THE UNIVERSITY OF NAIROBI

FACULTY OF THE BUILT ENVIRONMENT AND DESIGN

DEPARTMENT OF URBAN & REGIONAL PLANNING

ASSESSMENT OF NON-MOTORIZED TRANSPORT & ITS IMPLICATIONS ON URBAN LAND USES. A CASE STUDY OF KITENGELA TOWNSHIP

BY

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ABSTRACT

Non-motorized transport (NMT) is a mode of transport that offers efficient, cheap, safe and convenient mobility. Encouraging use of NMT reduces reliance on use of vehicles thus reducing challenges facing the world through emissions and traffic snarl ups. Major streets in Kitengela are not planned to accommodate NMT as a mode of transport. This street designs focuses on vehicular mobility and less concern on safety and mobility of NMT thus poses a great challenge on urban mobility. There is need to plan for NMT by allocating more space and being entirely focusing on those who walk and cycle along urban areas.

This research aimed at assessing Non-Motorized transport provision, usage and its implications on urban land use. The study further assessed the existing Non-Motorized transport modes and facilities within Kitengela township, their challenges and opportunities. Assessment of various urban land use that is currently in Kitengela township was done and further analyze the Non-Motorized transport interactions and conflicts with land use. The planning interventions to ensure safe, sufficient and seamless Non-Motorized transport mobility in Kitengela township will be determined.

The research targeted a sample of 120 traders and business premises owners, road users, Cyclists and Cart Pullers. Stratified Random Sampling was used and questionnaires were distributed geographically per stratum. Each stratum had 30 respondents distributed in all key roads (Namanga road, Old Namanga, Saitoti, Kitengela Prisons and New valley Roads). Key informants' questionnaires were carried out targeting key NMT players such KeNHA, KURA, County of Kajiado Transport and planning department, Kenya railways and academicians.

Primary data was obtained through field work questionnaire interviews with various road users, Online key informants' interviews, field crosscut walks, taking photographs and recording GPS coordinates for mapping. Secondary data was collected from various institution reports, internet search engine and university respiratory. Various software's were used to analyze such as; Microsoft Excel, AutoCAD and (ArcGIS)

The research rationale shows there is lack of NMT provision, unbalanced urban land uses and conflicts between commercial land uses and pedestrians, pedestrians and vehicular

traffic due to unplanned highway, commercial street vendors and other business. The study recommended various planning interventions such as provision of NMT facilities and amenities within the major streets, replanning some land uses by proposing a market, a parking facility, recreational facilities and railway station. The study further proposed replanning and redesign of Namanga highway into an urban street and creating eastern and western bypasses that will ease traffic within already congested township.

DECLARATION

This research project is part of the University requirement for the award of a Master of Arts degree in Planning, University of Nairobi.

Araka Geoffrey

Signature… **…** **Date…15th/November/2021…….**

Signature…_____… **Date…17th/November/2021…….**

Dr. Romanus Opiyo

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Signed…… **Date…18th/November/2021…….**

Mr. James Murimi

(Supervisor)

DEDICATION

I humbly dedicate the research to my parents Mr & Mrs Araka, My family and my daughter Lindsey Zawadi for encouragement and support during Master's Degree research.

ACKNOWLEDGEMENT

It a tough journey to finish research. My gratitude to Dr. Romanus Opiyo and Planner James Murimi for immense support during my academic research. I extend my heartfelt gratitude to my Course Tutor Dr Fridah Mugo for her resilience and positive comments towards my thesis research.

TABLE OF CONTENTS

ABSTRACT i
DEDICATION iv
ACKNOWLEDGEMENT v
TABLE OF CONTENTS vi
LIST OF TABLES x
LIST OF FIGURES/IMAGES xi
LIST OF MAPS xii
LIST OF PHOTOS xii
ACRONOMYS xiii
1.1. Introduction 1
1.2. Research Problem Statement 3
1.3. Research Questions 4
1.4. Research Objectives 4
1.5. Geographical & Theoretical Scope 5
1.6. Justification for Study 5
1.7. Definition of Terms 6
2. LITERATURE REVIEW 7
2.1. Introduction 7
2.2. Theories Related to the Research 7
2.2.1. Smart growth theory 7
2.2.2. New urbanism theory 7
2.2.3. Pedestrian mall theory 8
2.3. Non-Motorised Transport (NMT) 8
2.3.1. Non-Motorised Transport Modes 9
2.3.2. Non-Motorised Transport Facilities 12
2.3.3. Non-Motorised Transport in developing countries 15
2.3.4. Demurrals and opportunities of Non-Motorized Transport 16
2.4. Urban Land Use 17
2.4.1. The CBD (Central business district) 18
2.4.2. The inner city 19
2.4.3. Suburbs 19

2.4.4. The urban-rural fringe 19
2.5. Non-Motorised Transport and Urban Land Use 20
2.5.1. Interactions with Urban Land Use 20
2.5.2. Conflicts with Urban Land use 21
2.6. Non-Motorised Transport planning interventions 21
2.7. Policy Framework 21
2.7.1. Sustainable Development Goals (SDGs) 21
2.7.2. New Urban Agenda 22
2.7.3. Africa Agenda 2063 22
2.7.4. National Urban Development Policy (NUP) 22
2.7.5. Integrated National Transport Policy 22
2.8. Legal Framework 23
2.8.1. The Constitution of Kenya 2010 23
2.8.2. Kenya's Vision 2030 23
2.8.3. NTSA Act 2012 23
2.8.4. National Road Safety Action Plan 2018-2023 24
2.8.5. Traffic Act of 2015 24
2.8.6. Street Adoption Act 1963 (Revised edition 2012) 24
2.8.7. The Highway Code 25
2.8.8. Kenya Road Act of 2007 25
2.9. Overall Information Gap 26
2.10. Conceptual Framework 27
3. RESEARCH METHODOLOGY 28
3.1. Introduction 28
3.2. Research Outline 28
3.3. Targeted Demographic 28
3.4. Data Frame 28
3.4.1. Sample Size 28
3.4.2. Origin-Destinations (O-D) surveys 30
3.5. Data Sources, Types and Collection Methods 30
3.5.1. Key Informants Interviews 31
3.5.2. Field Observations and Taking Photographs 32
3.5.3. Secondary Data 32
3.5.4. List of research instruments 32

3.5.5. Spatial Data 32
3.6. Analysis of data 32
3.7. Interpretation of data 33
3.8. Data Need Matrix 34
4. RESEARCH STUDY AREA 35
4.1. Introduction 35
4.2. Regional, National and Local location 35
4.3. Population Statistics 36
4.4. Climatic Conditions 37
4.4.1. Rainfall 38
4.4.2. Temperature 38
4.5. Topography and Physiographic Features 40
4.6. Hydrology 42
4.7. Geology and Soils 42
4.8. Economic and Social Characteristics 42
4.8.1. Local Economy 42
4.8.2. Social Infrastructure 43
4.9. Physical Infrastructure 43
5. PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA 43
5.1. Introduction 43
5.2. Demographic Information 44
5.2.1. Respondents Rate 44
5.2.2. Name of the road distribution 45
5.3. Demographic Characteristics 45
5.3.1. Gender and Marital Status of the respondents 45
5.3.2. Age Distribution Rate 46
5.3.3. Level of education 46
5.3.4. Occupation of respondents 47
5.4. Non-Motorised Transport (NMT) 48
5.4.1. Current and Preferred modal Split in Kitengela 48
5.4.2. Origin - Destination and Trip Purpose in Kitengela 49
5.4.3. Trip Duration 49
5.4.4. NMT Facilities 50
5.5. Urban Land Uses in Kitengela Township 52

