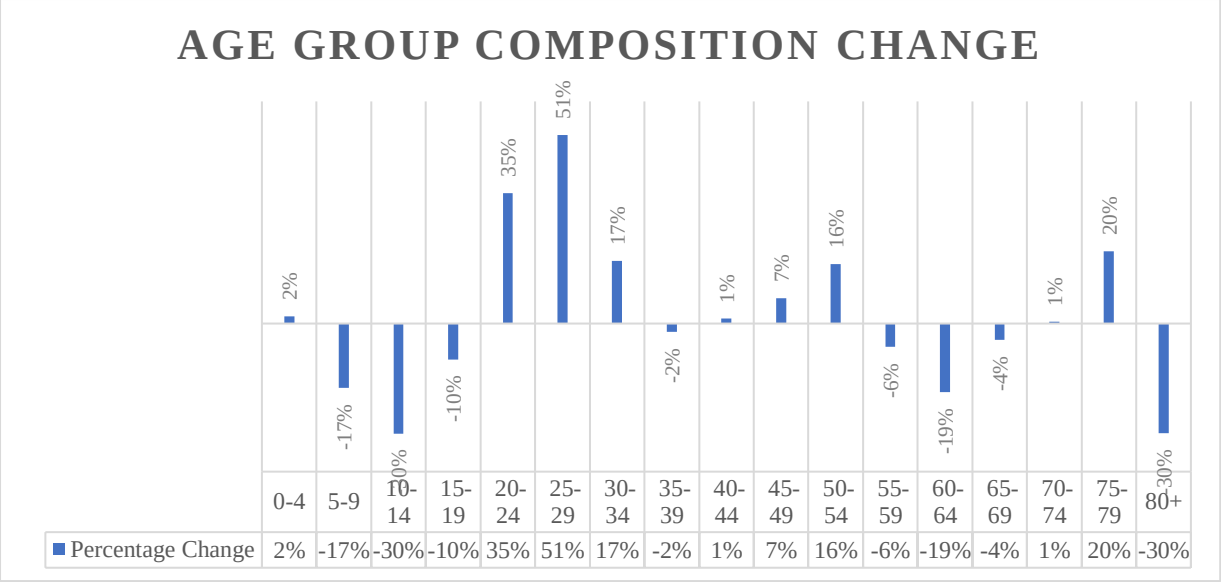


Figure 19:Age Group Composition

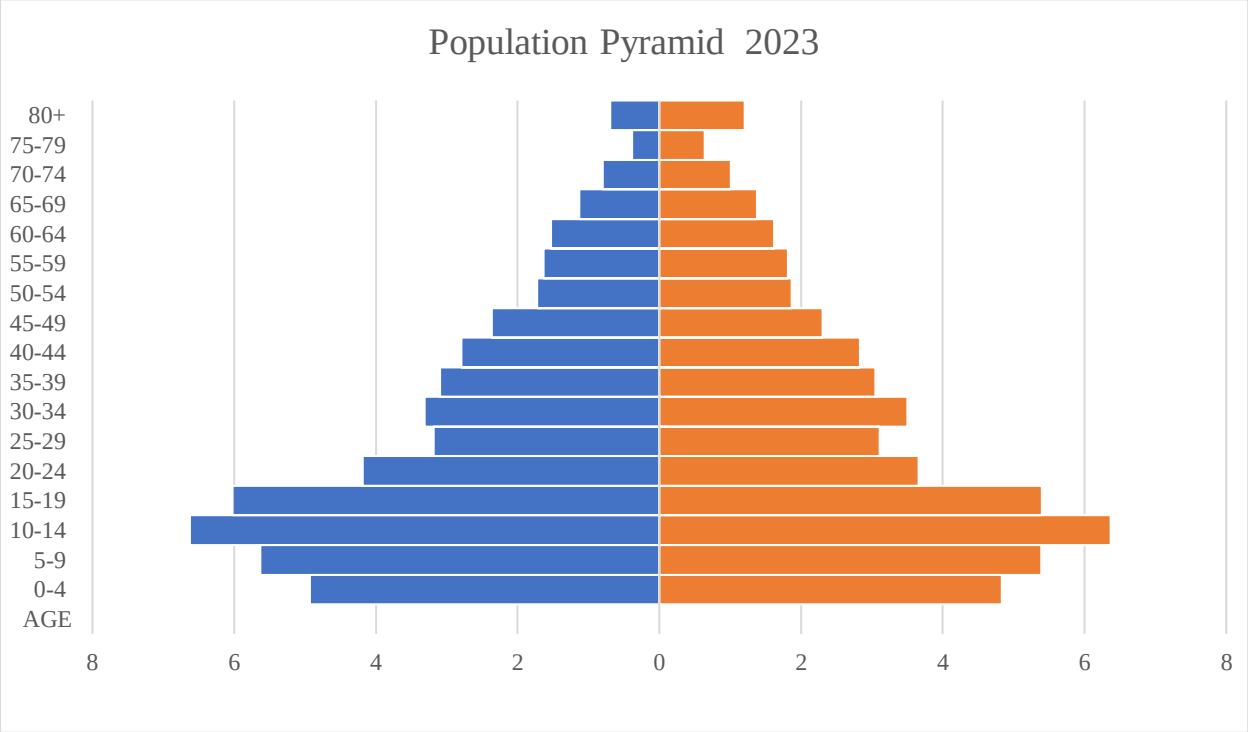


Figure 20:Projected Population Pyramid for 2023

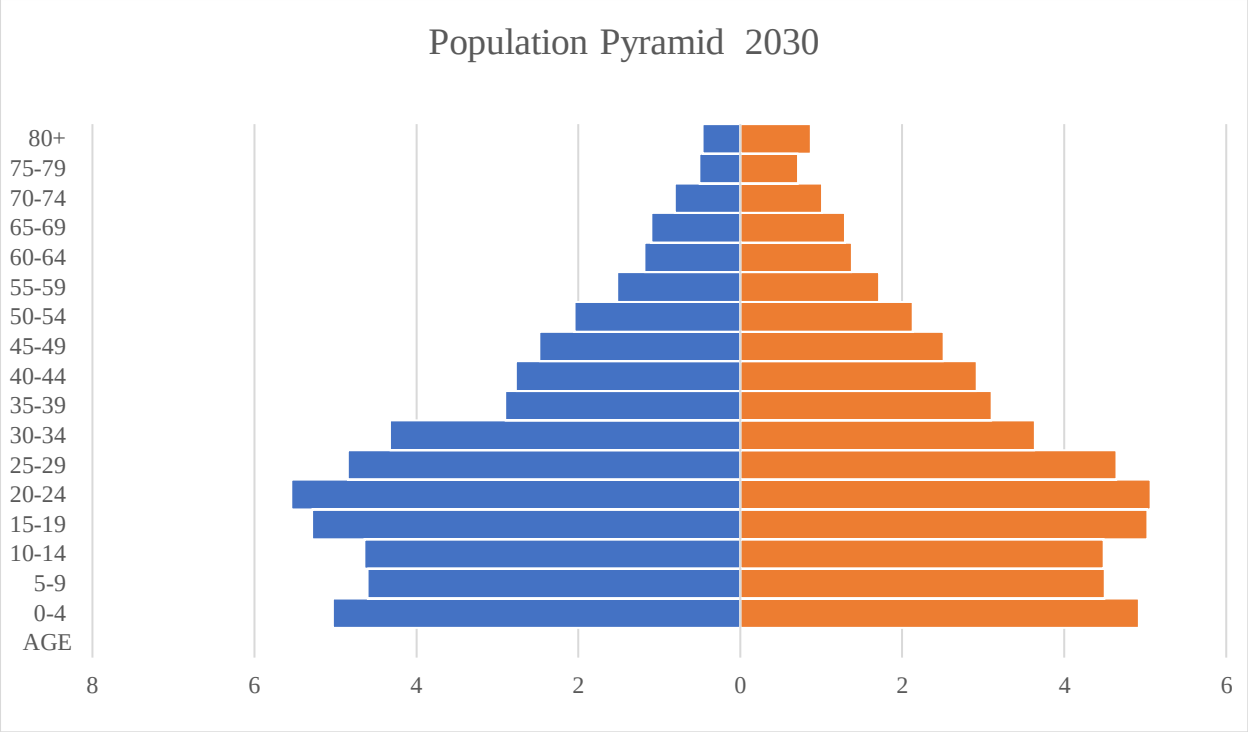


Figure 21:Projected Population Pyramid for 2030 (Source;Author)

4.6 Problem Map.

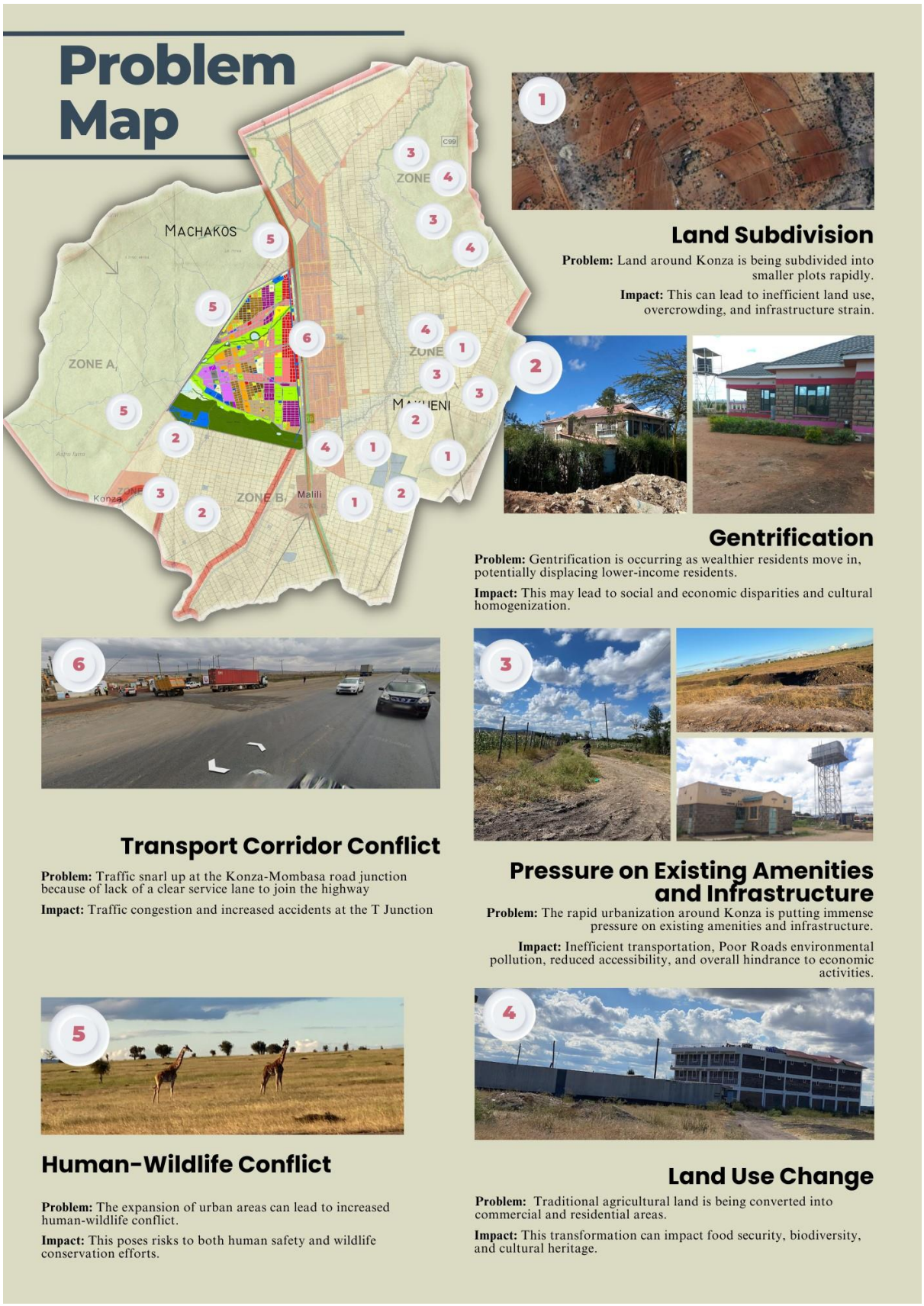


Figure 22: Problem Map (Source; Author)

4.7 Opportunity Map.

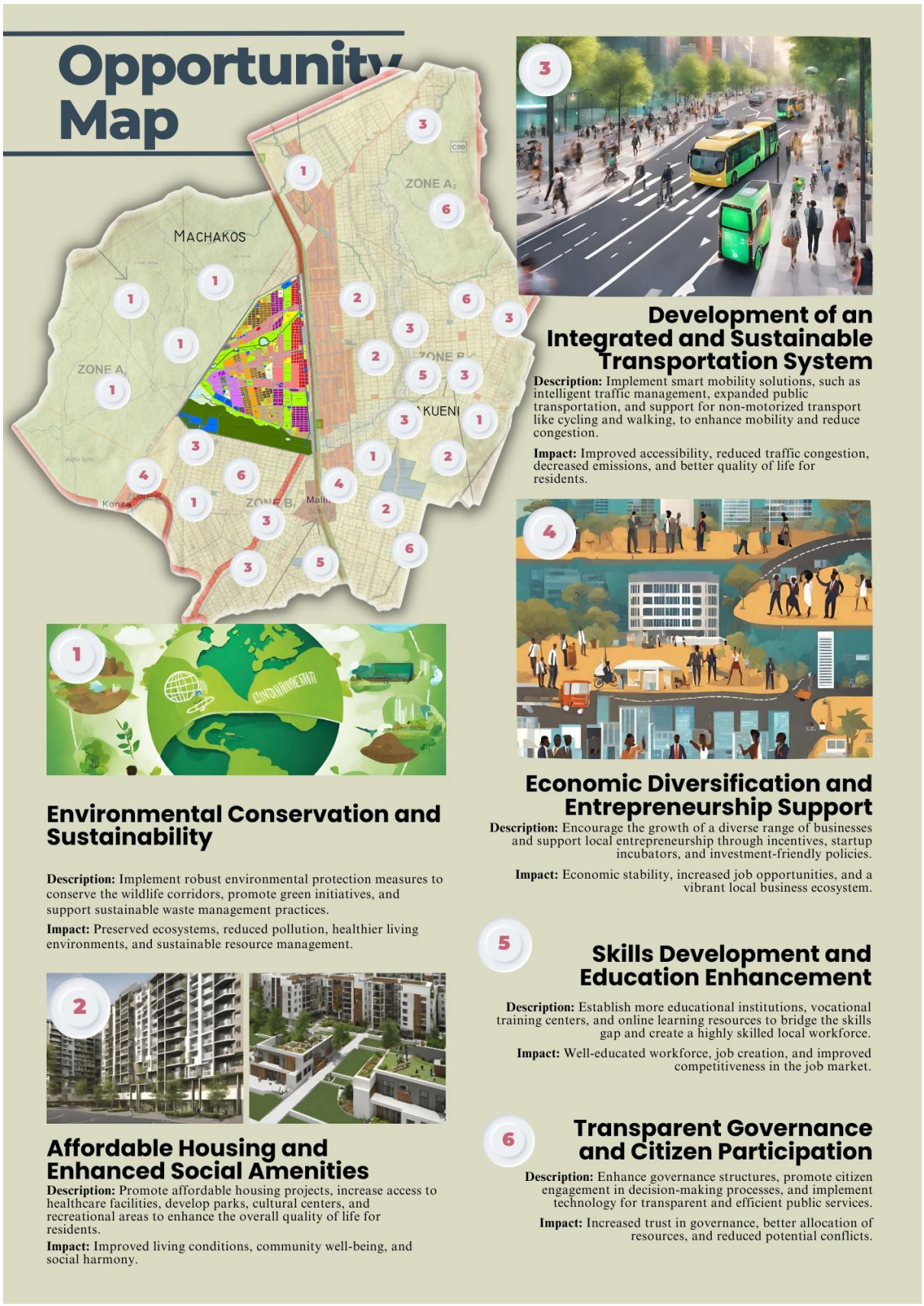


Figure 23 Opportunities Map

5.0 PRESENTATION, DISCUSSION, AND INTERPRETATION OF FINDINGS

5.1 Introduction

5.1.1 Recap of the objectives of the study

The first objective seeks to understand how the development of Konza City has influenced the surrounding areas, including changes in land use patterns, economic activities, and social dynamics. By investigating these implications, the research intends to gain insights into the overall impact of Konza City on its neighbouring communities and their livelihoods.

The second objective focuses on the reciprocal relationship between Konza City and adjacent land uses. It aims to analyze how the city influences activities and developments adjacent to it. The investigation includes exploring potential challenges or opportunities arising from the interactions between the city and its neighbourhood.

The third objective delves into the perceptions, roles, and behaviour of stakeholders involved in or affected by the development of Konza City and the adjacent land uses. It includes residents, government agencies, private entities, community leaders, and other stakeholders interested in the smart city project. Understanding stakeholders' perspectives and actions is crucial for formulating effective strategies that foster collaboration, inclusivity, and sustainable development for Konza City and the neighbouring areas.

The research seeks to provide comprehensive insights into the dynamics between Konza City and its neighbouring regions, formulating strategies to ensure the sustainable growth and development of smart cities and the well-being and prosperity of the adjacent land uses. By fulfilling these objectives, the study aims to contribute to the knowledge and practices in smart city planning and development, promoting an inclusive and equitable approach to urbanization and its impacts.

5.1.2 Overview of the respondent profile

Demographics

Demographic information relating to different age groups was captured, as presented in Table 2

Age Category in Years	*Frequency*	*Percent*
16-20	4	4%
21-25	7	8%
26-30	18	20%
31-35	13	14%
36-40	11	12%
41-45	2	2%
46-50	4	4%
51-55	13	14%
56-60	15	16%
61-65	2	2%
66-70	4	4%
Total	92	100%

Table 3:Demographics

The total sample comprised 92 individuals, and their ages were divided into ten distinct groups. These age groups range from 16-70, with each subcategory containing five years.

As shown in Table 2 the respondents' modal age category is 26-30 years, accounting for 20% of the total respondent population. Closely following the respondent age group is 56-60, at 14% of the respondent population. Such respondent rationing proves valuable in assessing the perceptions and behavior of the residents. For example, younger stakeholders might have different perspectives on the city's potential benefits and drawbacks compared to older stakeholders as they might be more attracted to the city’s amenities and job opportunities than their counterparts.

Residence

Most respondents were study area residents, mainly from the Konza and Muumandu areas. It is essential for the research study since obtaining data from outside sources might be

misleading and present wrong information. Of the respondent population, 30% were from Konza city, while 60% were Muumandu area residents. The remaining 10% comprises 5 respondents who didn't feel comfortable disclosing their residence.

Residence Name	*Frequency*	*Percent*
KONZA	28	33%
MUUMANDU	55	67%
Total	83	100%

Table 4:Residence Location

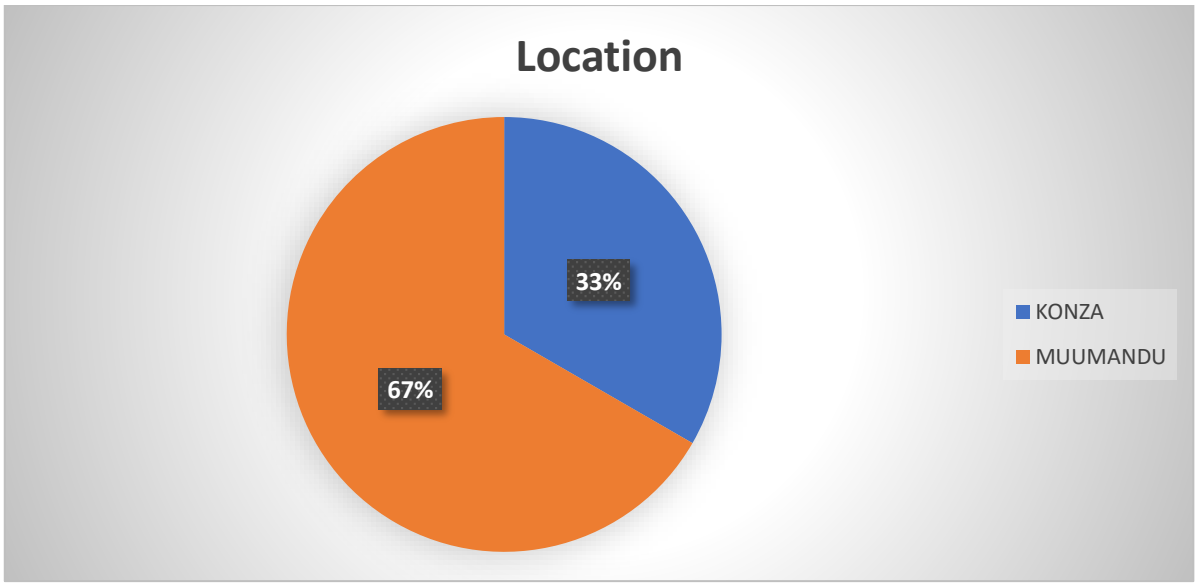


Figure 24: Location

Education

The respondents' education levels are categorized into four groups: Primary, College, Secondary, and University. Most respondents (36%) have attained primary education as their highest level of education, and 26% have gone up to secondary level. Only 14% and 12% have achieved college and university levels, respectively.