5.5.1. Residential Land Use. 52
5.5.2. Industrial Land Use 52
5.5.3. Educational Land Use 52
5.5.4. Recreational Land Use 52
5.5.5. Public Purpose Land Use 52
5.5.6. Commercial Land Use 53
5.5.7. Public Utility Land Use 53
5.5.8. Transportation Land Use 54
5.5.9. Undeveloped Land Uses 55
5.6. NMT interactions and conflicts with Urban Land Uses 57
5.6.1. NMT Interactions with Commercial Land Use 57
5.6.2. NMT conflicts with Commercial Land Uses 57
5.6.3. NMT Interactions and conflicts with other Land Uses 61
5.7. Planning Interventions 65
5.7.1. NMT provision and usage 65
5.7.2. Replanning Urban Land Use 66
5.7.3. NMT interactions and Conflicts with Land use 68
6. RESEARCH SUMMARY, CONCLUSION AND RECOMMENDATIONS 54
6.1. Introduction 54
6.2. Research Summary 54
6.2.1. NMT provision and usage in Kitengela Township 54
6.2.2. Urban Land Uses in Kitengela Township 54
6.2.3. NMT interactions and conflicts with Urban Land Uses 55
6.2.4. Planning Interventions 55
6.3. Conclusion 55
6.4. Recommendations 55
REFERENCES 57
APPENDICES i
RESEARCH WORK PLAN i
RESEARCH BUDGET ii
Road Users Questionnaire (NMT) iii
Traders Questionnaire viii
Cyclists, Motorcyclists, Motorist’s questionnaire ii
Key Informant Guide vi

LIST OF TABLES

Table 1 Data Sources, Types and Collection Methods; own source 31
Table 2 Data Matrix; Owner creation 34
Table 3 Population Comparisons; KNBS 37

Table 5. 1 Response Rate. (Source; Author 2021) 44
Table 5. 2 Gender and Marital Status of Respondents. (Source; Author 2021) 46
Table 5. 3 Age Distribution. (Source; Author 2021) 46
Table 5. 4 Occupation of the respondents. (Source; Author 2021) 48
Table 5. 5 Origin-Trip Purpose. (Source; Author 2021) 49
Table 5. 6 Existing Land Use Area (Source; Author 2021) 55

LIST OF FIGURES/IMAGES

Figure 1 Urban Land Use Model, Source; Bitesize 18
Figure 2 NMT Interaction with Urban Land Use, Source; Author Construction 20
Figure 3 Conceptual Framework; Author's Creation..... 27
Figure 4 Mean Monthly Rainfall; Source: weather-and-climate.com 2016-Kitengela 37
Figure 5 Mean Monthly Temperature; Source: weather-and-climate.com 2016-Kitengela 39
Figure 6 Average humidity over the year; Source: weather-and-climate.com 2016-Kitengela 39
Figure 7 Elevation map of Kitengela; Source NASA 41
Figure 8 Proposed Replanned Highway. Source; Author 68

Figure 5. 1 Road/Highway Name; (Source; Author 2021) 45
Figure 5. 2 Level of education. (Source; Author 2021) 47
Figure 5. 3 Current and Preferred modal split..... 48
Figure 5. 4 Condition of footpaths (Source; Author 2021)..... 50
Figure 5. 5 Condition of cycle tracks (Source; Author 2021)..... 51
Figure 5. 6 NMT Interactions with Commercial Land Use (Source; Author 2021) 57
Figure 5. 7 Car Park Effects to Commercial Business (Source; Author 2021)..... 60

Image 1 Lack of Footpaths; Field Galley..... 51

LIST OF MAPS

Map 1 Road Users Origin-Destinations (O-D) surveys location; Source own creation 30

Map 5 1 Existing Land Uses in Kitengela; (Source; Author 2021) 56
Map 5. 2 Namanga Roadside Activities; (Source; Author 2021) 58
Map 5.3 Conflicts Along Namanga Road; (Source; Author 2021)..... 59
Map 5.4 Collector Roads Conflicts; (Source; Author 2021)..... 63
Map 5.5 Collector Roads Conflicts; (Source; Author 2021)..... 64
Map 5.6 Proposed Western & Eastern By Pass. (Source; Author 2021) 67
Map 5.7 Proposed Western & Eastern By Pass. (Source; Author 2021) 69

LIST OF PHOTOS

Photo 1 A median walkway in Lusaka, Zambia. (Source: ITDP Africa)..... 11

ACRONOMYS

NMT - Non-Motorised Transport

MT- Motorised Transport

KeNHA - Kenya National Highways Authority

NEMA - National Environmental Management Authority

KURA – Kenya Urban Roads Authority

KNH - Kenyatta National Hospital

GPS - Geospatial Positioning System

GIS - Geographical Information System

VTPI - Victoria Transport Policy Institute

CHAPTER ONE

1.1. Introduction

As per Murray & Davies, 1998 they argued that development and advance of a city is related to the transportation of its people between activity in a given location. They further argued that appropriate transportation planning is an important element in the development of a city. They further argued that efficacy in transportation networks leads to societal evolution in terms of development and dictates how the society interacts. Lack of transportation infrastructures slows the development and interaction of a city. Population increases and economic status of a city increases number of journeys within a city. This is castigated by increase in population, rural-urban migration, and growth in the economy (Murray & Davies, 1998).

Murray & Davies, 1998 in their paper observed that when economic status of the population increases, more cars are bought thus more travel frequency. Increase in vehicles increases use of private cars and without efficient public transport system, there is a high private vehicle usage. Efficient transportation is influenced by demand of transport infrastructure and its efficiency. Over supply of transport infrastructure which overshadows the demand leads to decrease in efficiency. The increase in demand for transportation is castigated by urban sprawl and economic growth of the urban areas which increases usage of private vehicles (Murray & Davies, 1998).

Non-motorized transport (NMT) includes mobility without use of a motor engine. This mode includes walking, cycling, rickshaws, animal-drawn carts and skating for recreational purposes. NMT ensures there is growth of neighborhood by improving living standards of communities living in such neighborhoods. NMT is a major component of transport system since it ensures physical fitness of users, it does not pollute the environment, it's cheaper than motor transport and makes the neighborhood safer to live in. (Cape Town, 2005). NMT solves challenges that is not limited to mobility and accessibility as an alternative to use of vehicles. Most of the trips are started by walking and end by walking and its basically castigated by user's choice. Examples of NMT users are; Those work near neighborhood, School children, Market and Shop vendors and shoppers, recreational purposes such as swimming, skating and hill climbing and other uses. (Cape Town, 2005).

Litman in his book argued that transportation interacts with land use. He further argues that transportation planning affects land use development, and land uses affect transport mobility. This research analyzes land use planning decisions that affect non-Motorized transport. Land uses influence ability of users get services and activities; thus, it affects movement and frequency of their travel as per research done by Duranton, Guerra and Litman. Various land uses create different access demands. Urban land uses are more accessible and broad transport network with slow and expensive mobility. Sub-urban and rural areas have less accessible land uses with few trips but faster.

Kitengela township is located in Kajiado County, 30 km from Nairobi City and it borders Machakos County. The township has been undergone rapid development since 2011 (Kamau, 2016). Kitengela township is sprouting economically and a hub for real business evidenced by high-rise buildings both commercial and residential that generate human traffic daily. Growth of Nairobi City has led to urban sprawl in neighboring towns such as Kitengela town due to demand for residential and industrial space.

Kamau on his research identified that Kitengela township has various institutions and facilities both private and public. Among key institutions are educational centres such as Kitengela International School, Acacia International Schools, Aga-Khan Hospital and Gertrude children's hospital among others. Commercial institutions such as lending facilities are key within the town KCB bank, Equity bank, Cooperative bank among others. Chain of supermarkets and malls has been set up to take care of ballooning population within the town. Kitengela township has grown also due to proximity to industries within the vicinity of Athi River due to low cost of materials for industries such as limestone for cement industries and also houses employees working in those industries.

1.2. Research Problem Statement

The evolution of technologies dedicated to the movement of people and goods has brought about significant changes in people's lives. Forms of mobility that were not only convenient and easily accessible but also healthy and environmentally-friendly, have now been pushed quite literally to the anonymous edges of roadways worldwide. The growing popularity of the automobile in the last century has helped it take centre stage in planning for mobility. Traditional modes of travel like walking and cycling are less and less possible on roads engineered specifically for motor vehicles (Ministry of Urban Development India, 2016).

The problems caused by increasing motorization (namely congestion, accidents and pollution) however, have encouraged people to start reflecting on how Non-Motorised Transportation can become more of an option. NMT refers to all modes of transportation that are not powered by a motor. This includes walking, cycling, and other Non-Motorised Vehicles (NMVs) that can attain limited speeds, i.e., less than 25km/hr. The importance of NMT as an affordable and environmentally friendly transport mode is increasingly being recognized for its great potential in reducing emissions, improving safety, and create more sustainable urban environments (Ministry of Urban Development India, 2016).

NMT not only suffers from general neglect and lack of attention from policy makers, urban planners, and engineers, but also suffers from the social stigma brought about by the captive nature of NMT use. NMT, therefore, needs to be understood and encouraged from a policy, institutional, planning, culture, and enforcement approach. The outer side of the road, or the slow-moving side, is a highly contested space. Pedestrians and cyclists compete and conflict with hawkers, parked cars and motorcyles, property access, shops' spill overs, advertisements; as well as essential demands of public utilities including electricity and lighting infrastructure and amenities like toilets and dustbins. Added to the mix are vendors, auto rickshaw and cycle rickshaw stands, bus stops and street furniture. While all of these spaces need to be integrated in the street designs, the current road designs allocate most of the Right of Way (ROW) to the motorised carriageway, leaving all these functions to fight for space on the meagre 1.5m shoulders left on the sides. As a result, pedestrians and cyclists are usually found on the carriageway since that is the only clear path available. This results in accidents, congestion and general chaos on the street.

The traffic systems in place are designed to cater for motor vehicle neglecting pedestrian and cycling safety. The is low enforcement in the usage of zebra crossing, provision of pedestrian lanes and amenities such as benches and street lights. Major streets in Kitengela township lack footpaths and cycle tracks which exposes NMT to vehicle traffic which leads to most accidents. Existing footpaths have elevation variations, obstructions by road-side traders and open drainage system that poses challenges to users. Footpaths are not protected from vehicular encroachments which forces pedestrians to walk along the carriageway. Most crossings areas are not well marked and blocked thus pedestrians' cross main carriage way at any point thus exposure to Vehicular users.

1.3. Research Questions

1. What are the current NMT provision and usage in Kitengela Township?
2. What are the existing Urban Land Uses in Kitengela Township?
3. How does NMT interact and conflict with Urban Land Uses in Kitengela?
4. What are the planning interventions for effective NMT system in urban areas?

1.4. Research Objectives

1. To assess the current NMT provision and usage in Kitengela Township.
2. To assess the existing Urban Land Uses in Kitengela Township.
3. To investigate how NMT interacts and conflicts with Urban Land Uses in Kitengela.
4. To come up with NMT Planning Interventions in Urban Areas.

1.5. Geographical & Theoretical Scope

Kitengela township forms part of Kajiado County among other towns such as Rongai, Kiserian, Ngong, Kajiado among others. Its proximity to Nairobi city makes it park of larger Nairobi Metropolitan Area. Kitengela township borders Athi River town in Machakos County which is the home of several industries that are found within Athi River Township. The township has undergone rapid transformations due to demand of space and housing from neighboring towns and presence of employment opportunities within the nearby Athi river Township.

Residents and local dwellers perceive Kitengela as "having the best of both worlds," due to its proximity to Nairobi, Athi River and near key transport infrastructures such as SGR, ongoing Expressway and JKIA airport (James, 2014). The main focus of the study is to determine how non-motorized transport interacts and conflicts with urban land uses including contested urban areas. The research will outline the effects and impacts of effective NMT in influencing business environment.

1.6. Justification for Study

Various urban road infrastructure and facilities designs in Kitengela targets and favors vehicular mobility, with little attention given to the NMT. Walking and cycling is an environmentally friendly, cheap, efficient and effective mode of transport in urban streets. Non- Motorized Transport (NMT) remains a the most viable option as a connectivity to urban transport. Cycling and walking reduces private vehicle traffic which leads to green urban transport system. This focuses on the opportunity to determine NMT (cycling and walking) interactions with urban land uses and contested urban spaces as part of Urban Mobility within Kitengela. Strategic Improvement of non-motorized transport will open access to all population, ensuring safe mobility and improving living standards which is a major concern for Urban and Town Planners.

Despite Kitengela Town undergoing land fragmentation from a group ranch (in 1988) to the current urban center, there is no proper planning which has been done to cater for NMT. The town which begun as a group ranch (Kitengela group ranch) with a span of about 18,292 hectares which was further subdivided in 1988 by the Kenyan Government to increase land

ownership and commercialization of livestock production. After subdivision, land fragmentation and further subdivision was done at a faster rate due to demand of space from neighboring towns such as Nairobi City since land was affordable. Kitengela's strategic location along an international road (Nairobi-Arusha Road) has made it a hub for business and residential homes for middle class.

Population in Kitengela Township has doubled in the last 10 years from 17,347 in 1999 to 58,167 in 2009 and 147,097 in 2019 (KNBS, 2019). This rapid growth combined with inadequate NMT facilities and emergence of urban land use demand is severely constrained. Promoting motorized transport is an expensive venture due to un-availability of resources such as inadequate right of way, high rate of capital involved and high cost of vehicles that's out of reach by many households. As town and urban planners, there is need to improve on mobility of residents so that they help in building the economy of the town. This will be achieved by promoting NMT.

1.7. Definition of Terms

Non-Motorised Transport (NMT) - Non-Motorised Transportation, better known by its acronym NMT, means far more than simply walking and cycling in Kenyan context. It encompasses a wide array of people on streets riding in cycle, pulling handcarts, selling wares on vending carts, riding handicap tricycles and bullock carts.

Assessment – It's an evaluation process where a researcher or student or a manager defines, select, design, collect, analyze and interpret using available information on a physical phenomenon.

Interaction - Interaction is a kind of action that occurs as two or more objects have an effect upon one another.

Land Use Conflict – Land use conflicts are caused by increase in population which creates demand for land uses thus causing negative impacts on other land uses.

Urban Land Use - It comprises various activities that are found in urban areas such as residential homes, commercial shops, public space, transportation space among others

2. LITERATURE REVIEW

2.1. Introduction

It covers theories related to the study, the understanding of NMT, modes and facilities, Urban land uses, Interaction of NMT with land uses, planning interventions related to NMT, Institutional and legal Framework. The conceptual framework is also illustrated. This will help in identifying information gap and deeper understanding of NMT as mode of transport.

2.2. Theories Related to the Research

2.2.1. Smart growth theory

Smart growth theory focuses on growth in high density areas to promote walking and cycling to avoid sprawl. It advocates for a more walking and cycling land use. This forms of walking and cycling include; school going children, Street shopping, and high- and low-density housing developments. (Shrivastava & Sharma, 2012). The theory can be used in understanding mixed land uses, compact designs that include open spaces, preserve open spaces, enhance walkable neighborhoods and create attractive community. This theory is relevant in the case study of Kitengela in terms of NMT interactions with urban land uses that create a more compact, lovable and attractive environment with open spaces.

2.2.2. New urbanism theory

The theory advocates for diversity of land use in urban areas and it originated in the 19th century. As discussed by Talen, the idea of diversifying different housing types was driven by the idea that social diversification leads to equitable access to resources and development of social diversity (Talen, 2010). New urbanism was started by architects and town planners (Knaap & Talen, 2005).