Highest Education Attainment		Frequency	Percent
Valid	Primary	33	36%
	Secondary	24	26%
	College	13	14%
	University	11	12%
	Total	81	88%
Missing	System	11	12%
Total		92	100%

Table 5:Education Level

It offers valuable information regarding the respondents' knowledgeability and accuracy level their information offers. The data suggests that a significant portion of the respondents have completed only primary education, indicating that the survey sample might include individuals with a lower educational background. As a result, their knowledge and understanding of complex or specialized topics might be limited. On the other hand, the smaller percentages of respondents with college and university education levels may suggest that the survey sample includes individuals with higher educational qualifications. Such respondents might possess a deeper understanding of certain subjects and could provide more accurate and informed responses.

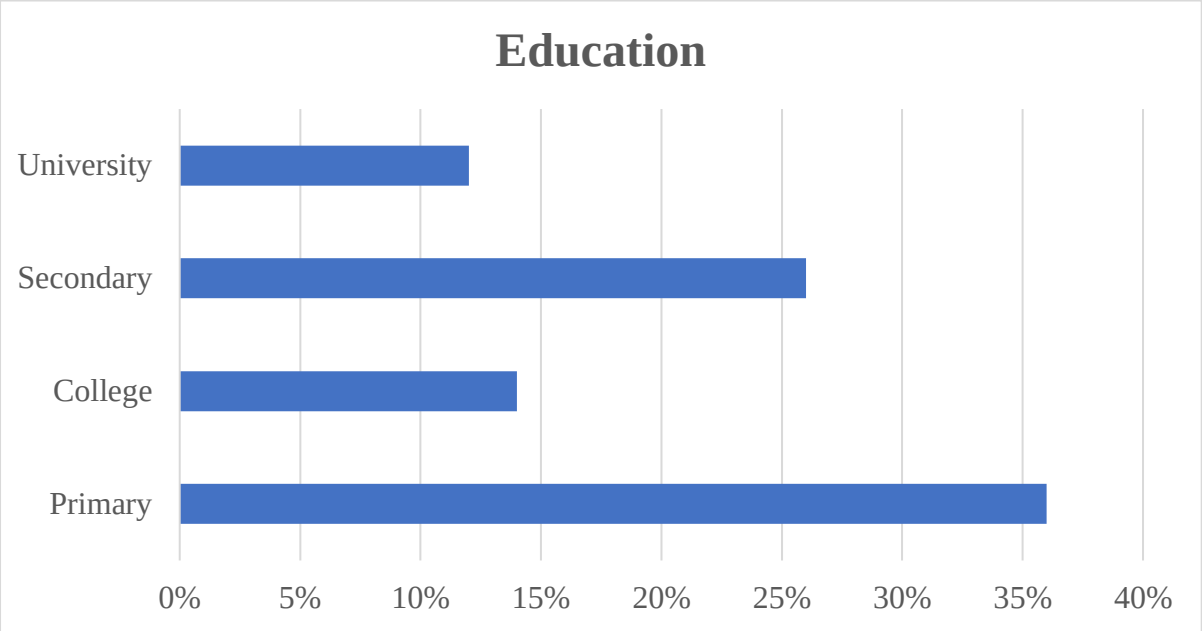


Figure 25:Education Level

Household Demographics

The most common household size in the study area is 3 members, with 15 households (30%) falling into this category. The second most prevalent household size is 1 member, with 8 households (16%). The sizes 2, 4, and 5 members have 5 households (10%), 7 households (14%), and 7 households (14%), respectively.

Overall, the data provides valuable information about the distribution of household sizes in the surveyed population. Understanding household sizes can affect various aspects, such as housing demand, resource allocation, and community social dynamics.

Household Size	*Frequency*	*Percent*
1	15	16%
2	9	10%
3	28	30%
4	13	14%
5	13	14%
Total	**77**	**84%**

Table 6:Household Demographics

Socio-economic Factors

Most of the interviewed individuals practice business, formal employment, and farming as a livelihood, while the minority are casual laborers. The most common occupation is business, with 16 individuals (32%) involved in this category, followed by formal employment, which includes 3 individuals (6%). 10% of the respondents (5 individuals) practice farming as the main occupation, while casual labor comes in last, involving 2 individuals (4%).

Understanding the distribution of occupations can be crucial for socio-economic analyses, policy-making, and resource allocation, as it provides insights into the composition of the workforce and the various economic activities pursued by the surveyed individuals.

Occupation		*Frequency*	*Percent*
Valid	Business	29	62%
	Formal Employment	6	12%
	Farming	9	19%
	Casual labor	4	8%

	Total	48	100%
Missing	System	44	
Total		92	

Table 7:Socio-economic Activities

Regarding places of work, the majority noted Malili Center at 32% (16 respondents) as the leading center where they carry out their activities. It implies that Malili Center as the central economic hub in the area.

	LOCATION OF WORK PLACE	FREQUENCY	PERCENT
VALID	Malili	29	32%
	Konza	4	4%
	Zeal Academy	2	2%
	Korean Institute	2	2%
	ICT	2	2%
	Kwa Mastiio	4	4%
	At Home	2	2%
	Konza Smart City	2	2%
	Total	48	52%
MISSING	System	44	48%
TOTAL		92	100%

Table 8:Work Area

Expenses

Food expenses

Most residents in the study area spend an average of 10001-20000 (18%) and 5001-10000 (14%) on food items. It indicates that many of the surveyed population falls within the middle-income bracket. 12% of the respondents can spend 20001-50000, which shows a higher income range as they have higher purchasing power and can afford relatively more expensive food items. The lowest spending category is 1001 - 5000, with 9 individuals (18%) falling into this range. These individuals have relatively lower food expenditures and may be considered part of the lower-income group.

Monthly Amount Spent on Food in KSH		Frequency	Percent
Valid	10001 - 20000	33	36%
	5001-10000	26	28%
	20001 - 50000	11	12%
	1001 - 5000	17	18%
	Total	86	94%
Missing	System	6	6%
Total		92	100.0

Table 9:Food expenses

Clothing Expenses

Most people (32%) can spend between 1001-5000 on clothing. The second most prevalent category is 5001 - 10000, comprising 6 individuals (12%). 0-1000 is the least represented category for clothing spending, with 2 individuals (4%). This implies that even though the community can spend more on food expenses, they are hesitant to spend on clothing. This data gives relevant implications on the community's income and affordability, consumption patterns, and inequality and poverty patterns in Konza.

Clothing Expenses in Kshs		Frequency	Percent
Valid	10001 - 20000	6	6%
	5001-10000	11	12%
	10001 - 20000	6	6%
	1001 - 5000	29	32%
	0-1000	4	4%
	Total	55	60%
Missing	System	37	40%
Total		92	100%

Table 10:Clothing Expenses

Electricity Expenses

Out of the total respondents, the majority fell within the "0-1000" expenditure category, accounting for 24% of the participants. It indicates that a significant proportion of the surveyed population had relatively low electricity expenses, staying within the first expenditure bracket. The second most common category was "1001-5000," comprising 4% of the respondents. The "5001-10000" and "10001-20000" categories represented 2% of the respondents, showing that only a small percentage of participants reported spending within these higher ranges. It suggests that many respondents keep their electricity costs relatively low, while only a few experienced higher electricity bills.

Electricity Expenses in Ksh.		**Frequency**	**Percent**
Valid	5001-10000	2	2%
	10001 - 20000	2	2%
	1001 - 5000	4	4%
	0-1000	22	24%
	Total	29	32%
Missing	System	63	68%
Total		**92**	**100%**

Table 11:Electricity Expenses

Transport Expenses

Most respondents fall into two expenditure brackets: "5001 - 10000" and "1001 - 5000." These categories account for 32.0% and 18.0% of the respondents, respectively, making up a significant portion of the valid responses. The two highest expenditure ranges, "10001 - 20000" and "0 - 1000," accounted for 2.9% and 17.6% of the valid responses, respectively. These ranges seem to represent outliers in the data, with only a few respondents falling into these categories.

Transport Expenses In Ksh.		Frequency	Percent
Valid	20001 - 50000	2	2%
	5001-10000	29	32%
	10001 - 20000	4	4%
	1001 - 5000	17	18%
	0-1000	11	12%
	Total	63	68%
Missing	System	29	32%
Total		**92**	**100%**

Table 12:Transport Expenses

Education Expenses

Most of the 92 respondents fell into the two middle expenditure categories. Specifically, 14% of the participants reported spending between 20,001 to 50,000 on education. It was followed by 8% of the respondents who allocated their expenses in the 5,001 to 10,000 range. Moreover, 22% of the participants indicated that their monthly expenditure on education falls from 10,001 to 20,000 units. The distribution shows a considerable proportion of respondents in this category, meaning that a significant portion of the sample population invests substantially in transportation to support their educational commitments. On the lower end of the spectrum, 12% of the respondents reported spending between 1,001 to 5,000 units on education-related transportation expenses. Meanwhile, only 4% of the participants claimed to allocate a relatively smaller budget, spending between 0 to 1,000 units on educational transportation.

Education Expenses in Ksh.	*Frequency*	*Percent*
20001 - 50000	8	23%
5001-10000	5	13%
10001 - 20000	13	37%
1001 - 5000	7	20%
0-1000	2	7%
Total	35	100%

Table 13:Education Expenses

Agriculture Expenses

The largest group of respondents, comprising 14 individuals, reported spending within the range of 1001 - 5000. This category accounts for approximately 30.4% of the valid responses, indicating that it is the most common agricultural expenditure range. The second most common expenditure range was 1 - 5000, reported by 10% of the respondents, making up 21.7% of the valid responses. Moreover, 8% of the respondents fell into the expenditure range of 5001 - 10000, contributing to 17.4% of the valid responses. Similarly, 5 respondents (10%) reported spending between 10001- 20000 units, representing 21.7% of the valid responses.

Agricultural Expenses in Ksh.	***Frequency***	***Percent***
20001 - 50000	7	22%
5001-10000	6	17%
10001 - 20000	7	22%
1001 - 5000	10	30%
0-1000	3	9%
Total	32	100%

Table 14:Agriculture Expenses

Rent Expenses

According to the data, most respondents spend between 1001 and to 5000 on rent, with 11 participants falling within this category. It accounts for approximately 22.0% of the respondents, making it the most prevalent rent expenditure range among the survey participants. These findings suggest that many respondents have a moderate rent burden, spending a considerable portion of their income on housing expenses. The next most common category is the 5001 to 10000 range, with 6.0% of the respondents falling into this group. It accounts for a total of 3 participants. Only one respondent spends between 10001 and 20000 units on rent, constituting just 2.0% of the total participants. On the lower end of the spectrum, 6.0% of the respondents, which also amounts to 3 participants, reported spending between 0 to 1000 on rent. It indicates that a small but noticeable portion of the respondents live in low-cost housing options or availing of subsidized accommodations.

Rent Expenses in Ksh.	*Frequency*	*Percent*
20001 - 50000	2	5%
5001-10000	5	16%
10001 - 20000	2	5%
1001 - 5000	17	58%
0-1000	5	16%
Total	30	100%

Table 15:Rent Expenses

Savings Expenses

The most significant percentage of respondents falls into the "1001 - 5000" savings range, accounting for 36% of the valid responses. It suggests that a considerable portion of the participants have savings within this range. The next most prominent savings bracket is "5001-10000," comprising 21% of the respondents. The "0-1000" category, representing the smallest savings range, is reported by 14% of the respondents. It indicates that a limited number of participants have savings in this lower range.

Savings in Ksh.	*Frequency*	*Percent*
20001 - 50000	6	21%
5001-10000	6	21%
10001 - 20000	2	7%
1001 - 5000	10	36%
0-1000	4	14%
Total	27	100%

Table 16:Savings Expenses

5.2 Implications of Konza City on the Adjacent Land Uses

5.2.1 Changes in neighbouring land uses since the development of Konza City

Most respondents (31%) stated notice of changes in the neighbouring land uses since the development of Konza City, while 19% stated no change.

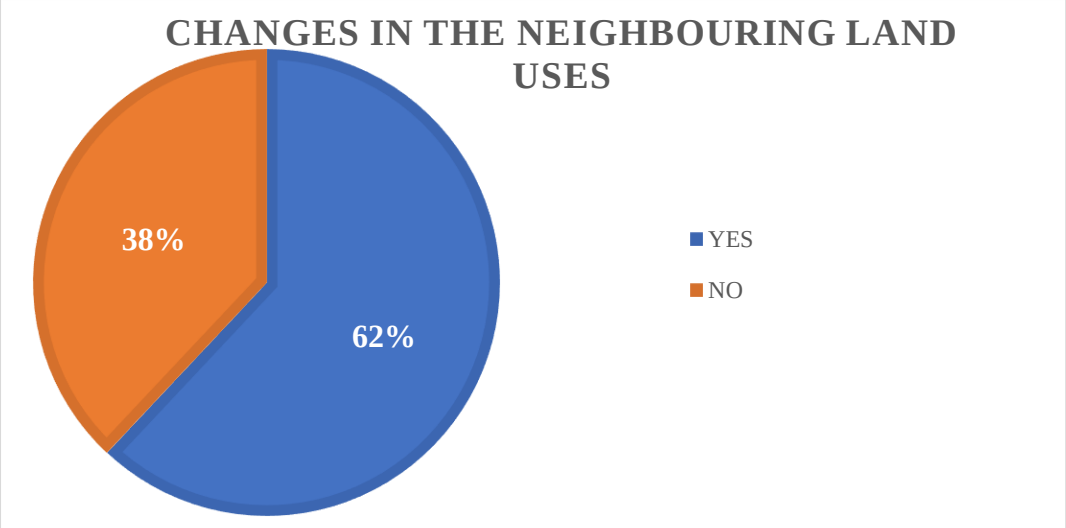


Figure 26:Changes in the neighbouring land uses since the development of Konza City

Among the changes noted, most interviewees (16 participants) reported changes relating to urban development, population growth, infrastructure development, and connectivity. 2% noted changes in the impact on wildlife and grazing land, while some suggested changes in the social impact, increased property value, and economic and employment changes.

Effects in the Neighbourhood	***Frequency***	***Percent***
Social Impact	6	6
Increase in residential development	2	2
Urban Development and Population Growth, Infrastructure and Connectivity	29	32
Impact on Wildlife and Grazing Land	2	2
Infrastructure and Connectivity	6	6
Economic and Employment Changes	2	2
Property Value	6	6
Total	52	56
	92	100

Table 17:Reported changes

However, some of the respondents stated they didn't notice any change. According to their responses, some reasons for no change are that infrastructure needs to be improved, and thus no improvement was made. This response was made by 2% of the respondents. At the highest percentage, 12%, were respondents who stated that there were still no local jobs. Lack of development, laxity of government officials, and lack of accessible and public utilities were other reasons given for the lack of changes, as shown in the table below.

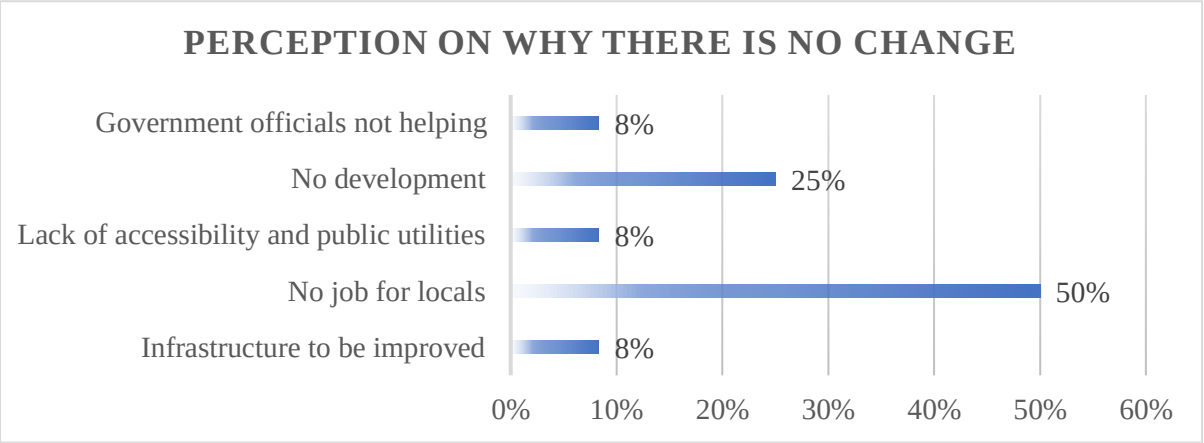


Figure 27:Perception on why there is no change

5.2.2 Stakeholders' perceptions of the development of Konza City

With a cumulative percentage of 54%, the stakeholders firmly believe that Konza City has had a positive effect on the community. It corresponds to 27 respondents who either moderately or strongly agreed with this statement. An average of 16 respondents disapproved of Konza City's positive effect on neighbouring areas. Only 6 gave a neutral response.

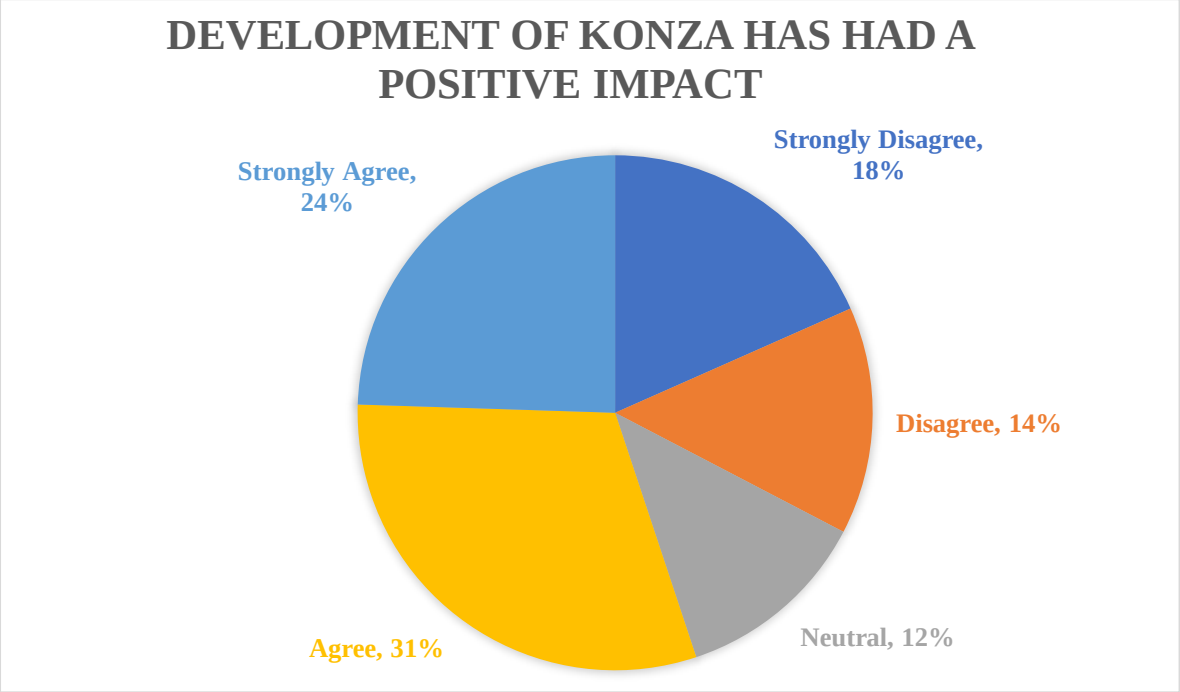


Figure 28:Positive effect of Konza to the community

Overall, the data portrays various opinions among the stakeholders regarding Konza City's impact on the community. While a substantial number view the development positively, a

notable segment remains critical of its effects. These varying perspectives underscore the importance of ongoing assessments, transparent communication, and engagement with stakeholders to address concerns, capitalize on positive outcomes, and ensure the sustainable development of Konza City for the benefit of the broader community.