The New Urbanism theory encompasses walkability in neighborhood to be within few min walk from home and work by offering enough space streets free from cars in special cases. Better connectivity ensures less congestion and less traffic congestion that means less driving. It emphasizes on pedestrian safety and creating ownership. The theory is relevant in that it acts a pillar of NMT planning in Urban areas in relation to neighborhoods.

2.2.3. Pedestrian mall theory

Zegeer on his book which he published in 1997 defined a pedestrian mall as urban spaces that are reserved for pedestrians and vehicular movement is highly restricted with exception of emergency vehicles such as ambulances. The only vehicles allowed are delivery, waste removal and emergency vehicles. Aecom and others argued that this theory will help shoppers within urban areas to shop with a lot of comfort and safety. They further argued that the streets are well connected to public transport system and near parking lots (Aecom et al, 2011).

The theory summarizes need for access in public spaces by walking, cycling, using public transportation or private vehicle. Pedestrian zones are well located and able to accommodate effective uses and comfort. Comfort includes how safe people are from natural and human interferences. A number of design considerations must be taken into account creating public space that include physical form and amenities within a public space that are essential or pedestrians

This theory will be the pillar of re-organizing the urban street and major highways by limiting some streets to NMT only and thus blocking use of Motorized transport. This ensures safe, reliable and all weather NMT facilities to be constructed along the urban streets. Example is Luthuli Avenue in Nairobi CBD where motorists are not allowed along the street. This has helped to improve business along the busy street.

2.3. Non-Motorised Transport (NMT)

Non-Motorised Transportation, better known by its acronym NMT, means far more than simply walking and cycling in Kenyan context. It encompasses a wide array of people on streets riding in cycle, pulling handcarts, selling wares on vending carts, riding handicap tricycles and bullock carts. All of these modes conflict with a number of motorised modes on urban roads, which lead to unsafe and congested conditions. Litman in his research mentioned that NMT forms an integral and crucial component of efficient transport system. The significance of an efficient NMT transport system is dynamic as it varies over time from place to place. NMT is one of the most efficient modes of travel in that its cheap and eco-friendly with less emissions.

Research carried out by Victoria Transport Policy Institute (VTPI) found that NMT improves neighborhood living standards and urban areas free of emissions. NMT provide physical exercise that leads to good health. Despite the fact that NMT is cheap, offers physical exercise, and the most efficient mode of transport, walking and cyclin offers a linkage between homes and public transport system, bus stations, railway stations, airports and other modes (VTPI, 2007). NMT is a vital link in urban mobility but there is no much development in terms of making it a reality. Various surveys conducted found out 2% of trips generated are only walking and cycling, which means improving NMT as a mode will not solve transport problems. However, those surveys did not take care of Non-Motorised Transport trips such as school children, leisure walks and shopping.

Master transport plans takes into consideration the use of vehicles in mobility and accessibility and ignores the need for walking and cycling. This is achieved by considering the time taken to reach destination as compared to other factors such as congestion, cost of purchasing cars and emissions rather the value walking and cycling bring in terms of health, less cost and livelihood. (Litman, 2003). This assumptions has led to flaw in planning decisions at expense of walking and cycling. This can be justified by various ongoing expansion of roads such as bypass, expressways and parking lots to increase vehicle traffic and speeds thus neglecting need to improve walking and cycling lanes and accessibility. The stigmatization of walking and cycling is outdated and it's regarded a sign of poverty in developed countries. (Litman, 2003).

2.3.1. Non-Motorised Transport Modes

1. Walking

As per Schnact & Unnithan, walking is very common mode of transport since 18th century but its under-utilized. 'Pedestrian' is the term used describe those who practice walking as a mode of transport. Pedestrians are rarely are neglected in transport systems unlike motorized transport. Transport planning as much as it recognizes walking as a personal choice, it does not take care of trip generation and interlinks to other modes (Schnact & Unnithan, 1991).

In a transport system, walking as a travel mode is basically a personal choice and risks such as road safety, weather conditions, security and vulnerability to conflicts from motorized

transport. Time and energy are a major factor to consider when a person walks. Personal security is a major factor in streetscape design and activity levels in largely pedestrian areas, and a very real factor for many groups in the community. These include children, young women and the elderly. Pedestrian activity in mall areas is undertaken for a number of reasons, including shopping, exercise and sociability. However, the feeling of personal security is an important element in this process (Schnact & Unnithan, 1991).

Shopping is the major contributor of walking largely that people buy and not vehicles. This is evident in areas where streets are closed for motorists to encourage walking. The 1986 ORS Study showed that shopping was second only to travel to work as far as walking is concerned. Shopping takes 57% of males who walk and 157% for women category. Walking is a major transport mode, of crucial importance to several large groups in the community. It is not clear who is responsible for the planning and provision of services to these groups, and by default it is the road safety area that has paid most attention.

There are many reasons for enhancing walking trips made. Rising traffic congestion, better use of public transport and more effective parking space utilization have now been joined by international agreements to reduce the levels of motor vehicle emissions. These are reasons for encouraging a shift from motorised to non-motorised movements.

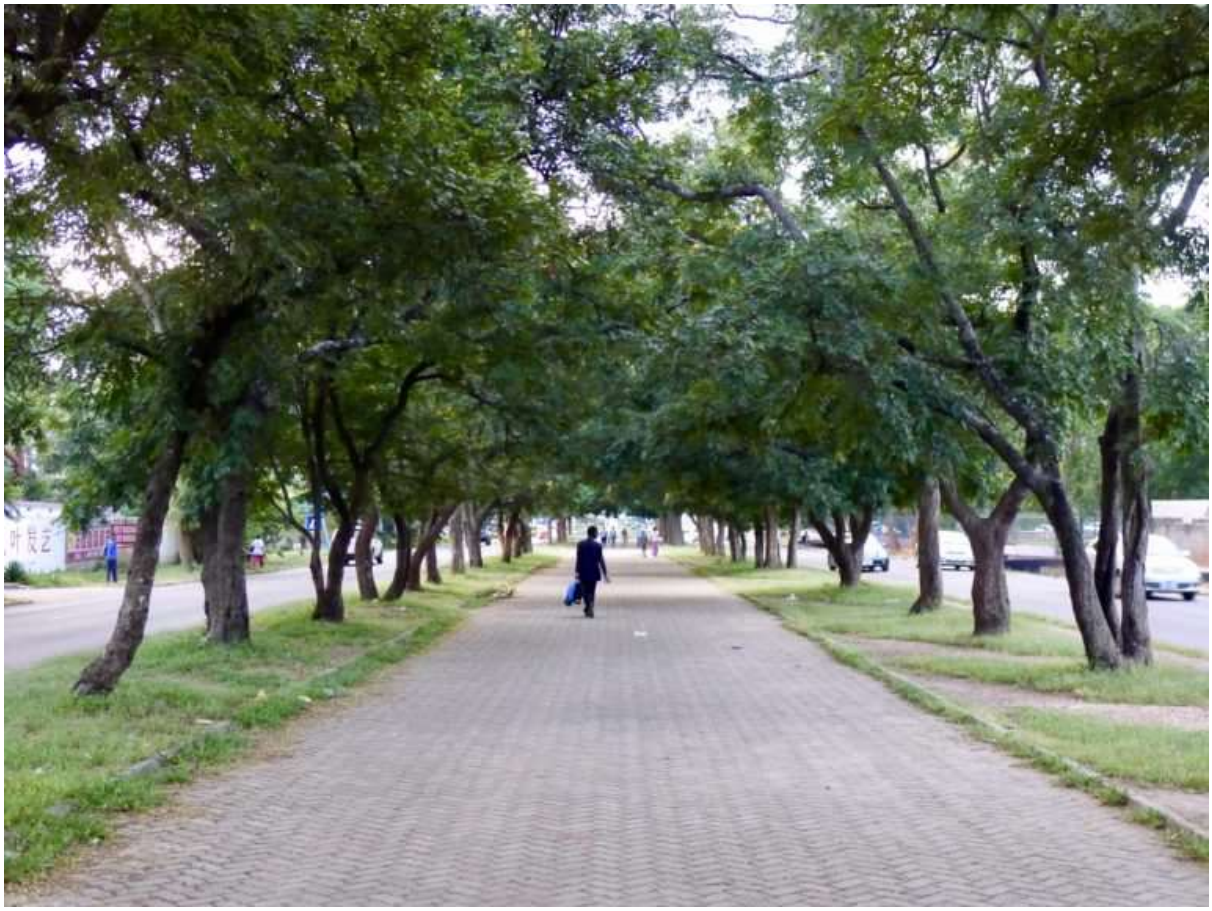


Photo 1 A median walkway in Lusaka, Zambia. (Source: ITDP Africa)

2. Cycling

This is the use of bicycle for mobility such as recreational or sport activities. Cycling has been in existence right from 19th Century. The significance of cycling is associated with good health and physical fitness as per research done by WHO. World Health Organization (WHO), did research that shows having regular physical exercise is more important since lack of it is second to use of Nicotine which is very harmful by creating cancer and heart diseases. This clearly shows that Cycling is a benefit to the health of people.

Statistics from the Department of Transportation show that, per billion kilometers travelled, pedestrians are killed more than cyclists and this statics does not make cycling nor walking a dangerous activity. Normal cases, cycling in painted lanes feels more comfortable but research done by Sally Watson shows that it's not safer either. In his article, he stressed that cycling infrastructure should be integrated in urban mobility for all population regardless

of current statistics of those who cycle which is 3% (Watson 2019). Some developed countries have prioritized cycling safety by dedicating their lane and protecting them from vehicle encroachments.

3. Pulling Handcarts

Handcart transport is undertaken in major urban centres of Kenya and more so in Nairobi playing a dual role in the efficient functioning of the city. As a source of employment for its operators it directly and indirectly provides livelihood thus should be well planned. It links numerous and diverse activities to the business environment, hence supplementing the role of other transport modes, notably, motorised transport. In spite of its significant role and persistence as a ubiquitous economic activity in many urban centres of Kenya, no planning interventions has been done to accommodate cart pullers. There is therefore there need for a comprehensive and systematic planning to sustain handcart transport activity in urban areas

4. Bullock Carts.

As per educalingo, A bullock cart is pulled by oxen or donkey. This mode of transport can be traced back to 18th century and BC (Before Christ) when Jesus Rode on Donkey. To date, they are found in some urban areas such as Kitengela township where they are used by water vendors to transport water to various users. This mode of NMT has been used by women in various parts of Kenya and in some urban areas, bullock carts are used to ferry water form one point to another. Kitengela being basically in Maasai land, use of donkeys as bullock carts is evident thus planning for such NMT is basically a role of Town planners.

2.3.2. Non-Motorised Transport Facilities

As per report dated 2013 by DTTS, the first thing before promoting NMT is by having effective facilities. NMT facilities are efficient and shortens route for journeys, trip generated and are majorly constructed along the road. These facilities consist of footpaths, paved walkways and bicycle lanes. The natural vegetation and medians should be maintained to offer aesthetics, safe and secure environment. Lighting should be provided at night along NMT facilities along roads and streets to improve security. (DTTS, 2013)

1. Non-Motorised Transport along Roads

The journey starts and ends with walking regardless of the other mode of transport such as private and public transport and thus a good NMT is very vital for such trips. Motorized transport is characterized by high traffic for long distances there is need for freeways and highways that forms transport mobility corridor thus excluding NMT from using such corridors. NMT are forced to share motorized corridors thus creating more conflicts and safety issues. It is important to integrate NMT in urban and major corridors without compromising on safety of the users. Most NMT facilities are provided within the right of way of all roads where NMT users are significant (NDoT, 2015).

2. Pedestrian Facilities

These facilities include footpaths, foot bridges due to low costs and recreational facilities such as parks. Pedestrians are important as they interact with nearby land uses such as commercial and residential activities. Pedestrian facilities such as parks, act as recreational destination for users and forms as an attractive link for NMT routes. (NDoT, 2015). Various components of Pedestrian Facilities include;

a) Pedestrian Crossing Facilities

Pedestrian crossing is the most dangerous part of the journey according to the research done by Vanderscherun and Galaria in 2003 and Beherens in 2005. These facilities thus are very crucial in the NMT routes to be safe and efficient. Siting dynamics of these facilities focuses on location and their design to meet the pedestrian needs as per existing urban environment.

i. Grade Crossing Facilities

These facilities are cheaper and easy to design and aligned to the urban streets. They are important as they the key components that regulate motorists' speeds by giving pedestrians the priority to cross first. Examples of such facilities include;

- Zebra crossing and rumble strips
- Signalized traffic lights with zebra crossing
- Calming infrastructure such as slow bumps and traffic lights

ii. Elevated Crossing Facilities

These facilities are very important where the design speeds are high for vehicles or there is a one-way traffic lane that may pose danger to pedestrians. Elevated crossings facilities for pedestrians include foot bridges and tunnels. Pedestrian bridges allow pedestrians to cross motorized traffic by raising the bridge and offering ramps for wheel chaired pedestrians and stair cases for other pedestrians. Where the road is raised, tunnels are used for the same purpose.

b) Pedestrian Link Facilities

These facilities are very important since they act as a link between various origins and destinations and also crossing facilities. They are design to offer comfortable, convenient and safer mobility. They are characterized by security lighting at night, standard surfacing such as cabros and tarmac, adequate safety, street furniture, trees for aesthetics thus becoming a key route for pedestrians. These link facilities connect various important areas such as schools, parks, sport arenas, bus stations, hospitals and shopping areas. The major aim is to offer seamless mobility and access from other modes of transport and land uses.

c) Pedestrian Amenities

These are facilities that assist pedestrians offer a humble space for resting during the journey. They include; street furniture's like benches and shelter shades in bus and railway stations that protect pedestrians from extreme weather conditions. In this list is recreational places such as people parks that offer various ranging activities with well manned grass, trees, swimming pool, vendors and photography.

3. Cycling Facilities

These are facilities that are specifically designed and implemented for cyclists. They offer free moving lanes that is free of vehicular encroachment thus offering safety and minimize conflicts between pedestrians and motorists. They create a well linked routes and well network of corridor free of encroachments and surrounded by green areas. At night, there is installed street lights that ensure safety of users.

a) Cycling Crossing Facilities

These facilities are categorized at grade/intersections or elevated ones such as cycle tunnels. Most designs should override motorists over NMT however, NMT facilities and cycling cross facilities are overlooked thus causing accidents during crossing. Cyclists re forced to use motorists' lanes and they cluster behind the vehicles which causes blind spots that pose danger to the users. These facilities help cyclists to cross at intersections and by changing directions such as;

- Cycle crossing points
- Tunnels where roads are raised
- Signalized intersection
- Intelligent transport systems that give cyclists priority

b) Cycling Link Facilities

These are link facilities that offer a higher speed than pedestrian link facilities thus linking the cyclists with other important origins and destinations. Should the cyclists get punctures, these is ample and safe lanes for repairs free of pedestrians and motor vehicles by ensuring a continuous lane that offer efficiency and mobility.

2.3.3. Non-Motorised Transport in developing countries

In Kenya, walking is the most used means of transport in rural areas and some urban areas followed by public transport in urban areas. NMT is integral to transport system, in that it acts as a connectivity and a link to public transport system. Better planning systems and integrated plans reduces trip distances thus improving cycling among the users. As per various research, cyclists and pedestrians are forced to walk to cycle by prevailing circumstances.