5.2.3 Impact of Konza City on property values and rental prices

According to the respondents' responses and views, Konza city development has greatly influenced property values and rental prices. It comes after 52% of the respondents strongly agreed with this statement, and 36% moderately decided as shown in the table below. Only a cumulative 8% disagree, with 4% being neutral.

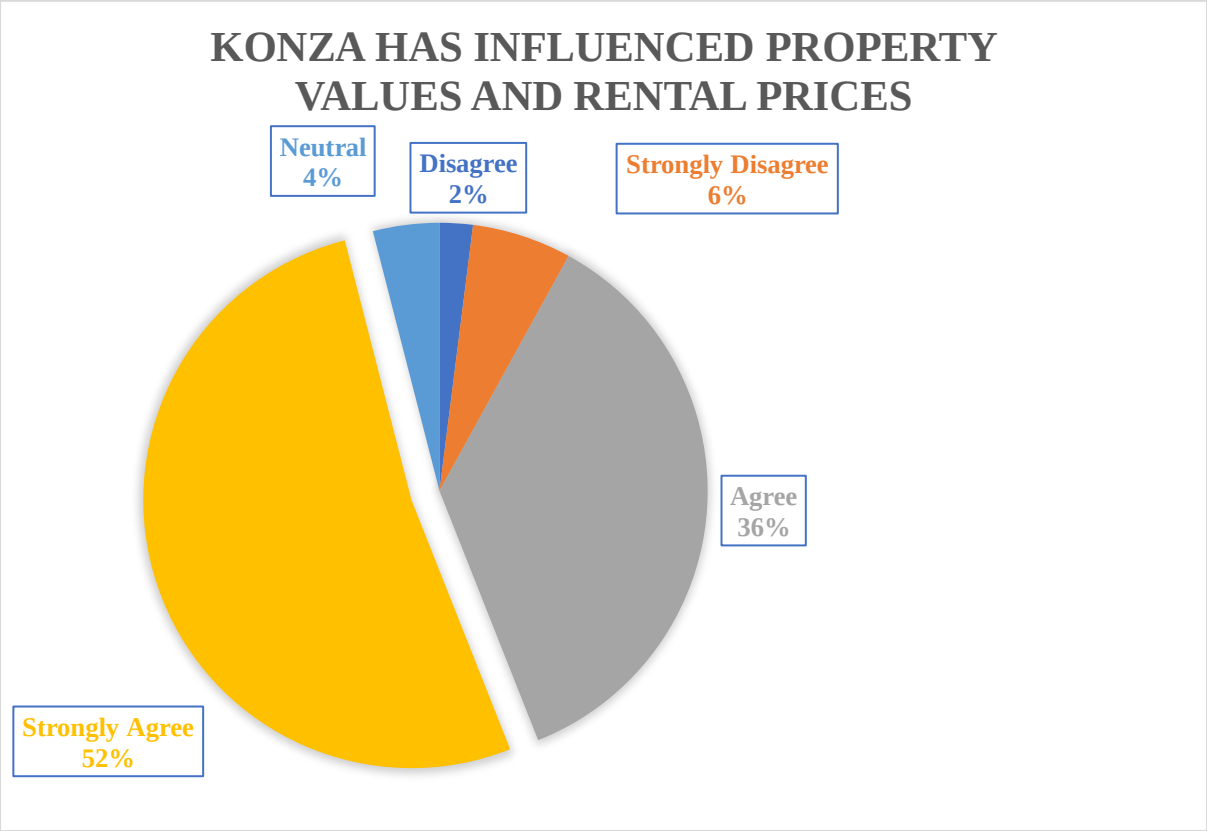


Figure 29:Konza Has influenced property values and rental prices.

Overall, the overwhelming agreement among the respondents (52% strongly agreeing and 36% moderately agreeing) underscores the positive influence of Konza City development on the real estate market. This alignment in views suggests that the development project has been successful in positively affecting property values and rental prices in the area. However, it is vital to consider the opinions of the dissenting 8% to gain a comprehensive understanding of the various perceptions and experiences related to the impact of Konza City's development on the local real estate market.

5.2.4 Traffic flow changes in the adjacent areas

The responses show that traffic flow has increased since establishing Konza Smart City. 34% of the respondents agreed with this statement, while 12% strongly agreed. 10% disagreed with the idea, and those strongly disagreed. 32% stated a neutral opinion. In conclusion, the establishment of Konza Smart City has brought about tangible changes in the traffic flow within the area, according to the responses received from the survey participants. A substantial majority (34%) of the respondents agreed that traffic flow has increased since the city's inception, with 12% expressing strong agreement. It indicates a prevalent observation of heightened vehicular movement and congestion.

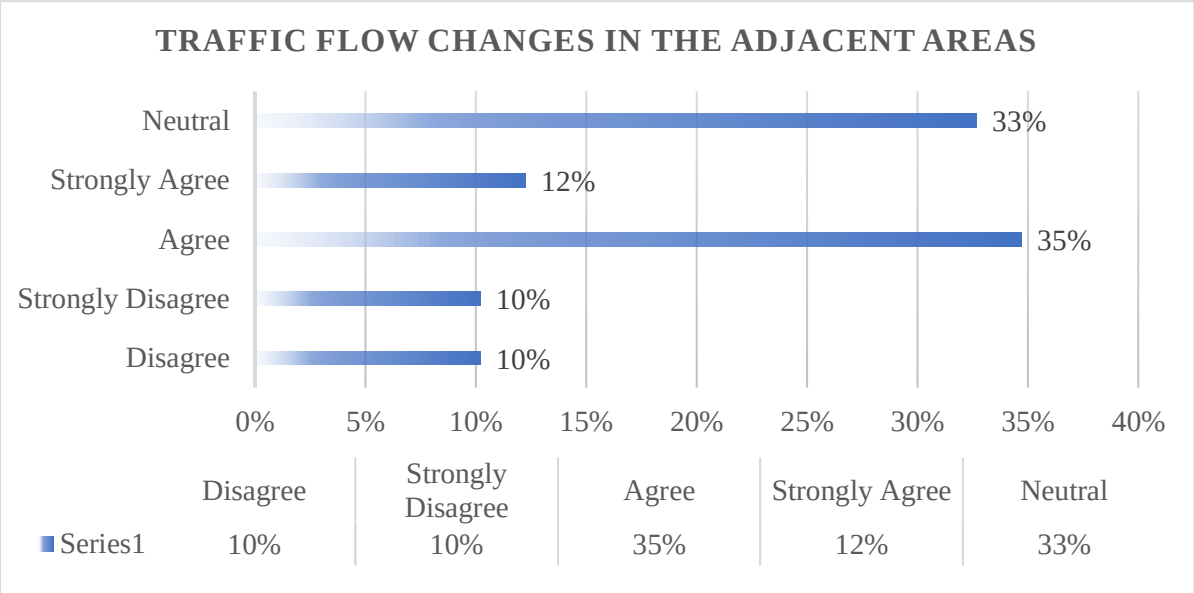


Figure 30:Traffic flow changes in the adjacent areas

5.2.5 Changes in the availability of public services

Among the respondents, 26% expressed "Disagree," indicating that a significant proportion of participants believed that public services had not improved since the city's development. An even larger group, comprising 38%, strongly disagreed, holding pessimistic views about any positive impact on public services. Conversely, 22% of respondents agreed that public services had improved, while a smaller subset of 6% strongly agreed, expressing a more optimistic perspective on the city's impact on public services. Lastly, 8% of respondents remained neutral, either undecided or uncertain about the changes in public services during Konza City's development.

	Frequency	*Percent*
Disagree	24	26%
Strongly Disagree	35	38%
Agree	20	22%
Strongly Agree	6	6%
Neutral	7	8%
Total	92	100%

Table 18: Changes in the availability of public services

5.2.6 Social dynamics in the adjacent areas due to Konza City development

According to the data collected, out of the total respondents, 14.0% (7 individuals) disagreed with the idea that the development of Konza City has led to an increase in urbanization, economic activity, and social cohesion in the neighboring regions. Similarly, another 14.0% (7 individuals) strongly disagreed with the statement. On the other hand, 42.0% (21 individuals) of the respondents agreed with the idea, indicating that they believe the development of Konza City has positively impacted the adjacent areas regarding urbanization, economic activity, and social cohesion. Among these respondents, 16.0% (8 individuals) strongly agreed with this positive impact. A smaller proportion of the respondents, constituting 12.0% (6 individuals), remained neutral, neither agreeing nor disagreeing with the statement.

Social Dynamics	***Frequency***	***Percent***
Disagree	13	14%
Strongly Disagree	13	14%
Agree	39	43%
Strongly Agree	15	16%
Neutral	11	12%
Total	92	100%

Table 19:Social dynamics in the adjacent areas due to Konza City development

5.2.7 Residents' attitudes towards the development of Konza City

Generally, the residents have a positive attitude toward the development of Konza city in the neighborhood. Most respondents cited that the project has led to increased job opportunities and empowerment (35%) while some cited population increase and urban growth (31%). 23% supported the development of Konza City, citing rise in property values and investments.

However, some community members had a negative attitude towards the project citing that it has led to increased crime and corruption.

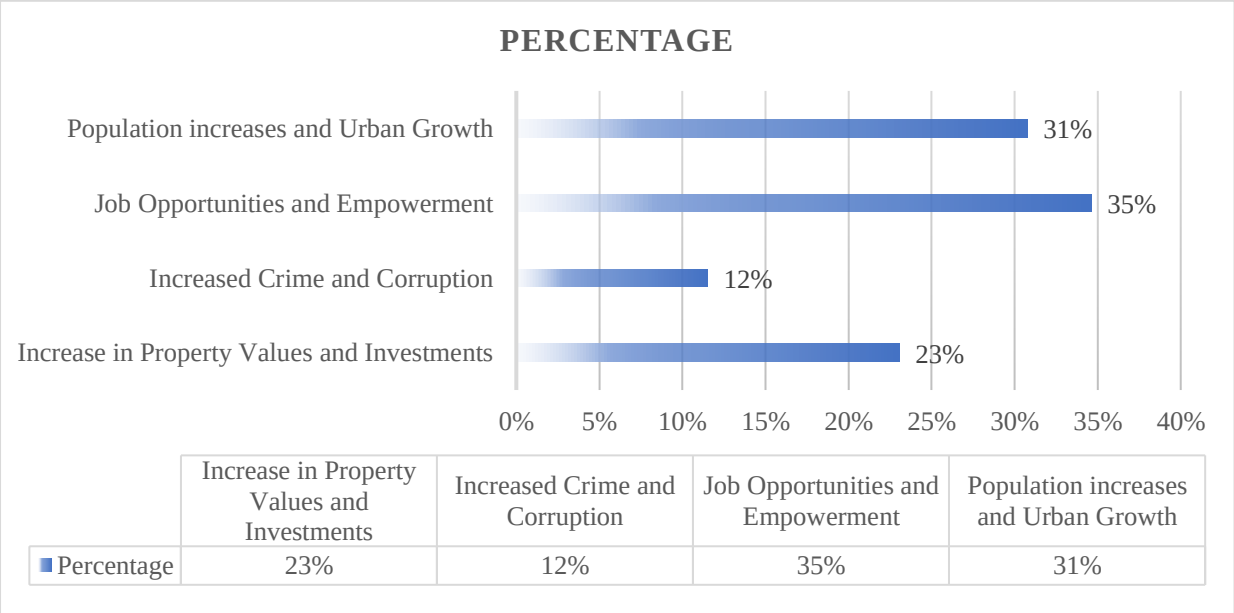


Figure 31:Residents' attitudes towards the development of Konza City

When asked whether Konza City should have been developed in this area, majority of the respondents (91%) stated that they approved of its development while only 9% cited it should be developed elsewhere.

Figure 32:Where Should have Konza been constructed

5.3 Factors attributing to the interrelationship between Konza City and the adjacent Land Uses.

5.3.1 Infrastructure and service provisions

Water Provision

Water in the adjacent areas is obtained mainly from boreholes as cited by 86% of the respondent population. Piped water provision (4%), rainwater (8%), and water vendors 2% of the water supply.

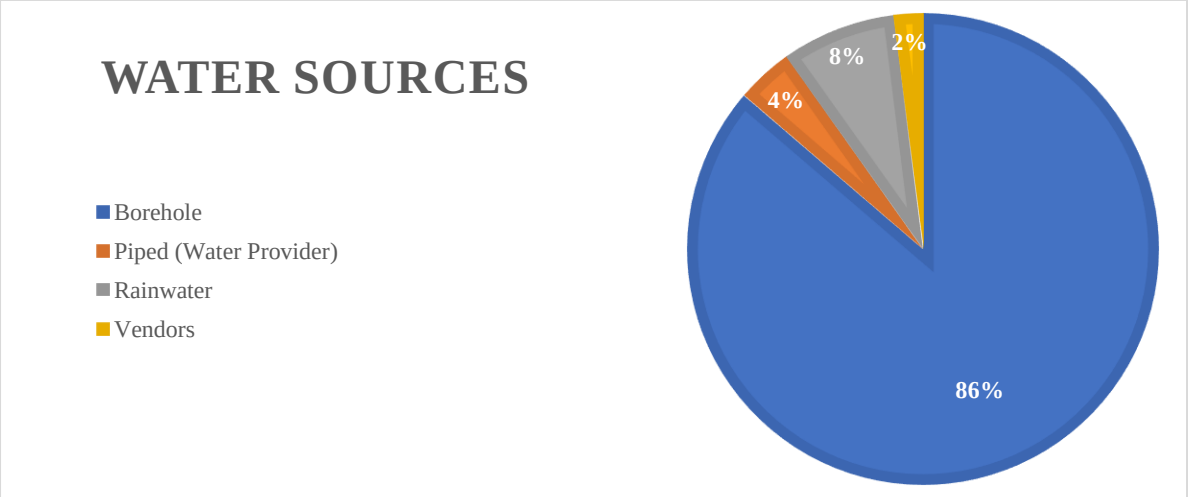


Figure 33:Water Sources

The main water provider in the neighborhood is the private sector providing 33% of the respondent households with water. Water vendors supply 22% of the water in the neighborhood with 11% being supplied by the county. 16% of the respondent population cited being supplied their water by both county and private suppliers.

Water Provider	***Percentage***
Vendors	22%
Private Sector	33%
County Provider	11%
Kiosks	4%
NGO	4%
County Provider, Private Sector	17%
Private Sector, Vendors	7%
Private Sector, CBOs	2%

Table 20:Water Sources

68% of the water provided is safe to drink while only 32% is not safe to drink or has a odor taste.

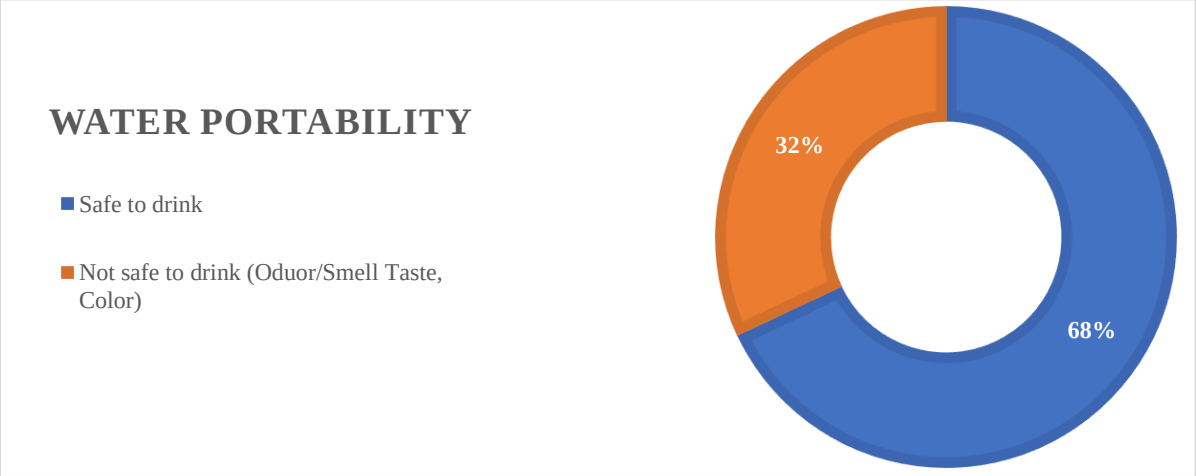


Figure 34:Water Portability

Main challenges that face water provision in the area as cited by the respondents are the limited water sources nearby (57%), high costs of water (27%), and insufficient water infrastructure (7%).

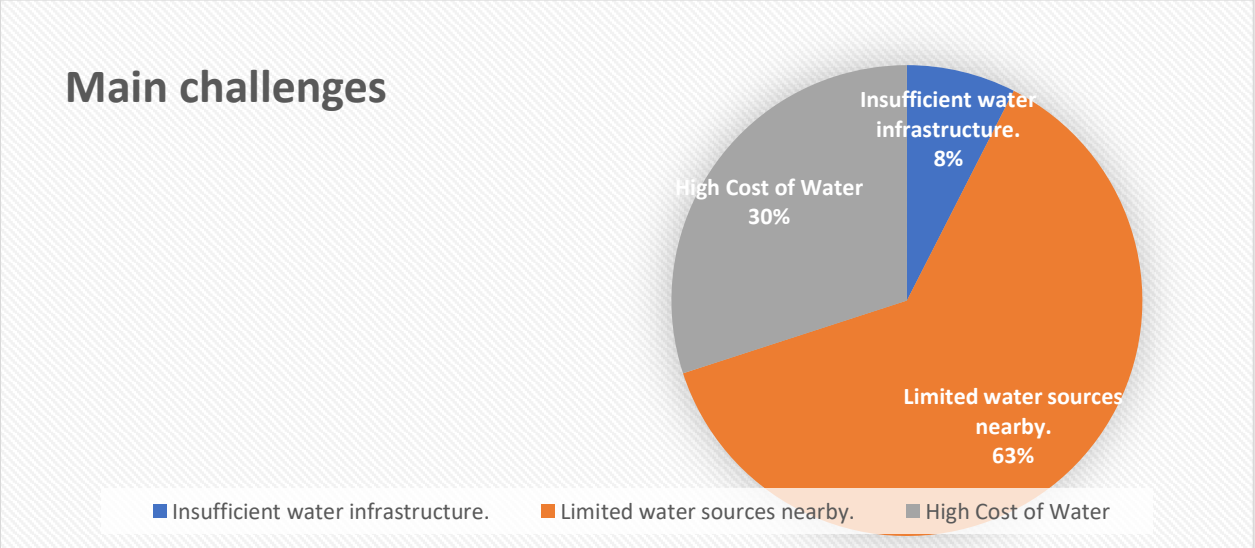


Figure 35:Water Challenges

Energy Provision

Solar energy is the most common source of energy that is utilized in the study area with 59% of the respondents citing its usage. Electricity follows closely 27%. Only 8% use lanterns for lighting in their households.

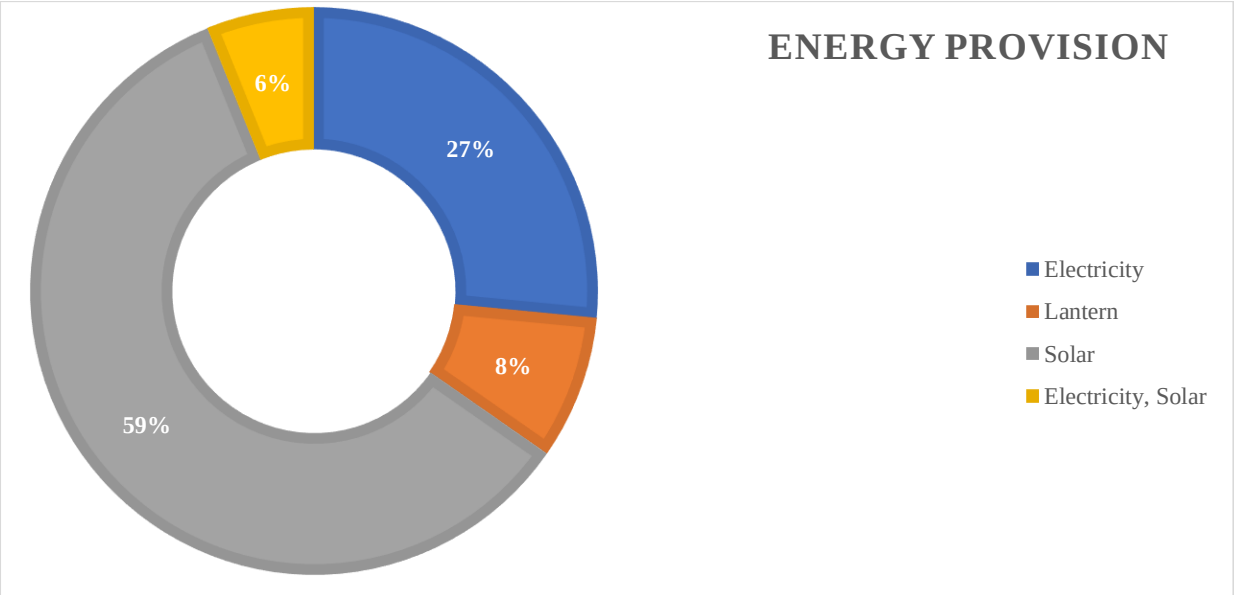


Figure 36:Energy Provision

Among the major challenges faced while accessing energy in the area are the high energy costs, limited access to electricity, frequent power outages, and difficulty accessing clean energy options. Also, insufficient infrastructure for energy distribution and frequent blackouts are major issues faced by the residents while accessing the energy.