NTM benefits range from safety to clean environment mode. Planning for NMT increases safety for elderly and young people who act as vulnerable group, as they are prone vehicle conflicts that lead to accidents. As per study done, these accidents often are associated when pedestrian's cross busy roads where there is no proper signalization or crossing facilities. NMT users tend to neglect use of bridges since it is perceived long and tiring thus, they tend

to cross the roads despite safety challenges. NMT safety planning parameters include slow bumps and zebra crossing which reduces vehicular speeds thus reducing accidents.

Economic advantages of NMT economically are neglected and assumptions are made in regard to motorized transport. Improved NMT infrastructure and amenities in commercial and urban areas brings customers closer to their business thus more volume of sales and increase in value of land. NMT despite the challenges, is the most eco-friendly mode of travel. They do not pollute the environment as compared to the vehicles which release toxic emission. Cycling and walking is a form of exercise protect users from respiratory diseases. People who walk or cycle to work has options in their travel rather using a car which helps in exercise and emissions.

2.3.4. Demurrals and opportunities of Non-Motorized Transport

The economic and efficiency viability of non-motorized transport is crucial trip generation that's People begins and ends with walking or cycling. NMT opportunities include; The health improvements from physical activity involved, reduces respiratory diseases such as stroke and heart diseases, and improve quality of life among users. Many trips daily are less than five kilometers, yet 72% use vehicles instead. Article written by Jeroen (2009) discusses about cycling and walking as options that bypass traffic congestion and its faster than cars in such scenario.

Research that was conducted by department of transport in UK (2008) shows investing and operating a motor vehicle is expensive about Ksh One Million a year as compared to average of Ksh12000 of owning and operating a bicycle. This a whooping 98% percent savings. The research makes walking and bicycling as options of saving costs. The promotion of bicycling and walking has improved mobility of the poor and the rich in in urban areas. NMT increases ownership in older age, and young people who has no options of driving. Study done by Ministry of Transportation in Canada (2005) indicates that cycling and walking have a huge influence on livability of an area by creating a safer place for people to live and work.

As per Harris and Goodwin 2003, 85% of in the world uses fossil fuels for energy. The World oil exploration and prices will soar by year 2030 as by Campel 1998 and MacKenzie in 1996 research. The major global warming agents are the burning of fossil fuels due to

increased vehicles. The emissions-induced global warming has caused reduced crop yields, extreme weather such as high temperatures, decreased water availability such as drained springs, flooding in polar regions and diseases (Harris et al, 2003).

Despite the positive rationale of cycling and walking, there is also negative impacts. They include frequent accidents which involve pedestrians and cyclists. Most pedestrian accidents occur when pedestrians cross and there are no special crossing facilities or walking and they get hit by vehicles. Report done by World Bank in 2002 indicates that cities in Africa lack street lighting, scarce NMT furniture and infrastructure that lead to safety issues.

2.4. Urban Land Use

As per British Broadcasting Corporation Bitesize, Urban areas are made up of; land use types and level of spatial distribution of those land uses. The nature of land use is attributed by the activities that are taking place within given area whereas spatial accumulation is associated compactness and intensity of land use. Central areas such as commercial areas have a high spatial accumulation as compared to outskirts of the town. Land use has a set of activities for example, commercial land use involves interaction between customers and retailers while relationships deal with mobility of people, goods and services. Urban areas are dynamic in that there is a lot of movements of people in and out of the area. This is characterized by high-rise of building within a given time. This is well demonstrated using Concentric zone land use model

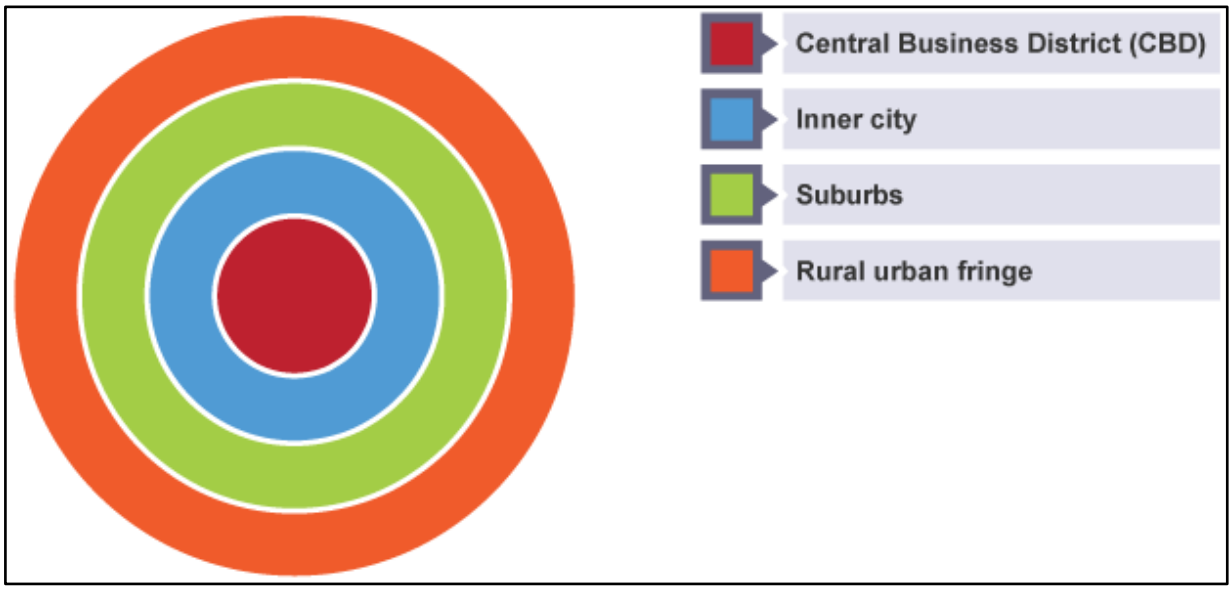


Figure 1 Urban Land Use Model, Source; Bitesize

2.4.1. The CBD (Central business district)

The land in urban areas is used for many different purposes:

- Leisure and recreation facilities such as parks
- Low, Medium and High Residential land uses
- Transport Network of various modes
- Commercial, offices, shops and banks
- Industry such as factories, warehouses and other light industries.
- Public Utility - goods or services that are essential, like water, electricity and sewer lines
- Public Purpose – Police station, Government offices

A CBD is characterized by the following:

- High rise commercial and residential areas
- Increased and ballooning land values
- Shopping malls and pedestrian routes, parking lots
- Old historic buildings, museums and libraries
- Offices, finance, banks, administration, town hall
- Bus and railway stations, airports and taxi

2.4.2. The inner city

The inner-city is a zone of urban area that is characterized by industrial centers and their housing scheme. It's the zone after CBD and has a higher demand for workers who are employed in various industries and factories. The current 21st century has improved the inner-city to Highrise building to cater for demands for space and majority of land uses has been replanned.

2.4.3. Suburbs

Suburban is a zone after inner city and the quality of houses is higher and larger than those in inner-city. They are characterized by well-planned roads and land uses, with bungalows and mansions, cheaper land prices as compared to inner-city and CBD, presence of schools, churches, parks and hospitals and also some shopping malls. The Suburbs house middle class who usually visit CBD using available modes of transport such as road and railway.

2.4.4. The urban-rural fringe

The urban-rural fringe is the zone after suburbs where urban area ends ad rural area begins. It is characterized by airports such as JKIA, golf clubs, low density housing, business parks and some hotels. The is no controlled developments within the zone thus users' conflict with others due to various needs.

2.5. Non-Motorised Transport and Urban Land Use

2.5.1. Interactions with Urban Land Use

NMT especially pedestrians start their journey from residential land uses and uses transport land uses for mobility. Along the routes, they interact with various land uses such as recreational and public purpose then finally commercial areas where they act as the key users and customers for business in buying goods and services. Reducing the allocated space for roads and parking improves NMT interactions with various land uses as discussed by Bryant (2005). In his research, he stated that residential houses near towns and industries reduces time travel, costs and encourage NMT as opposed to Motorized transport. It also encourages commercial activities such as food vendors and shops that improving economic income of the people around it.

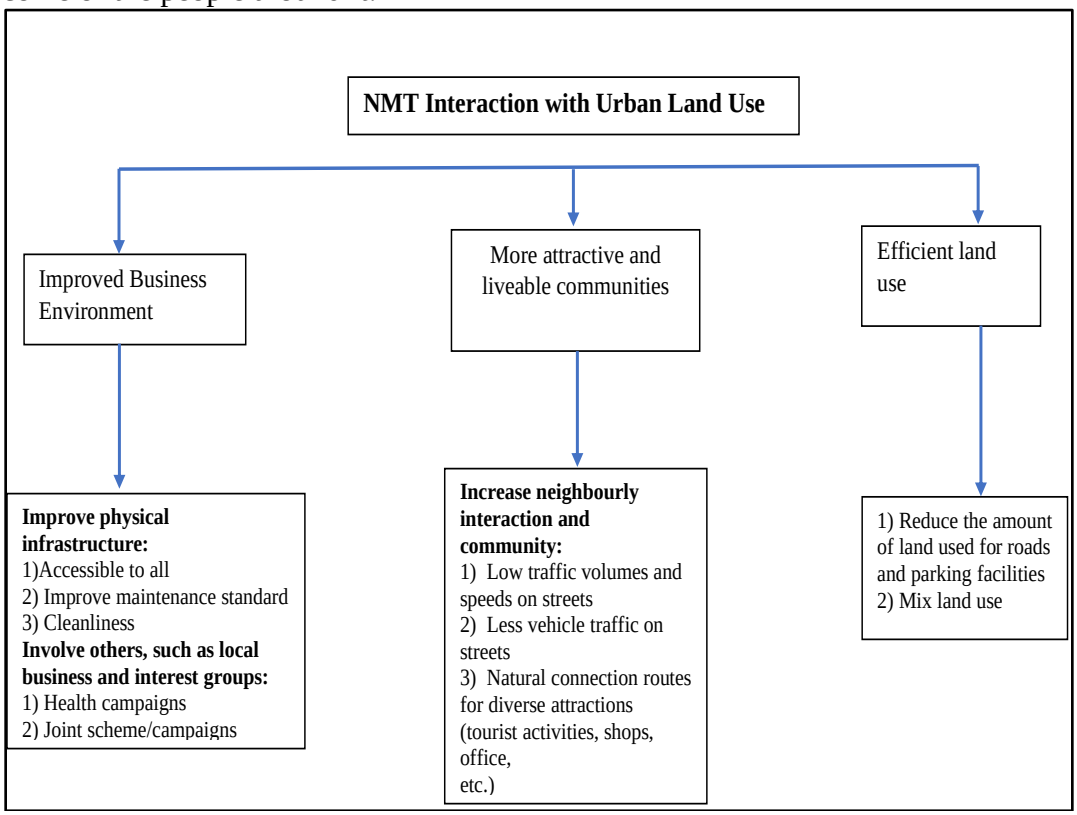


Figure 2 NMT Interaction with Urban Land Use, Source; Author Construction

2.5.2. Conflicts with Urban Land use

Key conflicts between NMT and land uses are;

- Contested Urban Spaces
- Encroachment to NMT facilities routes
- Un-planned urban design (buildings and public realm) that do not follow building lines and setbacks
- Too much land for roads and parking
- Blocked Urban Spaces

2.6. Non-Motorised Transport planning interventions

There are many specific ways to improve non-motorised transport:

- Construct and rehabilitate crossing and link facilities such as footpaths and cycle tracks.
- Protect NMT routes from vehicular traffic by creating a buffer.
- Design for pedestrians with disabilities and special needs.
- Integrate NMT by developing Land Use Oriented to walking and cycling.
- Improve road designs to include pedestrian facilities.
- Construct and rehabilitate NMT amenities such as street furniture and street lights.

2.7. Policy Framework

2.7.1. Sustainable Development Goals (SDGs)

Sustainable development ensures that there is a sustainable transport system. Sustainable Development Goals (SDGs) has a direct influence to urban transport mobility. Urban mobility has been focusing on motorized transport by investing in wider roads and investing heavily which has led to neglect of NMT as far as walking and cycling is concerned. NMT as an eco-friendly mode has been integral in ensuring a sustainable urban growth. It improves accessibility and improve health of users. SDGs goals in achieving carbon free world has led to more advocacy in NMT as an eco-friendly mode as compared to Motorized Transport that emit poisonous gases.

2.7.2. New Urban Agenda

New Urban Agenda is a structure that guides how cities should are planned and managed to promote urban sustainability. It represents vision for a better and more sustainable future by giving opportunities and equal rights to all in accessing opportunities and benefits in various sectors including urban planning. It recognizes their relation between urbanization and development of urban areas by providing linkage between goods, services, livelihood and improved life by implementing policies and strategies.

2.7.3. Africa Agenda 2063

It aims at having Africa with inclusive growth and sustainable development. The policy framework delivers efficient transport at all levels. This is an agenda of African States and as they develop and targets their Agenda of 2063.

2.7.4. National Urban Development Policy (NUP)

A national urban policy (NUP) concentrates on the need for sustainable urbanization which addresses need for various human settlements from rural areas to urban areas. This is guided by development framework and national urban policies to support development and improving urban policies.

2.7.5. Integrated National Transport Policy

The Integrated National Transport Policy (2012) appreciates the significance of NMT in addressing the needs of the less unfortunate in the society and it promotes a good living environment for the residents. The policy also involves transport policies that support motorized transport and neglect NMT in urban areas. The policy therefore recommends integration of NMT infrastructure in ensuring urban mobility.

2.8. Legal Framework

2.8.1. The Constitution of Kenya 2010

Under Article 10 The constitution advocates for human rights, equity, equality and protection of marginalized communities and human rights. The Bill of Rights article 39 ensures that all Kenyan citizens have rights of movement including those vulnerable among the population (young and elderly, persons with disability). Article 27 promotes equality and freedom by providing for equitable and universal access. The constitution mandates the national government to rehabilitate, construct and operate trunk and county roads. The constitution provides for establishment of County Government with integration of department for Roads and Transport for planning, maintenance of county roads, street lighting and parking facilities.

2.8.2. Kenya's Vision 2030

This policy provides a ground for formulation of the strategies for growth of Kenya into industrialization platform by ensuring good life to all its citizens by 2030. This can only be achieved if the needs of NMT users are met to facilitate mobility, accessibility, safety and security in the transport and infrastructure sector.

2.8.3. NTSA Act 2012

Although provides for road safety, however, has focused on the motorized road transport regulations. Yet in Section 4d stipulates that the NTSA is mandated to develop and implement road safety, educate the public and conduct research/audits on road safety. With these functions, the Act has been interpreted to focus more on the motorized transport and safety concerns are within the road motorized transport. The Act also provides for the NTSA to compile inspection reports relating to traffic accidents. These are key functions that if implemented with focus to protect the NMT users will enhance a shift in development and management of NMT facilities and infrastructure.

2.8.4. National Road Safety Action Plan 2018-2023

This is a policy that was discussed and validated in 2018 by stakeholders to come up with a National Road Safety plan of 2018-2023. This was to guide all state nations to develop and implement the road safety policies as a major measure to reduce road carnages. In Kenya, the policy is related to SDG's goal 3.6 and 11.2 which ensures the country is able develop the road safety goals. The policy also brought the issue of NMT as there is need to have safe and inclusive urban streets and develop a robust urban land use which integrates NMT infrastructure.