Energy Provision	***Frequency***	***Percent***
"Inconsistent Frequent Blackouts"	2	2%
Limited access to electricity.	25	27%
High energy costs.	27	29%
Limited access to electricity., Insufficient infrastructure for energy distribution.	6	7%
Frequent power outages.	12	13%
Difficulty accessing clean energy options.	12	13%

Insufficient infrastructure for energy distribution.	8	9%
Total	**92**	**100%**

Table 21:Energy Provision

Transportation

According to the survey results, motorcycles are the most widely used means of transport, with 46.0% of the respondents (42 individuals) reporting that they use motorcycles for their daily transportation needs. Private vehicles, on the other hand, are relatively less commonly used, with only 6.0% of the respondents (6 individuals) relying on their own vehicles for commuting. Walking emerged as another popular mode of transportation, with 16.0% of the respondents (15 individuals) indicating that they prefer walking for their daily travel. Public transport was also a notable choice, with 22.0% of the respondents (20 individuals) relying on various public transportation options for their commuting needs. Some respondents reported using a combination of different transportation methods. For instance, 8.0% of the respondents (7 individuals) mentioned using both public transport and motorcycles for their travel needs. Another 2.0% of the respondents (2 individuals) reported using a combination of motorcycles and walking as their preferred means of transportation.

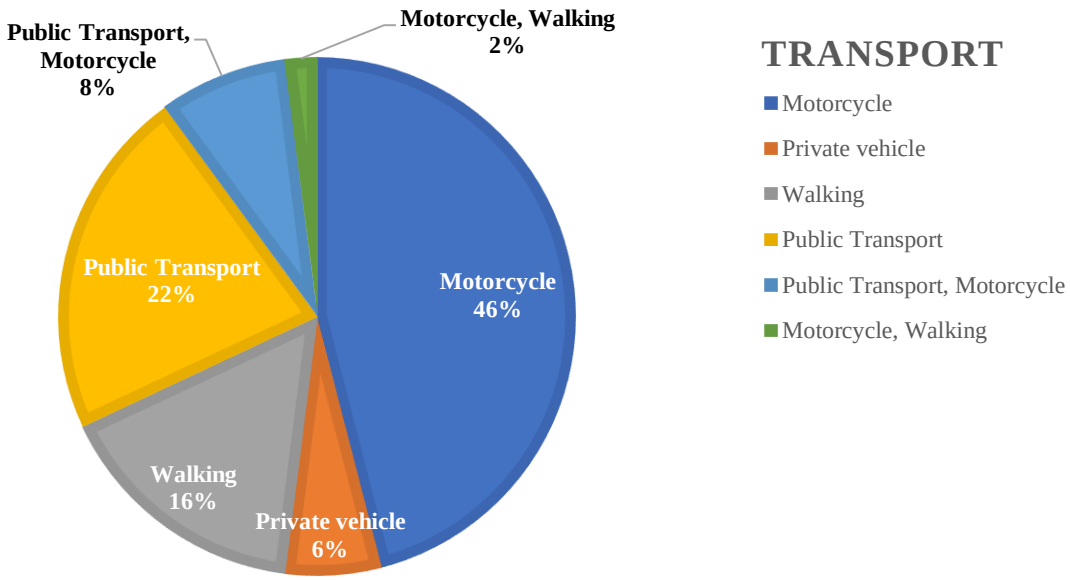


Figure 37:Transport

Among the challenges cited in the transportation sector include poor road conditions as cited by 32 respondents, 6 respondents (12.0% of the total) indicated that high transportation costs are a major challenge for them, 1 respondent (2.0% of the total) reported facing challenges with inadequate or unreliable public transportation schedules while 2 respondents (4.0% of the total) stated that they deal with limited public transportation options compounded by poor road conditions.

Transport	***Percent***
Poor road conditions	64%
High transportation costs	12%
Inadequate or unreliable public transportation schedules	2%
Limited public transportation options, Poor Road conditions	4%
Total	82

Table 22:Transport

5.4 Roles, Perceptions, and Behaviour of Stakeholders towards Konza City and Adjacent Land Uses

5.4.1 Stakeholders' perceptions of Konza City's development

The majority of the stakeholders, the residents with a cumulative percentage of 76%, believe that smart cities like Konza should be developed to improve the sustainability of the neighboring land uses, indicating a positive perception towards the project.

Development of more smart cities like Konza city in the area will improve sustainability of the neighboring land uses					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	7	8.0%	8.2%	8.2%
	Strongly Disagree	2	2.0%	2.0%	10.2%
	Agree	39	42.0%	42.9%	53.1%
	Strongly Agree	31	34.0%	34.7%	87.8%

	Neutral	11	12.0%	12.2%	100.0%
	Total	90	98.0%	100.0%	
Missing	System	2	2.0%		
Total		92	100.0%		

Table 23:Stakeholders' perceptions of Konza City's development

5.4.2 Stakeholders' roles in shaping Konza City and adjacent land uses

Community stakeholders mainly participate in decision-making meetings that involve community development.

		Frequency	Percent
Valid	46	50%	50.0
	46	50%	50.0
	92	100%	100.0

Table 24:Stakeholders' roles in shaping Konza City and adjacent land uses

Of the stakeholders interviewed, 50% noted they attended community meetings while 50% stated they didn't. Those who participate added that they attend the meetings on a weekly, monthly, yearly, or when the need arises.

Table 25 Frequency of stakeholder participation in meetings

		Frequency	Percent
Valid	Monthly	11	12%
	When need arises	28	30%
	Yearly	2	2%
	Weekly	6	6%
	Total	46	50%
Missing	System	46	50%
Total		92	100.0%

Among the main modes of participation outlined included local barazas, county forums, and individual organized groups where mainly the stakeholders participate in talks and contribute to developmental proposals and social matters.

Table 26 Modes of stakeholder participation

		Frequency	Percent
Valid	Individual Organized groups	15	16%
	Local Barazas	15	16%
	County forums	17	18%
	Total	46	50%
Missing	System	46	50%
Total		92	100%

Table 27 Purpose of stakeholder participation

		Frequency	Percent
Valid	Participate in talks	11	12%
	Contribution on development proposals, participate in talks, Contribute on development & social matters	28	30%
	N/A	4	4%
	Total	42	46%
Missing	System	50	54%
Total		92	100%

Some stakeholders cited lack of interest, lack of awareness about community initiatives, and language barriers as the main reasons for not participating in community decision-making meetings.

Table 28 Barries to stakeholder participation

		Frequency	Percent
Valid	Lack of interest.	13	14%
	Lack of awareness about community initiatives.	11	12%
	Language barriers or communication issues.	6	6%
	5	6	6%
	Total	35	38%
Missing	System	57	62%
Total		92	100%

5.5 Strategies for Sustainable Smart Cities and Adjacent Land Uses

5.5.1 Identified challenges for sustainable development.

The significant challenges and setbacks hindering sustainable development in Konza city development are outlined in Table 28.

Table 29 Challenges hindering sustainable development in Konza City

		Frequency	Percent
Valid	Lack of resources., Insufficient support from authorities.	6	6%
	Lack of resources.	29	32%
	Insufficient support from authorities.	4	4%
	Inadequate information dissemination.	9	10%
	Limited community engagement.	13	14%
	Total	61	66%
Missing	System	31	34%
Total		92	100%

Lack of resources came in strongest with 32% support from the stake holder's response. Limited community engagement came in second at 14% and inadequate information dissemination at 10%. Some respondents cited lack of resources and insufficient support from authorities as the main challenges hindering sustainable development.

5.5.2 Stakeholders' recommendations and proposed strategies

Among the recommendations issued by the stakeholders include regulating land development, involving community members in decision-making and improving infrastructure and services.

Most stakeholders, 58%, believe that creating more job opportunities for the local community members will ensure the sustainability of Konza city and the neighbouring areas. Only 10% disagreed, and 2% held a neutral vote.

Table 30 Likert scale showing stakeholders who believe local job creation will ensure sustainability of Konza.

		Frequency	Percent
Valid	Disagree	9	10%
	Agree	28	30%
	Strongly Agree	53	58%
	Neutral	2	2%
	Total	92	100%

Regulating land development to ensure the sustainability of Konza city and the neighboring areas was proposed by the stakeholders as a forward strategy. Cumulatively 80% of the stakeholders supported this proposal, with only 5 % disapproving.

Table 31 Likert scale showing stakeholders who believe regulating development will ensure sustainability of Konza.

		Frequency	Percent
Valid	Disagree	2	2%
	Strongly Disagree	4	4%
	Agree	33	36%
	Strongly Agree	40	44%
	Neutral	11	12%
	Total	90	98%
Missing	System	2	2%
Total		92	100%

84% of the stakeholders proposed involving community members in the decision-making before land development, ensuring the sustainability of Konza city and neighboring areas. 12% disapproved of this strategy, while 2% held a neutral opinion.

Table 32 Likert scale showing stakeholders who believe community engagement in decision making will ensure sustainability of Konza

		Frequency	Percent
Valid	Disagree	2	2%
	Strongly Disagree	9	10%
	Agree	37	40%
	Strongly Agree	40	44%
	Neutral	2	2%
	Total	90	98%
Missing	System	2	2%
Total		92	100%

Improving infrastructure and services e.g roads and health facilities, held a popular approval rate of 90% by the stakeholder respondence. Only 8% disapproved of this strategy, with 2 % holding a neutral opinion.

Table 33 Likert scale showing stakeholders who believe improving infrastructure will ensure sustainability of Konza.

		Frequency	Percent
Valid	Disagree	2	2%
	Strongly Disagree	6	6%
	Agree	33	36%
	Strongly Agree	50	54%
	Neutral	2	2%
	Total	92	100%

5.5.3 Importance of community participation in promoting sustainability

According to the survey, involving community members in decision-making before land development ensures sustainability of Konza City and the neighbouring areas.

Table 34 Likert scale showing stakeholders who believe stakeholder engagement in decision making before development will ensure sustainability of Konza.

		Frequency	Percent
Valid	Disagree	2	2%
	Strongly Disagree	9	10%
	Agree	37	40%
	Strongly Agree	40	44%
	Neutral	2	2%
	Total	90	98%
Missing	System	2	2%
Total		92	100%

Among the respondents, 44% strongly agreed with the statement, 40% moderately agreed and 12% collectively disagreed. It shows strong acceptance of the statement's logic that when community members are collectively involved in decision-making that involves their problems, the solutions are more successful and impactful.

5.6 Discussion and interpretation of findings in context of previous research.

The findings of this study agree with Hasanawi and Winarso (2018) who stated that increase in demand and rise of land prices in the adjacent areas was attributed by the smart city of Gadebage which is a similar case on what is being experienced at Konza City. The findings also show that that gentrification has been fueled by the smart city changing the character of the neighborhood which is a similar case to what happened in Gadebage as per the findings of Hasanawi and Winarso (2018).

Noorloos, Avianto and Opiyo (2017) found in their study that the announcement of Konza City attracted an influx of people who were in anticipation for job opportunities and improved infrastructure. This study agrees with it as the findings show an increase in population after the commencement of Konza City. Most respondents confirmed that the increase was due to the fact that the smart cities would offer improved living conditions in the area. In line with roles, perception and behavior of stakeholders, the findings of this study agree with Avianto (2017) demonstrated that lack of proper community involvement in the planning and implementation process leads to a disconnect between a smart city and the adjacent land uses.

The study by Tom Erik Julsrud & Tanu Priya Uteng, (2015) found that most people residing within and in close proximity to smart cities prefer that they can easily access the services they require with very few relying on motorized transport. Urban mobility is therefore a critical component in the planning of smart cities and their adjacent neighborhood.

6.0 SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS.

6.1 Summary of the findings

The research aimed to examine the implications of Konza City on adjacent land uses, assess the possible impacts of neighbouring land uses on Konza City, and evaluate stakeholders' roles, perceptions, and behaviour towards both Konza City and its adjacent land uses. The study was conducted to gain insights into the overall impact of Konza City on its neighbouring communities and their livelihoods, as well as to understand the reciprocal relationship between Konza City and its adjacent land uses. The following were the summary of the findings as per the objectives.

6.1.1 Findings on the effects of Konza City on the adjacent Land Uses:

The development of Konza City has significantly influenced the surrounding areas in terms of land use patterns, economic activities, and social dynamics. The establishment of the smart city has led to a transformation of land uses in the adjacent regions, with a shift towards more urban and commercial activities. It has increased investment opportunities and economic growth for nearby communities, generating employment and improving the overall quality of life. However, it has also brought challenges such as rising land prices, gentrification, and increased pressure on infrastructure and services.

6.1.2 Findings on the reciprocal relationship between Konza City and Adjacent Land Uses:

The research found that activities and developments outside of Konza City mutually influence the city itself. Infrastructure developments, economic activities, and social changes in neighbouring areas have affected the smart city's growth and development. For instance, improvements in transportation and connectivity in the surrounding regions have facilitated access to Konza City, enhancing its attractiveness to investors and residents. On the other hand, challenges like environmental degradation and competition for resources from adjacent land uses have posed potential risks to the sustainable growth of Konza City.

6.1.3 Findings on Stakeholders' Perspectives and Actions:

The study revealed diverse perspectives and roles among stakeholders involved in or affected by the development of Konza City and the adjacent land uses. Residents in the surrounding areas had mixed feelings about the smart city project, with some embracing the opportunities

it brings while others expressing concerns about potential displacement and loss of traditional livelihoods. Government agencies and private entities played crucial roles in planning, funding, and implementing the project, but there were also conflicting interests and priorities. Community leaders and other local stakeholders played essential roles in advocating for the well-being of their communities and ensuring inclusive development.

6.1.4 Findings on strategies to ensure sustainable smart cities and the adjacent Land Uses.
Several strategies were reported to hinder sustainable smart cities and adjacent land uses. These included lack of resources and insufficient support from relevant authorities. Other setbacks included inadequate dissemination of information and limited community engagement. To ensure sustainable smart cities, a framework for land development and proper stakeholder engagement were the most recommended strategies.

6.2 Conclusion.

The study concludes that Smart Cities have significant implications on the adjacent land uses changing the area's character. Based on the main findings of the study, the following conclusions were made on the specific objectives:

6.2.1 Effects of Konza City on the adjacent land uses:

a) Konza City's development has had a major impact on the land uses nearby, changing the value of the surrounding property and causing urbanization and increased commercial activity.
b) Konza City's growing quarrying and building operations have a detrimental impact on the local land uses, resulting in noise, dust pollution, and structural damage to neighbouring homes.
c) The presence of Konza City has affected the region's biodiversity in both positive and negative ways, highlighting the significance of conservation and sustainable land-use planning.
d) The area surrounding Konza City has undergone a dynamic shift in land use, from primarily agricultural to commercial and residential, signifying the region's potential for urban growth.
e) Although land use changes have been sparked by Konza City, the surrounding communities have not experienced the anticipated socio-economic improvements, highlighting the need for better strategies to ensure their direct benefits from the development.

6.2.2 Factors that have contributed to the interrelationship between Konza City and the adjacent land uses:

a) The interrelationship between Konza City and adjacent land uses is influenced by the city's masterplan, which initially consisted of business and office land uses, driving changes in the surrounding areas.
b) The proximity of Konza City to private ranches and developments has encouraged the transformation of once-agricultural land into commercial and residential zones, fostering urbanization.
c) The expansion of expressways and modernization of trade around Konza City has contributed to the area's changing character and potential as a medium-density zone.
d) Challenges in the area resulting from pressure on social and physical infrastructure and insecurity underline the complexities of managing the relationship between Konza City and the adjacent land uses.
e) The involvement of various stakeholders, including county governments, the Ministry of Lands, the Ministry of Environment, and others, has been instrumental in shaping and reviewing the sustainability of the masterplan for Konza City.

6.2.3 Evaluate the roles, perceptions, and behavior of stakeholders towards Konza City and the adjacent land uses:

a) Konza City's development has had a significant impact on the land uses nearby, changing the value of the surrounding property and causing urbanization and increased commercial activity.
b) Konza City's growing quarrying and building operations have a detrimental impact on the local land uses, resulting in noise, dust pollution, and structural damage to neighbouring homes.
c) The development of Konza City has affected the region's biodiversity in both positive and negative ways, bringing out the significance of conservation and sustainable land-use planning.
d) The area surrounding Konza City has undergone a dynamic shift in land use, from primarily agricultural to commercial and residential, signifying the region's potential for urban growth.
e) Although land use changes have resulted from Konza City development, the surrounding communities have not experienced the anticipated socio-economic

improvements, highlighting the need for better ways to ensure their direct benefits from the smart city.

6.2.4 Propose strategies that can ensure sustainable smart cities and the adjacent land uses:

a) Sustainable land use planning strategies should be continuously implemented to guide the development of Konza City and its harmonious integration with adjacent areas to have seamless integration.
b) Policies and mechanisms promoting environmentally friendly practices and resource management within Konza City and neighbouring land uses should be employed for long-term sustainability.
c) Integrating smart city technologies and infrastructure into the planning and development processes must be done with a strong focus on sustainability.
d) There is need to have collaborative engagement with all stakeholders as sustainable development requires the active engagement of local communities, the private sector, and government agencies, fostering a collaborative approach to urban growth.
e) Ensuring that future benefits from Konza City for both the present and future generations is pegged on innovative and adaptable strategies that address emerging challenges and opportunities in the smart city landscape.

6.3 Recommendations as per the study objectives.

6.3.1 Effects of Konza City on the adjacent land uses:

a) Comprehensive Environmental Impact Assessment: Conduct continuous and comprehensive environmental impact assessment to monitor and manage any negative effects of quarrying and construction activities in Konza City to adjacent land uses and take corrective actions whenever necessary.
b) Sustainable Urban Planning: Prioritization of sustainable urban planning practices that consider the compatibility and integration of Konza City to the surrounding land uses, ensuring that they coexist harmoniously.
c) Community Benefit Programs: Establish community benefit programs to ensure that the adjacent communities directly benefit from the economic growth and job opportunities generated by Konza City, improving their socio-economic well-being.

d) Biodiversity Conservation: Implement biodiversity conservation measures in and around Konza City to counteract the reduction in biodiversity resulting from development activities, including creating green spaces and conservation programs.
e) Stakeholder Engagement: Engage the local communities in dialogue and decision-making processes related to Konza City's development, ensuring their voices are heard and their concerns are addressed effectively.
f) Environmental Regulations: Strengthen and enforce environmental regulations to address noise and dust pollution from construction and quarrying activities in Konza City, protecting the quality of life for residents in the adjacent areas.

6.3.2 Factors that have contributed to the interrelationship between Konza City and the adjacent land uses:

a) Adaptive Master Planning: Review and adapt the masterplan of Konza City to accommodate the evolving character of the adjacent land uses, taking into account the transformation from agricultural to commercial and residential areas.
b) Integrated Transport Systems: Invest in integrated transportation systems, including improvement of public transportation, to manage the increasing competition for infrastructure.
c) Security Measures: Collaborate with local authorities and stakeholders to address security challenges in the region, ensuring that residents feel safe and secure in the evolving peri-urban area.
d) Strategic Partnerships: Foster strategic partnerships between the public and private sectors to stimulate the modernization of trade and to attract investment, further contributing to the smart economy of the area.
e) Network Governance: Establish strong network governance structures that involve all stakeholders and encourage ongoing dialogue and cooperation to manage the interrelationship between Konza City and adjacent land uses effectively.
f) Community-Based Planning: Promote community-based planning initiatives that empower local communities to actively participate in shaping the area's future and ensure their needs are considered.

6.3.3 Roles, perceptions, and behavior of stakeholders towards Konza City and the adjacent land uses:

a) Participatory Planning: Implement participatory planning processes that involve stakeholders in decision-making, ensuring their voices influence the development of Konza City and the adjacent land uses.

b) Benefit-Sharing Agreements: Develop benefit-sharing agreements that guarantee local communities a share of the economic and social benefits generated by Konza City, aligning perceptions with tangible advantages.

c) Land Rights and Compensation: Ensure transparent and fair land rights and compensation mechanisms, considering the history of land ownership and the diverse interests of stakeholders.

d) Continuous Engagement: Maintain continuous engagement with stakeholders through regular meetings, forums, and consultations to ensure a collaborative approach to smart city development and management.

e) Local Entrepreneurship: Encourage local entrepreneurship by supporting small and medium-sized businesses in the area, fostering economic growth and community well-being.

f) Skills Development: Establish training and skills development programs to enhance the capacity of residents, enabling them to participate in the job opportunities created by Konza City and its smart economy.

6.3.4 Strategies to ensure sustainable smart cities and the adjacent land uses:

a) Sustainability Guidelines: Develop and enforce sustainability guidelines that address environmental, social, and economic aspects, ensuring that all developments align with long-term sustainability goals.

b) Technology Integration: Continue to invest in the integration of smart technologies and infrastructure, promoting the development of Konza City as a model for smart living and smart governance.

c) Green Initiatives: Implement green and eco-friendly initiatives within Konza City and the surrounding areas, focusing on renewable energy sources, waste management, and sustainable transport.

d) Cross-Sector Collaboration: Foster collaboration across multiple sectors, including public, private, and non-governmental organizations, to promote a holistic approach to sustainability.

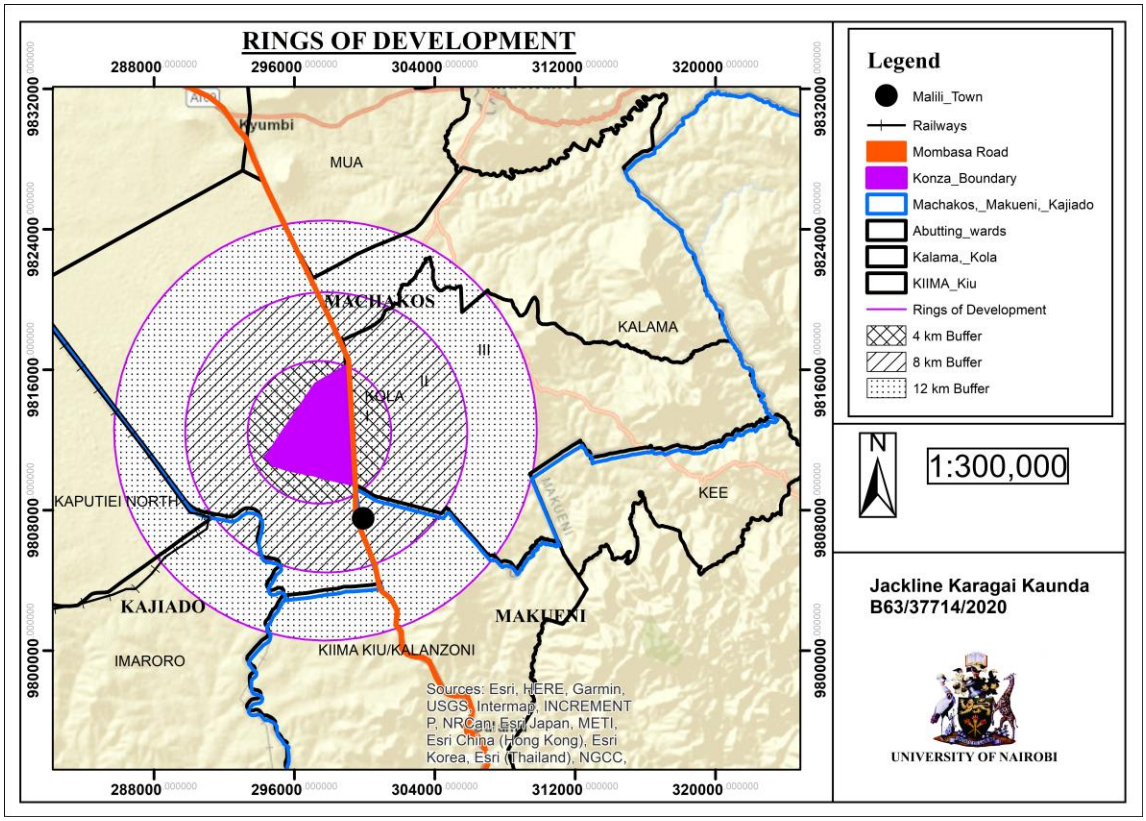
e) Resilience Planning: Develop resilience plans that account for potential challenges and crises, ensuring the sustainability of both Konza City and the surrounding land uses in the face of adversity.
f) Inclusive Governance: Establish inclusive governance structures that engage all relevant stakeholders in the decision-making and policy implementation processes, ensuring that smart governance promotes the common good and sustainability for all.

6.4 Implications to Planning Theory.

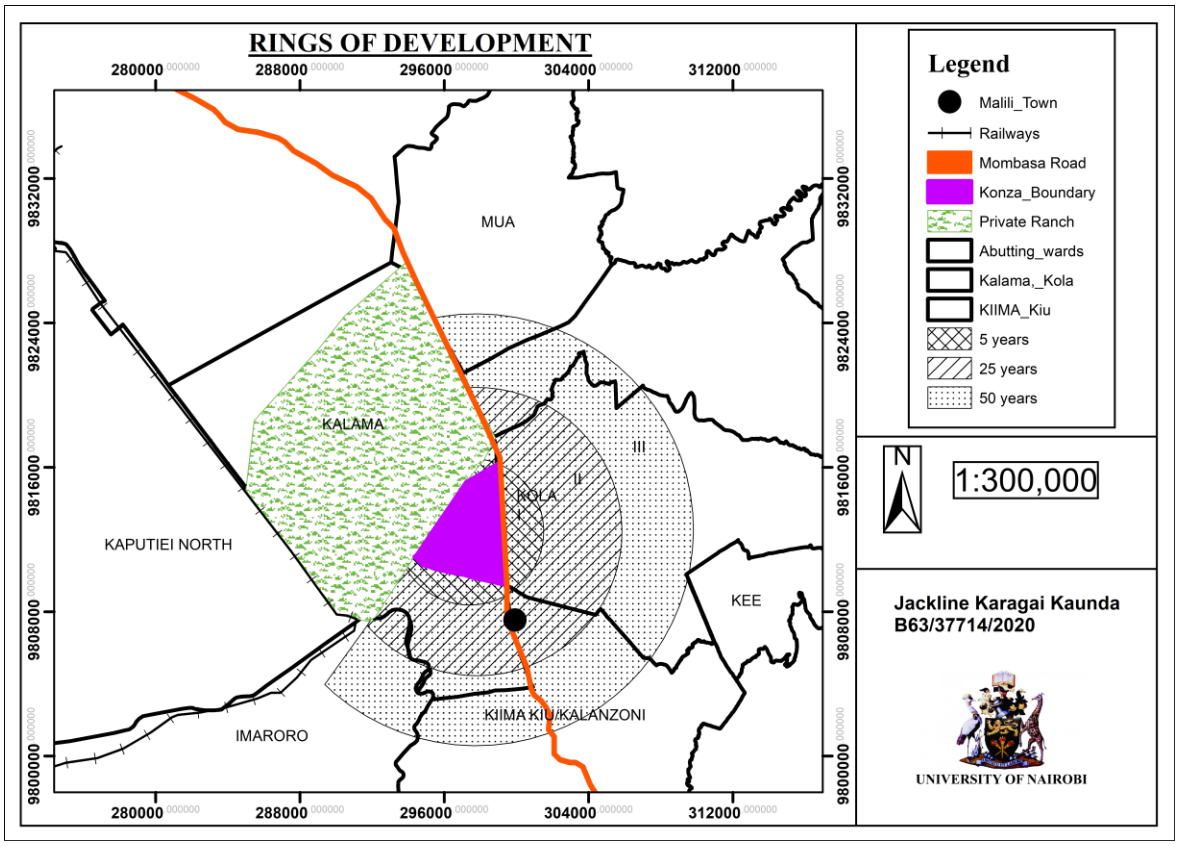
In examining the potential trajectories for the development of Konza Smart City and its adjoining areas, this research has sought to navigate the complex terrain of urban planning and sustainability. The goal has been to envision viable pathways that propel the region and the techno city towards prosperity while ensuring a harmonious coexistence with the surrounding natural environment. Within this backdrop, several spatial development alternatives were scrutinized, each carrying distinct prospects and implications for the future.

This culmination seeks to encapsulate the comprehensive understanding gained by exploring these spatial development models. It underscores the necessity of strategic foresight and calculated decision-making in urban planning endeavors. By delving into the advantages and disadvantages of each approach, a nuanced comprehension of the potential developmental trajectories for Konza Smart City and its neighboring zones has been delineated. The ensuing insights aim to illuminate a way forward that best aligns with sustainable growth, efficient resource utilization, and the long-term well-being of the urban populace and the surrounding ecosystems. Below are the alternatives discussed with their advantages and disadvantages.

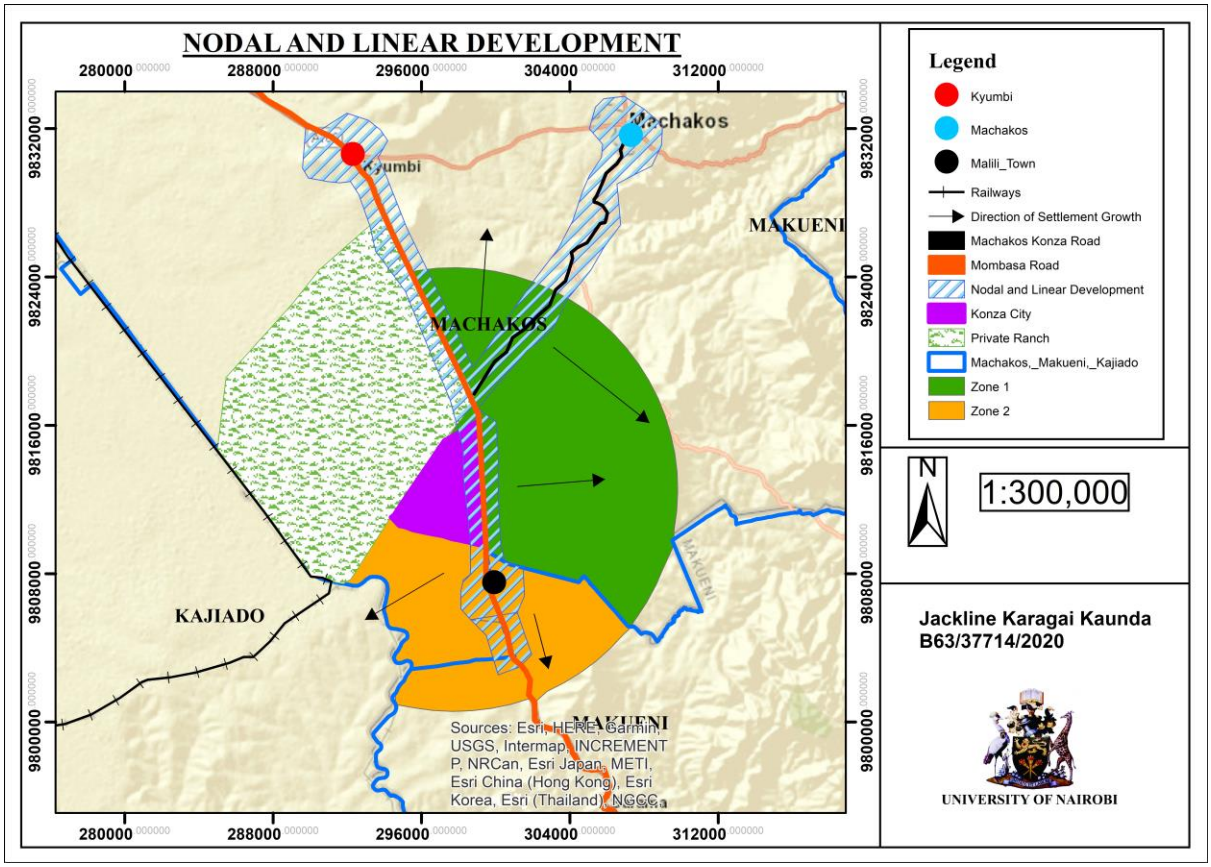
The following maps indicate the area's growth based on the concentric zone model.



Map 16 showing rings of development in Konza; SOURCE; Author



Map 17 showing rings of development in Konza; Author's creation



Map 18 showing nodal and linear development in Konza; Author's creation.

6.4.1 Spatial Development Alternatives

Spatial development alternatives are possible scenarios that would spur the development of Konza Smart City and its adjacent land uses within the planning period. Such development alternatives discussed in this section include nil intervention, nodal growth, compact mixed-use development, and integrated model alternatives.

a) Nil intervention

Drawing from the findings of the research, this intervention encompasses taking zero planning intervention of the emerging issues. If this model is implemented, there are some of the likely implications:

a) Unplanned growth has adverse social and economic repercussions as these areas lack sufficient infrastructure and community amenities.

b) Conflicts between humans and wildlife occurring within the wildlife corridors.

c) Ongoing encroachment into wildlife corridors and pastoral lands.

d) Managing and disposing of solid waste will surpass the capacity of the nearby land uses.

e) A myriad of land use challenges stemming from persistent incompatibility in land use patterns over time.

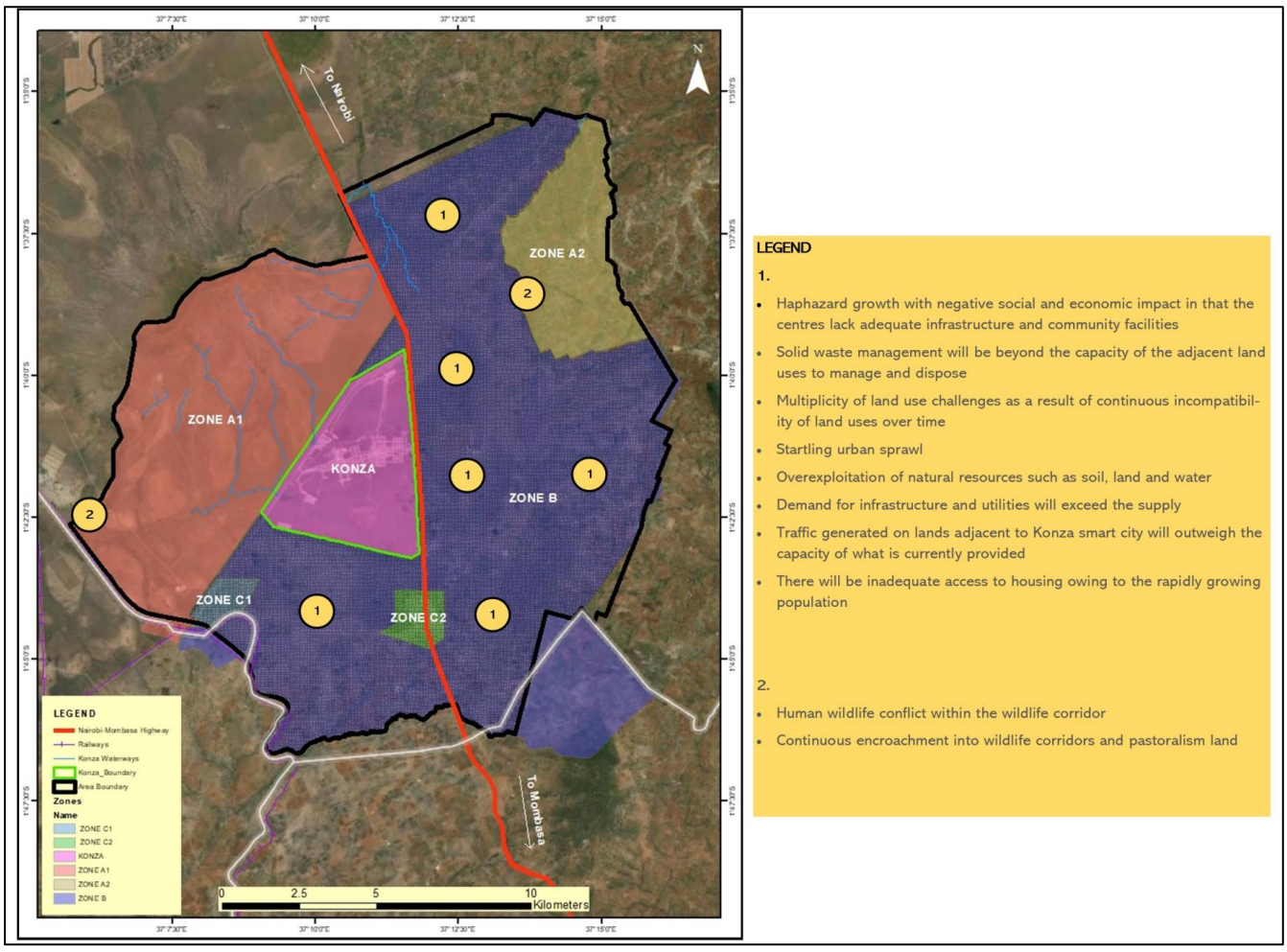
f) Rapid and uncontrolled urban expansion.

g) Excessive exploitation of natural resources, including soil, land, and water.

h) The demand for infrastructure and utilities will outstrip the available supply.

i) The volume of traffic generated in the lands adjacent to Konza smart city will exceed the current infrastructure capacity.

j) Insufficient housing accessibility due to the swiftly growing population.



Map 19 showing the nil intervention; Author's creation.

b) Ecological sustainability model

The ecological sustainability model is an approach that prioritizes the long-term health and well-being of the natural environment within urban areas. It emphasizes integrating ecological principles and sustainability considerations into the planning, design, and development of cities and metropolitan regions. This model seeks to create urban environments that coexist harmoniously with nature, conserve biodiversity, reduce environmental impacts, and enhance urban residents' overall quality of life. This model encompasses the following elements:

a) Integration of ecological principles- The ecological sustainability model seeks to integrate environmental principles and understanding of local ecosystems into the planning process. It includes considering natural habitats, biodiversity, water systems, air quality, and climate resilience. In this context, the area has wildlife corridors and agricultural and pastoralism land, which need to be preserved to enhance sustainability.

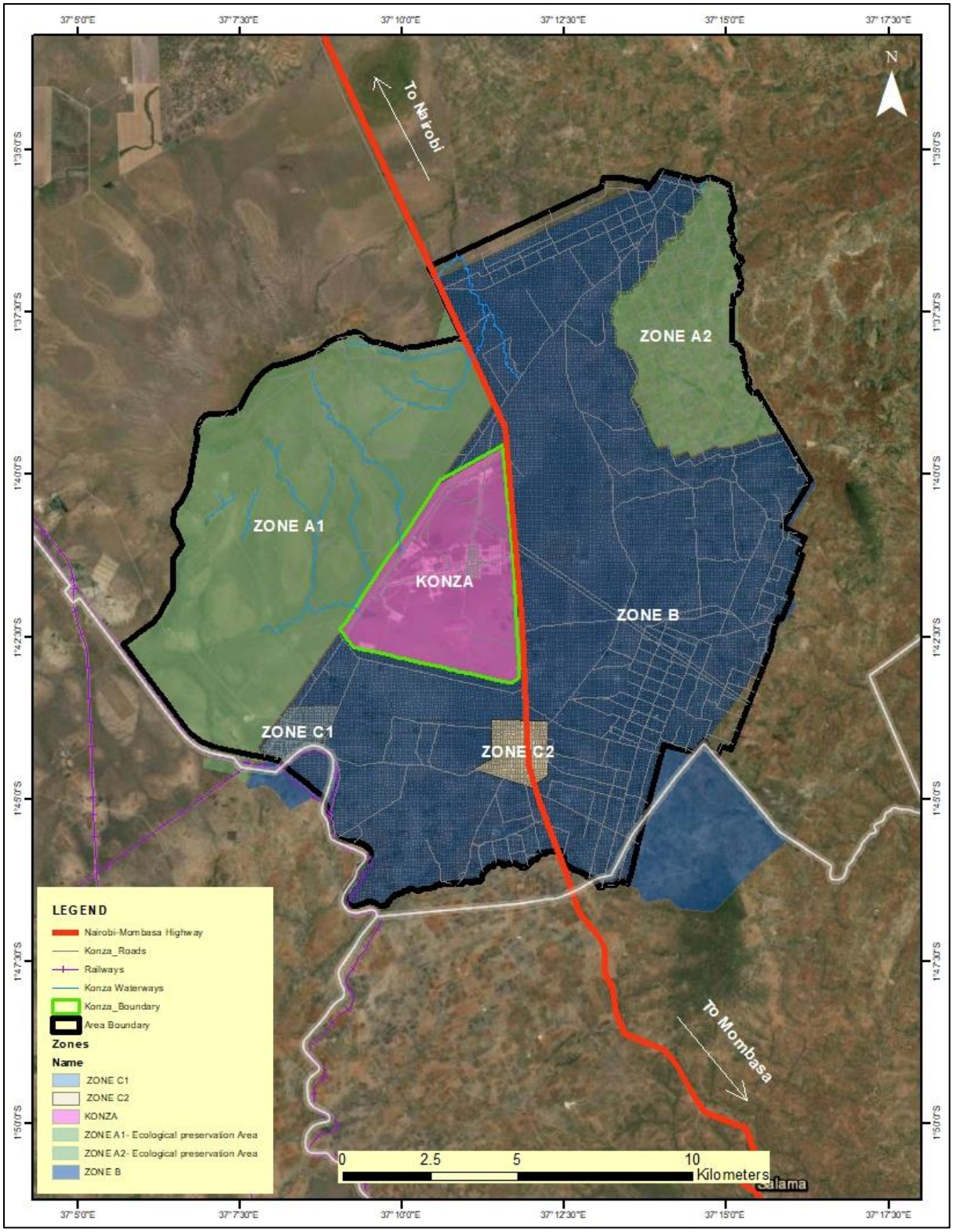
b) The model emphasizes using green infrastructure, which involves incorporating natural features and processes into urban design. Examples include parks, green roofs, urban forests, wetlands, and sustainable landscaping practices. These elements help improve air and water quality, mitigate urban heat islands, and provide recreational and aesthetic benefits. It shall be encompassed within zone B, which is quickly urbanizing and shall be operationalized through zoning ordinances and building codes.

c) Linkages between the rural and urbanizing areas- The lesser urbanizing parts of Konza were used for pastoralism and wildlife. Preserving these lands alongside urban areas delegates different functions to different parts of the planning area. It ensures that all areas perform their maximum intended functions while supporting each other through physical and functional linkages. It proposes that zones A1 and A2, which have lesser developments, be preserved for wildlife and pastoralism, and agroforestry.

d) Zoning and development control- Segregating land for specific functions limits the effects of sprawl and encroachment of incompatible land uses. Development control is a tool for planning that ensures environmental sustainability and urbanization are balanced. Within Zone B, the plan proposes mixed-use developments with an emphasis on agricultural activities with the provision of parks and open spaces.

Table 35 showing advantages and disadvantages of the eco-sustainability model in Konza; Author's creation.

Advantages	**Disadvantages**
Biodiversity conservation	Implementing this model requires significant upfront investments.
Enhanced climate resilience	Resistance to change due to over emphasis on land use for its value rather than preservation
Improved quality of life	Challenges in retrofitting ecological sustainability principles to existing urban areas
Long term cost savings in areas like energy efficiency, water management and waste reduction	



Map 20 showing the eco-sustainability model in Konza; Author's creation.

c) Monocentric Model alternative

This model alternative encourages the dominance of one center in this case Konza City. It ensures concentrated land uses on a major center and back access to the adjacent areas.

Advantages	Disadvantages
Increased densities will reduce pressure on land as all the dependence is on the dominant centre.	Increased traffic congestion
	Increased pressure on existing infrastructure
	Concentration of infrastructure at the Monocentric towns leaving other areas unattended

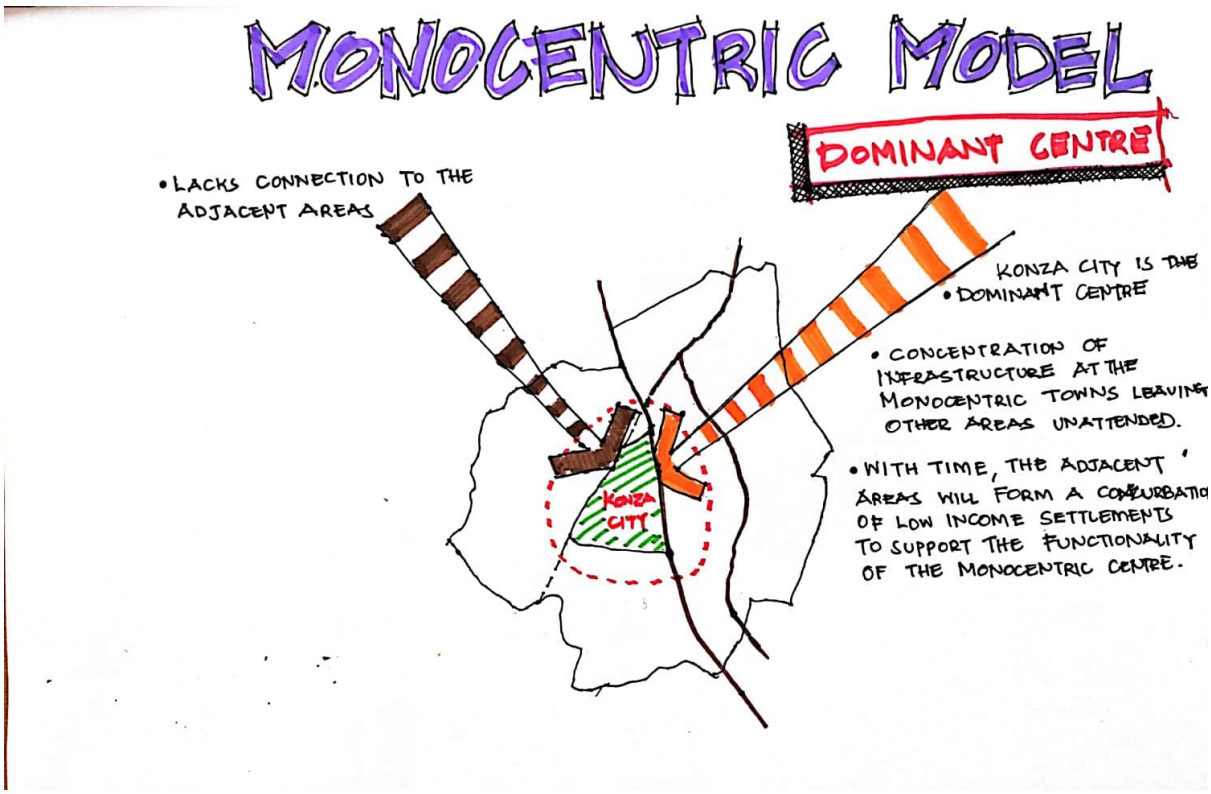


Figure 38: Monocentric Model, Source: Author

d) Polycentric Model Alternative

The polycentric model alternative involves organizing an area around several administrative, social and economic centers instead of one dominating center. This model gives rise to nodes serve as centers of activity, connectivity, and development, typically with a mix of residential, commercial, recreational, and transportation facilities. Polycentric models aims to achieve several goals, such as promoting sustainable urban growth, improving accessibility, reducing congestion, and enhancing overall urban quality of life. This model ensures:

a) Concentrated hubs- Nodal development involves the creation of concentrated activity centers within a city, often called nodes. These nodes are typically located at key transportation intersections, like major transit stations or highway interchanges. This model proposes the creation of the Konza City node, Mililli node, and proposed zone B nodes.

b) Developing alternative urban growth centres- The implications of Konza to the adjacent land uses have concentrated activities to the area such that there is haphazard development, encroachments, and loss of agricultural, pastoralism, and wildlife corridors, etc. Alternative urban growth centers, which will be classified, i.e., Primary node- Konza, Secondary node- Malili, and Tertiary nodes- Proposed nodes at zone B, have to be developed to concentrate development in specific places with mixed-use, compact development. Such proposed nodes can be developed within zone B of the area, which can enhance urban-rural linkages.

c) Mixed land uses- The nodes are designed to incorporate a mix of land uses, including housing, offices, retail spaces, cultural facilities, and parks. This mixed land use is intended to reduce the need for long commutes and promote walking and cycling.

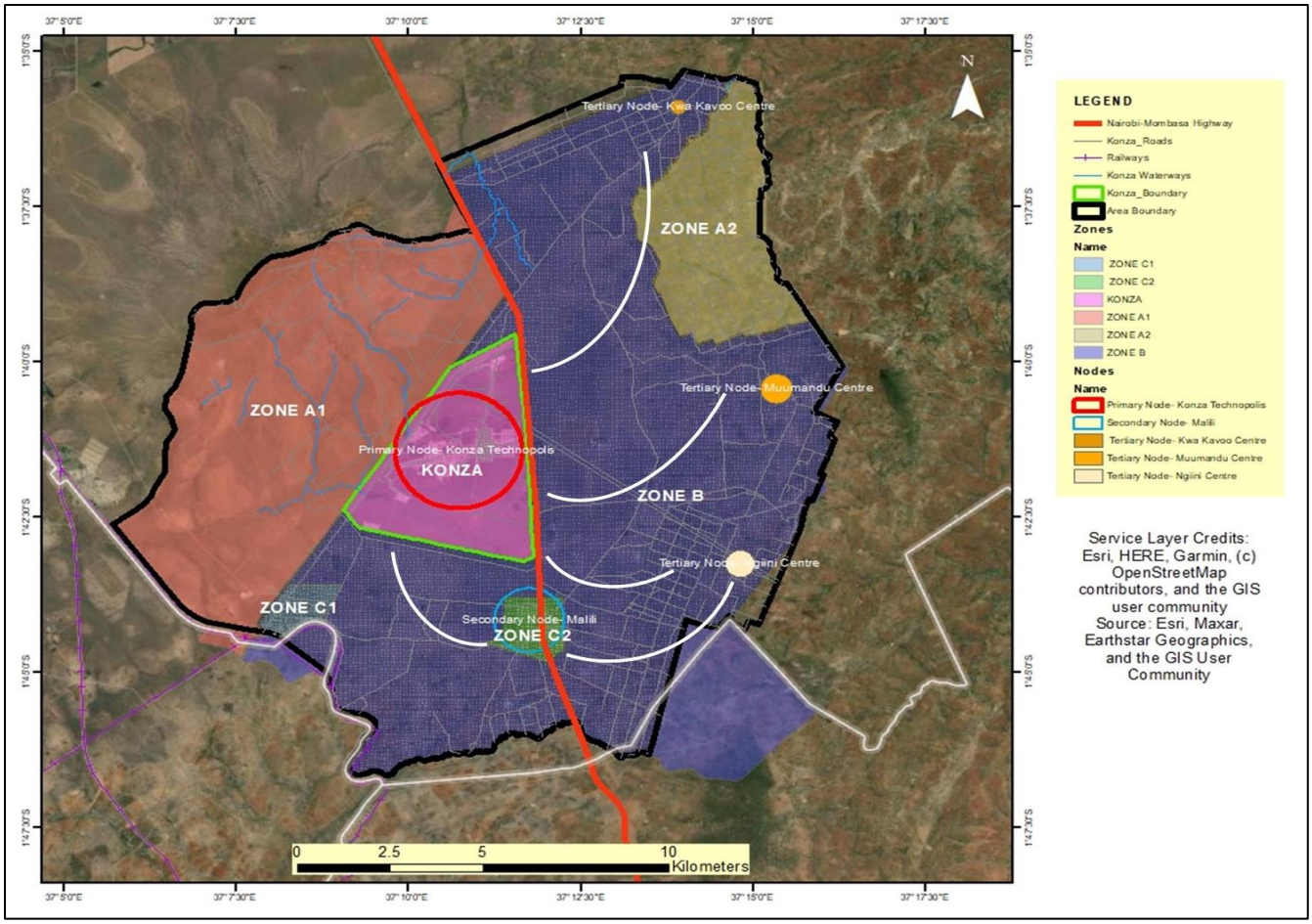
d) Compact development- This approach promotes the efficient use of land by concentrating development in a way that reduces sprawl and promotes sustainability. It goes hand in hand with the mixed-use development as aforementioned.

e) Transportation integration- This development option proposes a strong emphasis on transportation infrastructure. These nodes will be well-connected through various modes of transportation with good integration of motorized and non-motorized transportation.

f) Infrastructure investment- The model always attracts better investments towards infrastructure improvements around nodal developments such as better road networks, public transit, water, housing, etc.

Table 36 showing advantages and disadvantages of the eco-sustainability model in Konza ; Author's creation.

Advantages	**Disadvantages**
Nodal development optimizes land uses by concentrating activities, making it easier to provide services, utilities and infrastructure	Highly dependable on enforcement of development control policies
It supports sustainability goals	Potential accessibility problems within the nodes
Nodal developments stimulate economic growth.	Risk of Polarity- Konza City might still continue to grow and dominate other nodes
Protecting environmentally sensitive areas	Risk of gentrification
Acts as external linkage to other centers and settlements away from Konza	Initial costs for development of nodes are high due to concentration of activities
Improved and development infrastructure	
Acts as buffers for unwanted and unregulated development	



Map 21 showing nodal development model; Author's creation.

d) Integrated Model Alternative

It is the preferred model as it takes account of all development sectors and forms a hybrid foundation for development control guidelines. This model ensures:

a) Diminished reliance of Konza smart city as the sole driver of developments, encompassing commerce, trade, infrastructure, and service provision.

b) Augmented investments, employment opportunities, trade, and commercial prospects both within Konza and its surrounding areas.

c) Enhanced accessibility to services and amenities throughout the entire planning region.

d) The implementation of well-organized and regulated urban growth.

e) Heightened positive effects that cascade to the secondary nodes.

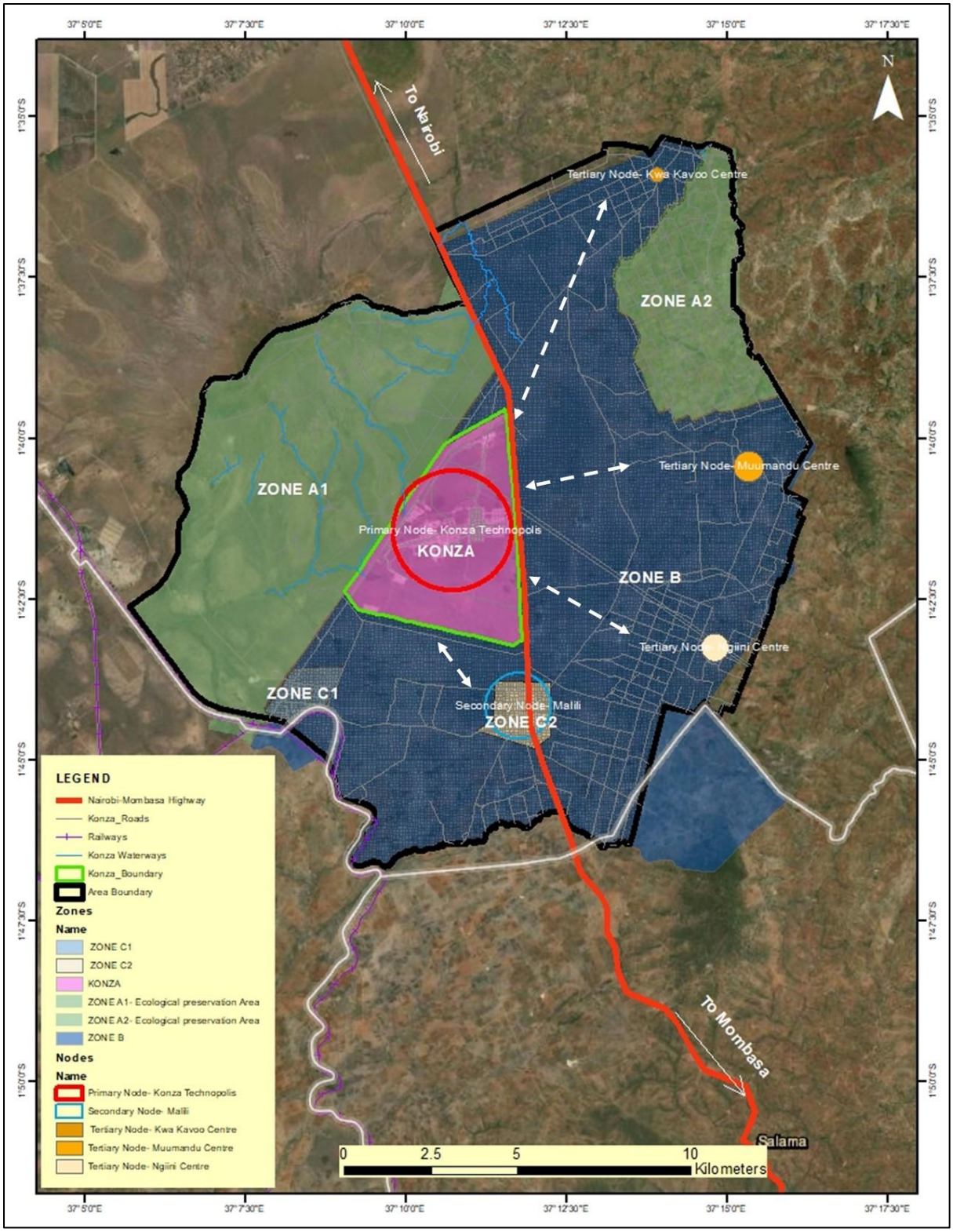
f) Improved ease of access and connectivity between interconnected nodes.

g) The pursuit of sustainable environmental conservation and responsible utilization of natural resources.

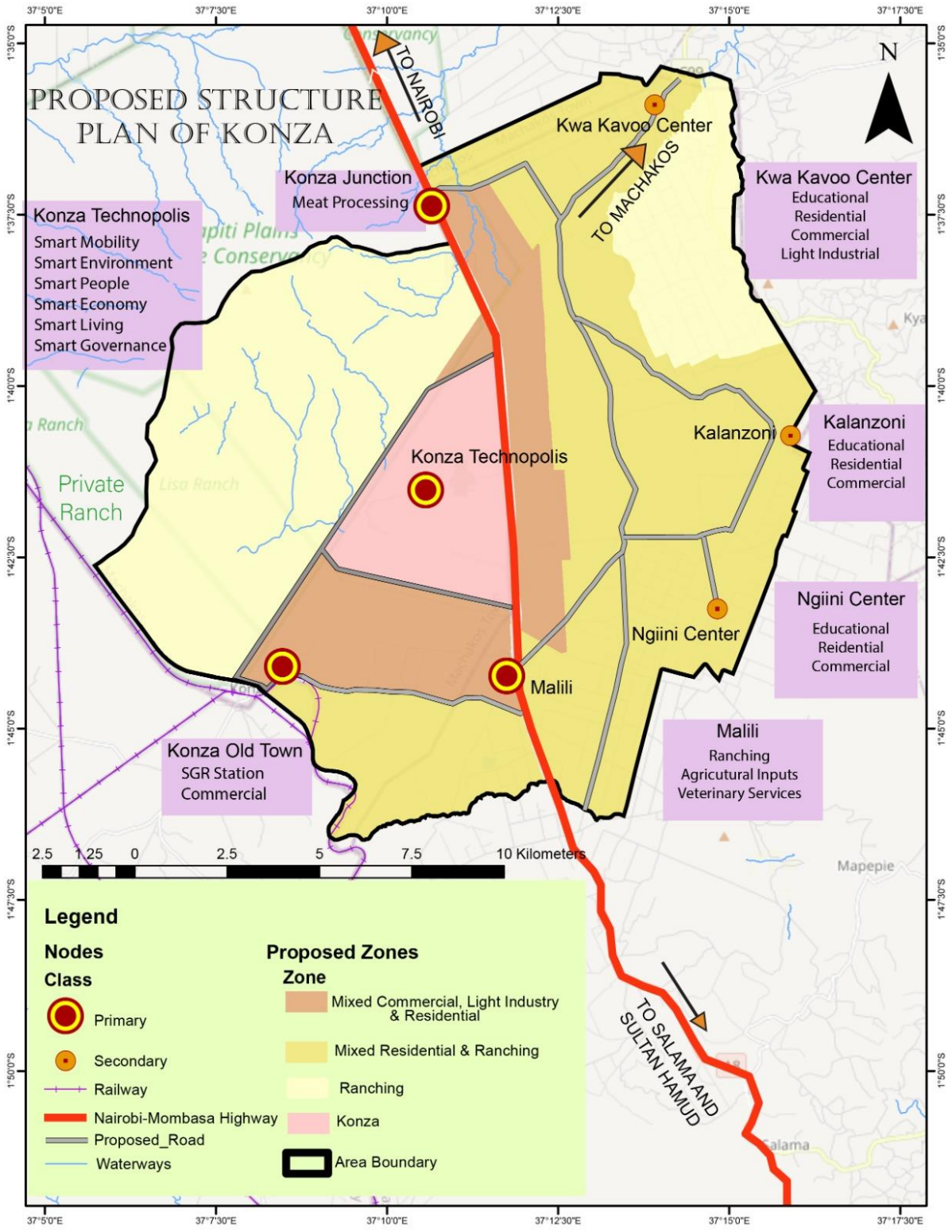
h) Alleviated strain on infrastructure, resulting from the elevation of other nodes to secondary and tertiary statuses.

Table 37 showing advantages and disadvantages of the integrated development model; Author's creation.

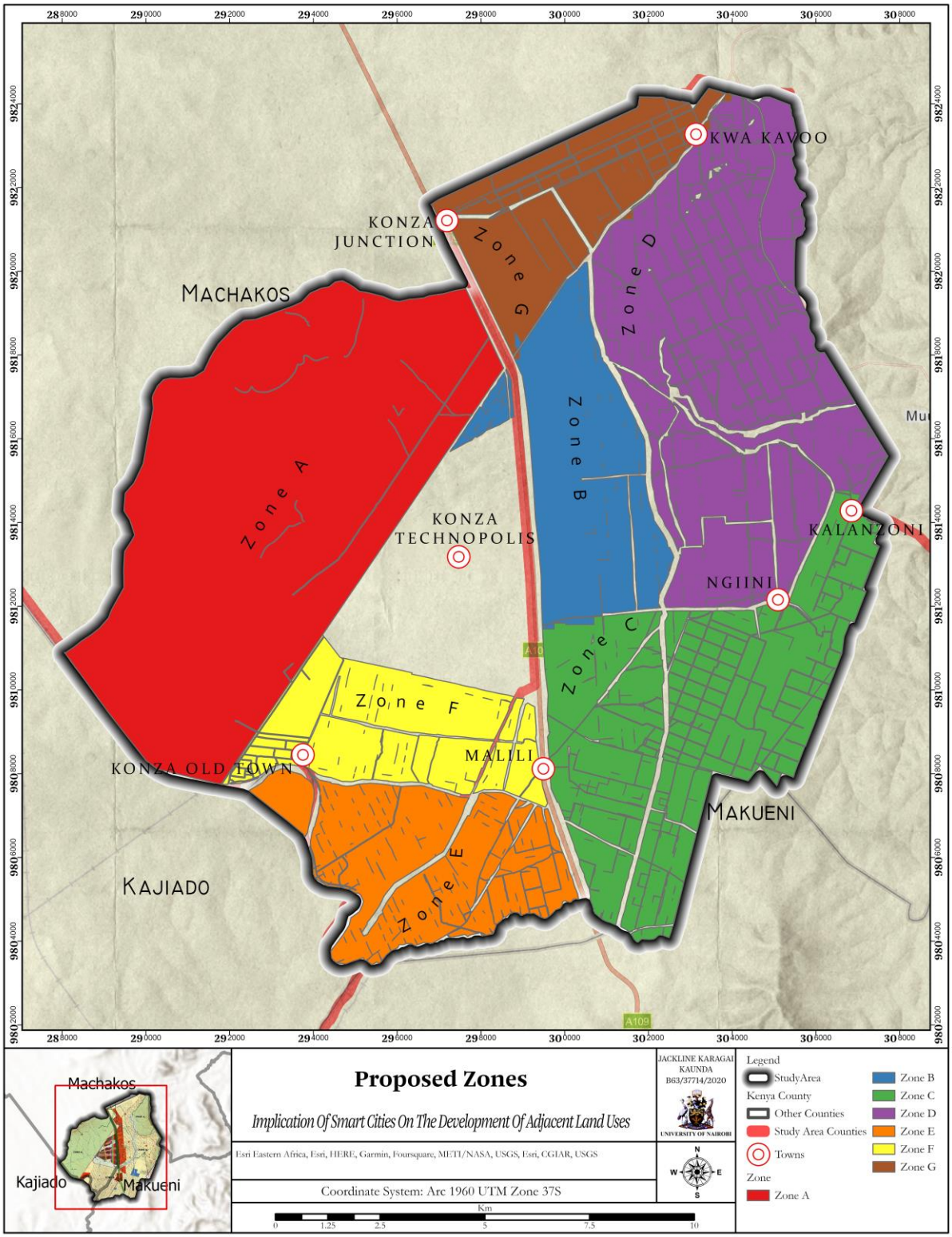
Advantages	**Disadvantages**
Increased service provision and opportunities in all planned secondary and tertiary nodes	High cost of implementation
Reduced traffic congestion on the major transport corridors and within planning area	Require strict development control measures and enforcement
General increased access to facilities and services	
Controlled urban developments	
Better conserved environment	
Reduced dependency on Konza as a primary node	
Reduced fragmentation of land parcel to uneconomical sizes	
Reduced overstretch of resources and infrastructure strain in Konza due to development of infrastructure and facilities in the secondary nodes	
Enhanced intra and inter regional access and connectivity	
Increased opportunities for revenue and wealth creation	



Map 22 showing the integrated development model of Konza; Author's creation.



Map 23: Proposed Structure plan of the study area



Map 24: Proposed Zoning Plan of the Study Area

Table 38: Proposed Zoning Guidelines for the Study Area

Zone	Subzone	Use	Maximum Height (Floors)	Ground Coverage	Min. size of plot	Green Space Ratio
A	Conservation	Conservation	N/A	N/A	N/A	N/A
B	B-Commercial	Commercial	30	80%	0.5 acres	20%
B	Mixed Use High Rises	Mixed Use	30	80%	1 acre	20%
B	Residential Medium Density	Residential	Varies	50%	0.5 acres	30%
B	Light Industrial	Light Industrial	10	50%	1 acre	30%
C	Agriculture	Agriculture	N/A	10%	5 acres	100%
C	Farm House	Farm House	N/A	10%	5 acres	100%
C	Commercial	Commercial	30	80%	0.5 acres	20%
C	Mixed Use	Mixed Use	30	80%	1 acre	20%
C	Residential	Residential	Varies	50%	0.5 acres	30%
D	Agriculture	Agriculture	N/A	10%	5 acres	100%
D	Farm House	Farm House	N/A	10%	5 acres	100%
D	Commercial	Commercial	30	80%	0.5 acres	20%
D	Mixed Use	Mixed Use	30	80%	1 acre	20%
D	Residential	Residential	Varies	50%	0.5 acres	30%
E	Commercial	Commercial	30	80%	0.5 acres	20%
E	Mixed Use	Mixed Use	30	80%	1 acre	20%
E	Residential	Residential	Varies	50%	0.5 acres	30%
F	Commercial	Commercial	30	80%	0.5 acres	20%
F	Mixed Use	Mixed Use	30	80%	1 acre	20%
F	Residential	Residential	Varies	50%	0.5 acres	30%
G	Commercial	Commercial	30	80%	0.5 acres	20%
G	Mixed Use	Mixed Use	30	80%	1 acre	20%
G	Residential	Residential	Varies	50%	0.5 acres	30%

6.5 Implications to Practice/ Additional knowledge in planning practice

- Urban Planning and Development: The findings offer valuable insights into the effects of smart city development on nearby regions. Planners and policymakers can use this information to design more inclusive and sustainable urban development strategies that consider the needs and aspirations of both the smart city and its neighbouring communities. Understanding the reciprocal relationship between Konza City and its surroundings can help identify potential challenges and opportunities, leading to better urban planning practices.
- Smart City Governance: The research sheds light on the roles and actions of different stakeholders involved in the smart city project. Understanding the perspectives of residents, government agencies, private entities, and community leaders can aid in crafting effective governance structures that promote collaboration, transparency, and citizen engagement. It can lead to more accountable and efficient decision-making processes in smart city projects.
- Social Impact and Livelihoods: The study's focus on the social dynamics and economic activities in adjacent areas helps understand how smart city development influences local livelihoods and social well-being. This information can be crucial for developing social safety nets and support systems to mitigate potential adverse impacts on vulnerable communities.
- Environmental Sustainability: Analysing the reciprocal relationship between Konza City and its neighbouring areas can shed light on potential ecological challenges from rapid urbanization. This knowledge is essential for implementing environmentally sustainable practices and ensuring smart city development is carried out with minimal ecological impact.
- Long-term Sustainability: The research findings can help devise strategies to ensure the long-term sustainability of Konza City and its surrounding regions. By understanding the complex interactions between the smart city and its adjacent land uses, decision-makers can adopt measures to foster resilience and adaptability to changing circumstances.

6.6 Implications to Policy

In the case studies reviewed, proper citizen engagement was found to be a key element in developing sustainable smart cities in Singapore and Rwanda. It is therefore important for Kenya to develop and enforce policies on public engagement in planning and developing smart cities in Kenya. The policy ought to ensure involvement of the people from the adjacent neighborhood from the plan inception phase to the monitoring and evaluation phase of projects.

The findings of this study also indicate that the planning of smart cities ought to integrate the neighbourhood. Therefore a policy should be implemented that all plans for smart cities should be accompanied by a proper structure and land use plan for the adjacent areas.

6.7 Implication to Academia / Suggestions for future research

To further enrich the understanding of smart city development and its impacts, future research could focus on the following areas:

1. Longitudinal Study: Conducting a longitudinal study that tracks the changes and developments in Konza City and its adjacent regions over an extended period would provide deeper insights into smart city projects' long-term implications and effects. Such research could help identify trends, assess the effectiveness of policies, and reveal any unforeseen consequences that may emerge over time.
2. Detailed Comparative Analysis: Comparing the experiences of Konza City with other smart city projects in different regions or countries would enable researchers to identify common challenges and successful strategies for smart city planning and implementation. Understanding cross-cultural and contextual differences could lead to more context-specific and adaptable approaches to smart city development.

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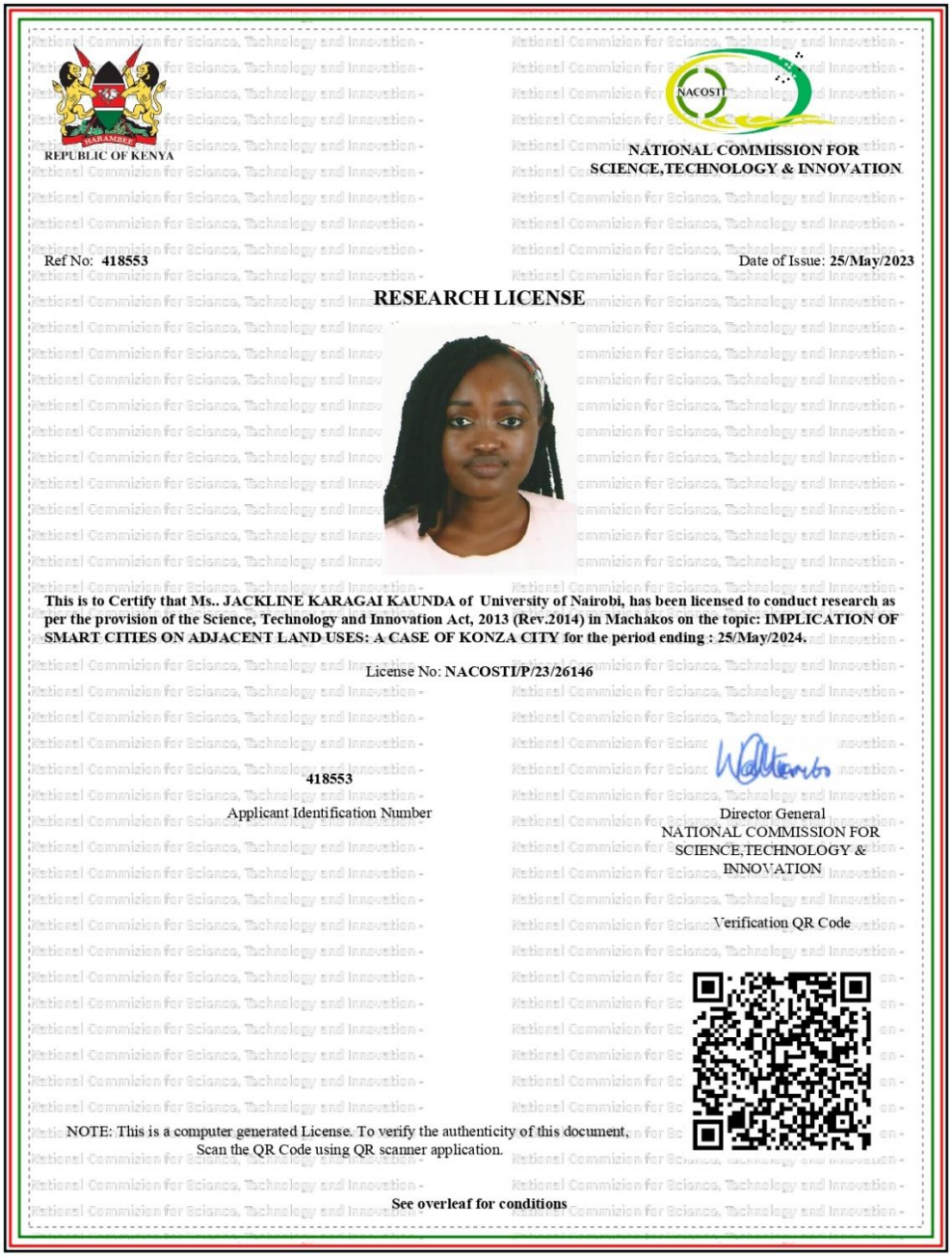
8.0 ANNEXES

Annex 1 – NACOSTI Research Permit



REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

Ref No: **418553**

Date of Issue: **25/May/2023**

RESEARCH LICENSE

This is to Certify that Ms.. JACKLINE KARAGAI KAUNDA of University of Nairobi, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Machakos on the topic: IMPLICATION OF SMART CITIES ON ADJACENT LAND USES: A CASE OF KONZA CITY for the period ending : 25/May/2024.

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See overleaf for conditions

Annex 2- University Introductory letters

University of Nairobi
Department of Urban and Regional Planning
Faculty of the Built Environment and Design
P.O. Box 30197, 00100 GPO Nairobi, Kenya
e-mail:durp@uonbi.ac.ke

10th May, 2023

TO WHOM IT MAY CONCERN,

RE: BUR 604: RESEARCH PROJECT: JACKLINE KARAGAI KAUNDA- B63/377714/2020

This is to confirm that Jackline Karagai Kaunda is an M.A Planning Student in the Department of Urban & Regional Planning, University of Nairobi.

As part of the Master of Arts in Planning programme, the students are required to acquire training in data collection, analysis and report writing .

This is to request you to allow Jackline to access your Institution/neighbourhood in order to collect data for her Project titled "***Implication of Smart Cities on Adjacent Land Uses: A Case study of Konza City, Konza Sub-location.***

Any assistance accorded to her will be highly appreciated.

University Of Nairobi Faculty of Built Environment & Design Department Of Urban And Regional Planning CHAIRMAN P.O. Box 30197 - 00100 Nairobi

DR. FRIDAH W. MUGO
CHAIR - DEPARTMENT OF URBAN & REGIONAL PLANNING

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10th May, 2023

National Commission for Science,
Technology and Innovation (NACOSTI)
P.O Box 30623, 00100
Nairobi.

RE: NACOSTI LICENSE - JACKLINE KARAGAI KAUNDA-B63/377714/2020

This is to confirm that Jackline Karagai Kaunda is an M.A Planning Student in the Department of Urban & Regional Planning, University of Nairobi.

As part of the Master of Arts in Planning programme, the students are required to acquire training in data collection, analysis and report writing .

Jackline is seeking to acquire a Nacosti Research License to facilitate her Research Project titled "***Implication of Smart Cities on Adjacent Land Uses: A Case study of Konza City, Konza Sub-location.*** The research will be carried out effective May, 2023 – July, 2023.

Any assistance accorded to her will be highly appreciated.

University Of Nairobi
Faculty of Built Environment & Design
Department Of Urban And Regional Planning
CHAIRMAN
P.O. Box 30197 - 00100 Nairobi

DR. FRIDAH W. MUGO
CHAIR - DEPARTMENT OF URBAN & REGIONAL PLANNING

Annex 3-Household Questionnaire

Annex 4- Business/ Commercial Questionnaire

Annex 5- Key Informant Interview schedules

Annex 6- Observation checklist

UNIVERSITY OF NAIROBI

FACULTY OF THE BUILT ENVIRONMENT AND DESIGN

DEPARTMENT OF URBAN AND REGIONAL PLANNING

RESEARCH PROJECT

HOUSEHOLD QUESTIONNAIRE

I am **JACKLINE KARAGAI KAUNDA (REG NO B63/37714/2020)** a graduate student at the University of Nairobi pursuing a Master's degree in Urban and Regional Planning.

RESEARCH TITLE: IMPLICATION OF SMART CITIES ON THE DEVELOPMENT OF ADJACENT LAND USES: A CASE OF KONZA CITY.

RESEARCH PURPOSE: *The purpose of this study is to assess smart cities and their implications of on the development of adjacent land uses and recommend strategies for sustainable land use integration to promote urban resilience for smart cities and its environs. The information and data collected will be confidential and is intended purely for the research study being undertaken for a project that forms part of the requirements to complete* ***Masters of Arts (Planning)*** *at The University of Nairobi.*

SECTION 1: RESPONDENT PROFILE	
1.1 PERSONAL INFORMATION	
1.1.1	Name of the respondent (Optional)
1.1.2	Age
1.1.3	Gender
1.1.4	a) Do you reside here? *a. Yes b. No* b) If yes, in which location do you live in? ……
1.1.5	Kindly indicate you Nationality
1.1.6	Kindy indicate your marital status. *a. Single b. Married c. Widow/Widower d. Divorced e. Separated*
1.1.7	Please indicate your highest level of education?
1.1.8	Are you the household head? *a. Yes b. No*
1.1.9	If no, what is your relationship with the household head?
1.2 HOUSEHOLD SIZE, COMPOSITION, AGE, SEX, EDUCATION AND EMPLOYMENT	

1.2.1	How many members live in this Household?						
1.2.2	If more than one, kindly fill the table below for each member.						
	No	**Relationship**	**Age** *(years)*	**Gender**	**Highest Education Level**	**Employment** *(Formal/Informal)*	**Sector**
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
1.2.3	i	a. What do you do for a living? ……... b. Kindly indicate where you work ……...					

	ii.	Kindly indicate how much you spend on the following:		
			EXPENSE	**AMOUNT (Ksh.)**
		i.	Food	
		ii.	Clothing	
		iii.	Electricity	
		iv.	Transport	
		v.	Education	
		vi.	Agriculture	
		vii.	Rent	
		viii.	Savings	
		ix.	Other Expenses	

	iii	What are the challenges affecting the household in regards to employment?

	iv.	What would you propose to solve the employment challenges?

1.3 MIGRATION, HOUSING AND SERVICE PROVISION

1.3.1	Were you born in this location? *a. Yes* *b. No*
1.3.2	If no, how long have you lived here? ……..
1.3.3	Kindly explain what attracted you to move to this area?
1.3.4	Housing Ownership, Typology and Condition

1.Ownership	**2.Typology**	**3.Building Materials**		
		a) Roof	**b) Wall**	**c) Floor**
1. Municipal/County Housing	1. Bungalow	1.Iron sheets	1. Mud	1. Earth
2. National Government Housing	2. Mansionette	2.Grass	2. Bricks	2. Cemented
3. Institutional Housing	3. Row housing	3.Concrete	3. Blocks	3. Tiled
4. Owner Occupier	4. Flat	Others	4. Rubble stones	4. Wood
5. Private Rental	5. Huts/traditional house		5. Cut stones	Others
6. Others	6. Others		6. Iron sheets	
			7. Wood	
			8. Others	

1.4. LAND USE AND LAND TENURE

1.4.1	a.) Do you own the land you reside in?
1.4.2	If yes, how did you acquire the land? *a. Inheritance* *b. Lease* *c. Government allocation* *d. Purchased* *e. Other Specify*
1.4.3	What ownership documents do you possess for the land? *a. Titles (Freehold* *b. Leasehold* *c. Temporary Occupation License* *d. Letter of Allotment* *e. Share Certificate* *Other specify*

SECTION 2: IMPLICATIONS OF KONZA CITY TO THE ADJACENT LAND USES

2.1.1 Have you noticed any changes in the neighboring land uses since the development of Konza City started?

a. Yes *b. No*

b. If yes, kindly explain the changes

c. If no, in your opinion, why are there no changes?

2.1.2 To what extent to you agree with the following statements with regard to development of Konza City.

(Kindly Tick)

	STATEMENTS	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
i.	The development of Konza City has had a positive effect on the community.					
ii.	Property values and rental prices have changed drastically since the development of Konza City.					
iii.	Traffic flow in the neighborhood has increased since the development of Konza City.					
iv.	Public services have increased since the development of Konza City started.					
v.	The development of Konza city has led to growth of the neighborhood.					
vi.	Development of Konza City has increased the level of urbanization/economic activity and social cohesion in the adjacent areas					

2.1.3 Kindly explain how the development of Konza city has affected the community.

2.1.4 Kindly explain how property values and the rent prices have changed since the development of Konza City began.

2.1.5 Kindly explain how traffic flow has changed since the development of Konza city started.

2.1.6	Kindly explain the changes in the availability of public services.
2.1.7	Please explain ways in which development of Konza city has impacted the neighborhood.

2.2 RESIDENTS ATTITUDE TOWARDS DEVELOPMENT OF KONZA CITY

2.2.1	a. In your opinion, do you think Konza City should have been developed in this location or elsewhere?		
2.2.2	b. Kindly state how the development of Konza City impacted your livelihood, both positively and negatively?		
		Positive Impact	**Negative Impact**
	i.		
	ii.		
	iii.		
	iv.		
	v.		
	vi.		
	vii.		
	viii.		
	ix.		
2.2.3	How has the development of Konza City affected the social dynamics in the adjacent areas?		

SECTION 3 BASIC PHYSICAL INFRASTRUCTURE PROVISION

3.1.1 **Water**

Main Source of water	*Service Provider*	*Level of Access*	*Water Quality*	*Quantity used daily (litres)*
i River ii Shallow Well iii Borehole iv Spring v Piped (Water Provider) vi Rain water	i. County Provider ii. NGO iii. Private Sector iv. Vendors v. Kiosks vi. CBOs vii. Others *(Specify)*	i. Household ii. Communal/Sha iii. red within plot iv. Communal v. outside the plot	i. Safe to drink ii. Not safe to drink (*Odour/Smell Taste, Color)*	

	vii Other *(Specify)*				

3.1.2	Kindly state the main challenges facing the household in terms of access to potable/safe water?
3.1.3	What are the possible solutions to address the challenges in accessing potable water?
3.2 Liquid Waste	
3.2.1.	What is the main household's liquid waste disposal method? *a. Pit Latrine b. Septic tank c. Sewer d. Other(specify) .....*
3.2.2 Solid Waste	

	a) Type of waste generated i. Biodegradable (food scraps, vegetables, wood etc.)	**b) How do you manage your household solid waste** i. Indiscriminate dumping ii. Burning iii. Trash/Compost Pit
	ii. Non-biodegradable (polythene paper, metal, bottles, rubber etc.) iii. Both	iv. Reuse/Recycling v. Burying vi. Collection vii. Other (specify) .....

3.2.3	**c) If collected, who collects?** i. County Government ii. Private Agencies iii. Organized Groups (Women, Youth, CBOs)	**d) How often is it collected?** i. Weekly ii. Bi-weekly iii. Monthly iv. More than a Month	**e) Do you pay for waste collection?** *a. Yes b. No* v) If yes, how much? .....
3.3 Energy			
	i) What is the main source of energy for house lighting and electric appliances? *a. Electricity b. Solar c. Lantern d. LPG lamp e. Other (Specify).....*		

ii)What is the main source of energy for cooking?

a. Electricity b. Biogas c. Firewood d. Charcoal e. Paraffin f. LPG

g. Other (Specify) .....

iii) Apart from cooking and lighting, are there other uses of energy?

a. Yes b. No

iv)If yes, please indicate the uses and the source of the energy.

Use of Energy	**Source of Energy**

v) What challenges do you experience in accessing energy.

vi) What solutions do you propose to address the challenges in acquiring energy?

3.4 Basic Social Provisions

a. Which of the following facilities do you have in your neighborhood and associated challenges?

a. Community Hall b. Fire brigade station c. Dispensary d. Maternity home e. Hospital

f. Cemetery g. Stadium h. Recreational Facilities

b. What challenges do you face in accessing the facilities?

i) What are the main challenges facing the household in terms of access to Health Facilities?

ii) What solutions do you propose to address the challenges in accessing health facilities?

iii) How far is the nearest fire station?

iv) What is the nearest hospital from here?

3.5 EDUCATION FACILITIES

3.5.1	a.) Kindly indicate the distance and names of the nearest educational facilities below.

	Name of Education Facility	Distance from home
	i. ECD school	
	ii. Primary school	
	iii. Secondary schools	
	iv. Tertiary Institutions *(University, college, TVET)*	
3.5.2	b.) Are there any technical institutions in this location? a. Yes b. No	
3.5.3	c.) What are the main challenges facing the household in accessing education?	
3.5.4	d.) What solutions do you propose to address the challenges faced in accessing education?	

3.6 TRANSPORTATION	
3.6.1	a) What means of transport do you use? *a. Public Transport b. Private vehicle c. Motorcycle d. Tuk-tuk e. Taxi f. Bicycle, g. Walking h. Animal Pulled Cart*
	b) i. Have the roads changes since the development of Konza City started? *a. Yes b. No* ii. Kindly explain.
	ii) What are the main transportation challenges you face?
	iii)What are the possible solutions to address the above problems/challenges?
3.7 COMMUNITY PARTICIPATION AND EXPECTATIONS	
3.7.1	i) Do you participate in community development initiatives? a. *Yes* *b. No*

	ii) If yes, how do you mainly participate? *a. Individual Organized groups b. Local Barazas c. County forums d. Other (specify)*
	iii) Which type of activities do you mainly participate in the identified levels?

	iv) If yes, how often do you participate? *a. Weekly b. Monthly c. Yearly d. When need arises*
	v) If no, what are the reasons for non-participation?
	vi) Is there any of your family members who has employed by Konza City since the development started? *a. Yes b. No*
	vii)What problems do you face in participation in community development activities?
	vii) What are the possible solutions to the problems indicated above?

SECTION 4: STRATEGIES TO ENSURE SUSTAINABILITY OF SMART CITIES AND ADJACENT LAND USES

4.1 a.) To what extent do you agree with the following statements with regard to promoting sustainability of smart cities and neighbouring land uses? *(Put a tick)*

		Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
i	Creating more job opportunities for the local members of the community will ensure sustainability of Konza City and the neighbouring areas.					
ii	Regulating land development will ensure sustainability of Konza City and the neighbouring areas.					
iii	Improving infrastructure and services e.g., *Roads, health facilities*					
iv	Development of more smart cities like Konza city in the area will improve					

		sustainability of the neighbouring land uses.					
4.2	v	Involving members of the community in decision making before development of land will ensure sustainability of Konza City and the neighbouring areas.					
	b.) Kindly state other factors that will ensure sustainability between the neighbouring community and Konza City.						

UNIVERSITY OF NAIROBI

FACULTY OF THE BUILT ENVIRONMENT AND DESIGN

DEPARTMENT OF URBAN AND REGIONAL PLANNING

RESEARCH PROJECT

COMMERCIAL QUESTIONNAIRE

I am **JACKLINE KARAGAI KAUNDA (REG NO B63/37714/2020)** *a graduate student at the University of Nairobi pursuing a Masters degree in Urban and Regional Planning.*

RESEARCH TITLE: IMPLICATION OF SMART CITIES ON THE DEVELOPMENT OF ADJACENT LAND USES: A CASE OF KONZA CITY.

RESEARCH PURPOSE: *The purpose of this study is to assess the implications of smart cities on the development of adjacent land uses and recommend strategies for sustainable land use integration to promote urban resilience for smart cities and its environs. The information and data collected will be confidential and is intended purely for the research study being undertaken for a project that forms part of the requirements to complete* ***Masters of Arts (Planning)*** *at The University of Nairobi.*

<table>
<tr><th colspan="7">SECTION A: RESPONDENT PROFILE</th></tr>
<tr><td>1.1</td><td colspan="6">Name of the respondent (Optional)</td></tr>
<tr><td>1.2</td><td colspan="6">Business Location</td></tr>
<tr><td>1.3</td><td colspan="6">Were You Born in this area? 1=Yes, 2=No</td></tr>
<tr><td>1.4</td><td colspan="6">If No to 1.3, When did you migrate to this area?</td></tr>
<tr><td>1.5</td><td colspan="6">If No to 1.3, Where did you migrate from? (County) if its Machakos, Kajiado or Makueni Specify subcounty</td></tr>
<tr><th colspan="7">SECTION B: BUSINESS CHARACTERISTICS AND INFORMATION</th></tr>
<tr><td>2.1</td><td colspan="6">For how long have you been in this business?</td></tr>
<tr><td>2.2</td><td colspan="6">Do you have employees? 1=Yes, 2=No</td></tr>
<tr><td rowspan="5">2.3</td><td colspan="6">If yes please fill in the table below</td></tr>
<tr><td colspan="6">How many Employees do you have?</td></tr>
<tr><td>No</td><td>Employee</td><td>2.Age (years)</td><td>3.Gender
1=Male
2= Female
3= Intersex</td><td>4.Highest Education Level
*See code below(i)</td><td>Monthly Income</td></tr>
<tr><td>1</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

	4					
	5					

i	*1= No formal Education , 2= Not of school going age, 3=Completed primary, 4=Not completed primary, 5=Completed Secondary, 6=Not completed Secondary, 7=Completed Tertiary Education, 8=Not completed Tertiary Institution,*
2.4	Who are the main consumers of your goods and services? *1=Immigrant Workers 2=Local Residents*
SECTION C: PHYSICAL PLANNING OF KONZA & MUUMANDU CENTRE	
3.1	Which type of business premise do you occupy? *1= Owner Occupier 2= Rented*
	(i) If renting, how much rent do you pay per month (exclusive of water and electricity)?
3.2	Looking at the current designs and structures of Konza & Muumandu Shopping center, does it appeal to your sense of beauty? *1=Yes, 2=No*
3.3	If No, what physical planning changes would you recommend for the planners? *1 =Provide for Social amenities 2= Provide Bodaboda Parking area 3= Water Supply Provision* *4 =Create Sections for different goods*

3.4	Is the location of your business convenient to you and your customers? *1=Yes, 2=No*
3.5	ii) If No, what do you suggest should be done to make it convenient
3.6	What is the condition of your business premise? (ventilation, safety, cleanliness, structural stability and beauty) *1=Very good 2= Good 3= Fair 4=Poor 5=Very poor*
3.7	What problems can you cite has been brought about by the operations of **Konza City** and **the population in Konza and Muumandu Sublocation** to your business and welfare?
SECTION D: SOCIOECONOMIC AND SOCIOCULTURAL IMPACTS	
4.1	How has the location of Konza City influenced your business?
4.2	Does the existence of Konza City influence nature of good/services and the market price of your business? *1=Yes, 2=No (Explain)*
4.3	If your business was established before the construction of Konza. Have you experienced any positive or negative impacts on your supply chain as a result of the development of Konza Technopolis?

4.4	Has there been a mix of culture in the area? If Yes How does the cultural diversity brought about by Konza City play about in the business and or cultural goods in the community?
4.5	What are your thoughts on the sustainability of Konza Technopolis and its potential to support long-term business growth? *(Explain)*
4.6	Have you noticed any changes in the local economy since the development of Konza Technopolis began?

4.7	How has the development of Konza Technopolis affected your competition in the local market?
4.8	Have you been able to establish any partnerships with businesses or organizations within Konza Technopolis? If so, how have these partnerships benefited your business?
4.9	Are there any challenges that you have encountered in doing business in or around Konza Technopolis? *(Explain the nature of the challenges if there are there)*
4.10	What role do you see your business playing in the growth and development of Konza Technopolis?
4.11	Are there any areas where you think the Konza Technopolis Development Authority could work more closely with local businesses to support their growth?
SECTION E: KNOWLEDGE OF POLICIES, LEGAL AND REGULATORY FRAMEWORKS GOVERNING URBAN PLANNING	

5.1	Are you aware of planning and management policies and legislative frameworks governing the development of urban centers? *1=Yes, 2=No*
5.2	Do you consider urban planning policies beneficial to the residents? *1=Yes, 2=No*
	If yes to the above ,How are they Beneficial?
5.3	In your opinion, which laws, regulations or policy do you think should be enacted to improve the operation and development of Konza City ? *1=Yes, 2=No*

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FACULTY OF THE BUILT ENVIRONMENT AND DESIGN

DEPARTMENT OF URBAN AND REGIONAL PLANNING

RESEARCH PROJECT

COUNTY PLANNER

---

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Name: _____ *Position Held:* _____

Email: _____ *Contact:* _____

1. What is the role of the county government of Machakos in the development of Konza Technopolis?
2. How does the county government of Machakos work with the Konza Technopolis Development Authority to manage land use and development in the area?
3. How does the county government of Machakos ensure that the development of Konza Technopolis is in line with national and regional development plans?
4. How has the development of Konza Technopolis affected property values in the surrounding areas?
5. Are there any plans to develop infrastructure such as roads and public transportation in the Konza Technopolis area?
6. How does the county government work with the Konza Technopolis Development Authority to attract investment to the area?
7. Are there any plans to involve local communities in the planning and development of Konza Neighborhood?
8. Are there any plans to expand or improve public services, such as healthcare and education, in the

Konza Technopolis Neighborhood?

9. How does the county government work with other government agencies and organizations to support the development of Konza Technopolis?
10. Are there any challenges that the county government has faced in managing land use and development in the Konza Technopolis area?
11. How does the county government ensure that the development of Konza Technopolis is sustainable in the long term?
12. What measures has the county government put in place to manage environmental impacts associated with the development of Konza Technopolis?
13. How does the county government ensure that the development of Konza Technopolis and adjacent areas is in compliance with local regulations?

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KONZA TECHNOPOLIS DEVELOPMENT AUTHORITY

(KoTDA)

---

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Email: _____ *Contact:* _____

Section A: Activities in Konza Technopolis

1. What motivated the development of Konza Technopolis as a smart city, and how is it expected to impact the adjacent land uses?
2. What measures have been put in place to ensure that the development of Konza Technopolis does not negatively impact the adjacent land uses and communities?
3. How have the adjacent land uses and communities been involved in the planning and development of Konza Technopolis as a smart city?
4. What is the process for acquiring land for development within the Konza Technopolis area, and how is this process managed by the county government?
5. What is the role of the Konza Technopolis Development Authority in ensuring sustainable development of both Konza Technopolis and the adjacent land uses?
6. How is the Konza Technopolis Development Authority working with other stakeholders, including government agencies, private sector, and local communities, to ensure the sustainable development of

Konza Technopolis and the adjacent land uses?

7. What strategies have been employed to address any negative impacts of Konza Technopolis on the adjacent land uses and communities, and how effective have they been?
8. How is the Konza Technopolis Development Authority addressing environmental concerns associated with the development of a smart city, particularly in the adjacent areas?
9. What is the role of innovation and technology in the development of Konza Technopolis, and how is it expected to impact the adjacent land uses and communities?
10. How is the Konza Technopolis Development Authority ensuring that the development of Konza Technopolis benefits both the local and national economies?
11. How is the Konza Technopolis Development Authority ensuring that the development of Konza Technopolis is inclusive and equitable for all stakeholders, including the adjacent communities?
12. What opportunities have arisen for the adjacent communities as a result of the development of Konza Technopolis, particularly in terms of employment and business opportunities?
13. How is the Konza Technopolis Development Authority addressing any social, economic, or environmental disparities that may arise from the development of Konza Technopolis?
14. What lessons have been learned from the development of Konza Technopolis in terms of ensuring the sustainable development of smart cities and their adjacent land uses?
15. What advice would you give to other cities or communities seeking to develop a smart city and ensure its sustainable development in the context of adjacent land uses?
16. How is the Konza Technopolis Development Authority ensuring that the development of Konza Technopolis is aligned with national and regional development goals?
17. Are there any plans to expand the Konza Technopolis area beyond its current boundaries? If so, what impact will this have on adjacent land use?

Section B: Adjacent Land Use Activities

1. How has the development of Konza Technopolis affected the land use patterns and economic activities in the adjacent areas?
2. What are the opportunities and challenges that have arisen from the development of Konza Technopolis for the adjacent land uses and communities?
3. How has the development of Konza Technopolis affected the social dynamics and cultural heritage of the adjacent communities?
4. What measures have been put in place to ensure that the development of Konza Technopolis does not displace the local communities or negatively impact their livelihoods?
5. How is the Konza Technopolis Development Authority ensuring that the development of Konza Technopolis is aligned with national and regional development goals?
6. What is the outlook for the future development of Konza Technopolis, and how is it expected to impact

the adjacent land uses and communities?

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OBSERVATION CHECKLIST

Section A: Current condition

Sector	***Elements***	***Observation***
Housing typologies	Permanent structures • Bungalows • Maisonette Semi-permanent Temporary	
Building materials	Roof • Iron sheets • Tile roofs • Asbestos • Thatched Walls • Stone/brick	

	• Mud and wattle Floor • Cemented • Earthen/ mud	
Ventilation	Windows Intersection between walls and the roof	
Lighting	Day • Natural source • Artificial source o Kenya power and lighting mains Night • Artificial source o Kenya power and lighting mains o Oil lamps/lanterns	

PHOTOGRAPH MATRIX

SUB-SECTOR			**PHOTOGRAPHS**
Housing	Housing typologies	• Permanent structures • Semi-permanent structures • Temporary structures	
	Building materials	• Roof • walls • floor	
	Lighting	• artificial and natural sources	
	Ventilation	• windows • opening between walls and roof	

SECTOR	FACILITY TYPE	LOCATION	CURRENT CONDITION
EDUCATION			
HEALTH			
SOCIAL FACILITIES			

TRANSPORT, INFRASTRUCTURE, LAND USE, AND CULTURAL ARTEFACTS

Area of Observation	Key Indicators/Determinants	Observation/Measurement
Transport	Traffic congestion	High, Moderate, Low
	Public transportation	Availability, Quality
	Non-motorized transport	Pedestrian paths, Cycling lanes
Infrastructure	Road network	Coverage, Condition
	Utilities (water, electricity, etc.)	Accessibility, Reliability
	Telecommunications	Broadband availability, Connectivity
Land Use	Zoning regulations	Residential, Commercial, Industrial
	Mixed-use developments	Presence, Integration
	Open spaces/parks	Quantity, Quality
Cultural Artefacts	Historical sites	Preservation, Accessibility
	Museums/galleries	Number, Exhibits
	Public art installations	Presence, Significance

Area (Location)	*Transport*	*Infrastructure*	*Land Use*	*Cultural Artifacts*
Observation 1( )				
Observation 2( )				
Observation 3( )				
Observation 4( )				
Observation 5( )				
Observation 6( )				
Observation 7( )				
Observation 8( )				
Observation 9( )				
Observation 10( )				
Observation 11( )				
Observation 12( )				
Observation 13( )				
Observation 14( )				
Observation 15( )				
Observation 16( )				

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Observation 34( )				
Observation 35( )				
Observation 36( )				
Observation 37( )				
Observation 38( )				
Observation 39( )				
Observation 40( )				

PHOTO TRACKING SHEET

PHOTO NUMBER	DESCRIPTION	LOCATION

COMMERCIAL ACTIVITIES

1	Describe the conditions of the markets?
2	What are the goods sold in the market?
3	How does sanitation in the area affect business in the markets?
4	Describe the formal and informal commercial activities in the ward?
5	What are the other commercial activities done in the ward?
6	What are the other commercial activities done in the ward?