2.8.5. Traffic Act of 2015

This Act consolidates various rules and regulations on Kenyan roads which provide speed limits and penalties along major highways and urban areas. The Act, therefore, directs the Highway authorities to construct and rehabilitate traffic signs and speed limit signage. It also guides the authority to install signage and calming facilities near institutions such as schools and churches to have safe and adequate NMT facilities and prohibits driving on pedestrian walkways as a measure to protect the NMT users. However, the focus is more regulating, restricting or prohibiting motor vehicles on the traffic routes but does not give emphasis to promote the usability of the NMT facilities and infrastructure. Therefore, enforcement of usability and safety of NMT facilities is not given priority by traffic officers.

2.8.6. Street Adoption Act 1963 (Revised edition 2012)

The Act aims to regulate the construction and improvement of streets in particular local authority areas including Nairobi City County. It provides various user needs for individual municipality, town council and counties to have standard urban street network. It also guides on any intention for layout, form, construction and rehabilitate footpaths, road carriageway, landscaping, and other utilities to enhance the usability of the street.

2.8.7. The Highway Code

The highway code guides on NMT improvement to enhance safety and usability of NMT facilities. It ensures that all road users adhere to traffic signs and directions by traffic police. It also dictates that all pedestrians to cross at zebra crossing or use of footbridges provided rather at any point. It also provides for the safety gears for the cyclists such that they are advised to have their protective gears and reflective jackets. However, does not provide special signs for persons with disability such as talking traffic lights. Most signs are placed near walkways that block the persons on wheelchair to maneuver freely.

2.8.8. Kenya Road Act of 2007

This act gives guidelines to classify, manage, construct and rehabilitate various roads in Kenya. It led to establishment of Kenya National highways Authority (KeNHA), Kenya Urban Roads Authority (KURA) and Kenya Rural Roads Authority (KeRRA) and lists their functions. This is important in coordination and management of NMT facilities within the city given that they are developed by different agencies.

2.9. Overall Information Gap

Understanding of NMT and Urban Land Use interactions and conflicts in Kitengela Township miss out on essential public participation on need and demand for NMT township residents. The promotion of Motorized Transport in our culture has led to decline in usage of NMT. This research will bridge the gap and increase understanding among Kitengela residents on the importance of NMT facilities and infrastructure. The research will confirm the importance of having efficient NMT and its implications on various urban land uses for town residents in ensuring that not only mobility and accessibility that has been solved but also the improvement in ensuring safe neighborhoods, improved business environment and value of land uses.

It will also confirm the role of urban land uses in ensuring NMT infrastructure are well done. The study will also help to identify lack of NMT facilities and road safety as main issues with vehicular conflicts. The institutional framework for NMT is weak when it comes to walking as a mode of transportation, an activity that has always been taken for granted. Similarly, cycling has always been considered primarily a leisure activity. This will lead to having planning interventions in ensuring smooth and efficient NMT as it influences the land use environment.

2.10. Conceptual Framework

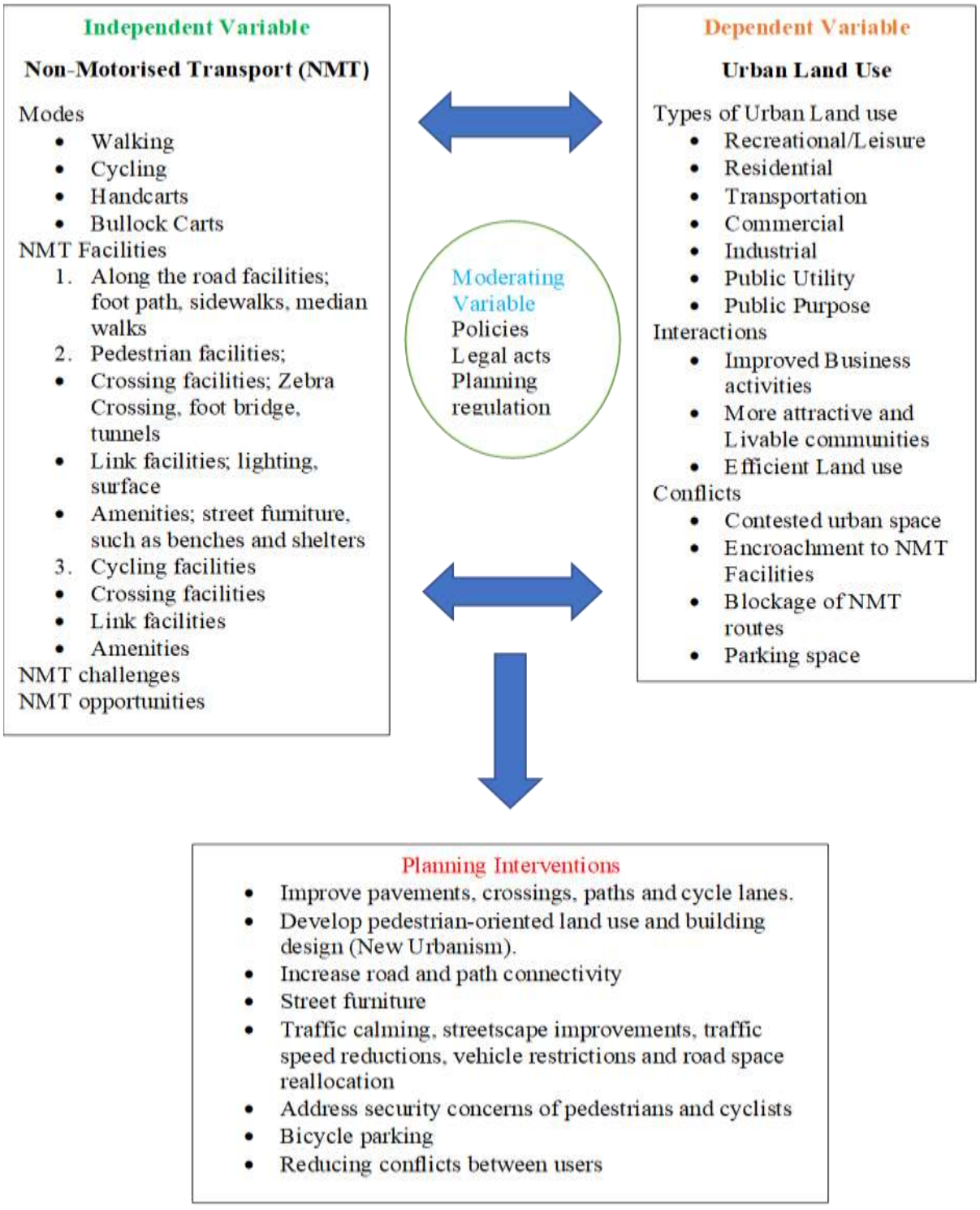


Figure 3 Conceptual Framework; Author's Creation

3. RESEARCH METHODOLOGY

3.1. Introduction

The chapter discusses research outline, targeted population, various methods of data collection, analysis and interpretation and also research instruments used.

3.2. Research Outline

Research outline provides a framework for collecting and analyzing data. The research will employ a non-experimental research method that used both qualitative and quantitative approaches. The research will follow all mandatory guidelines as follows.

- All correspondents were above 18 years.
- Face to face data collection was done and all respondents did wear a mask and kept social distance of at least one metre from research assistants.
- All data collection assistants followed Covid-19 protocols to ensure they are safe.
- Data collection was done between 8am to 5pm

3.3. Targeted Demographic

The research target population was selected based on the data needs of the research. Population was divided into strata for ease of data collection and analysis. Sampling was applied to obtain the desired target population due to its ability to: reduce cost of research; reduce time of study; cover wider scope; and it gives greater accuracy.

The first study population consisted of traders and business premises owners, road users, Cyclists and Cart Pullers. As per population census 2019, no data was given for population of mentioned strata thus the sampling was carried in equal respondents per strata. The second target population involved key informants from various sectors such as; KeNHA, KURA, County of Kajiado Transport and planning department, Kenya railways and academicians.

3.4. Data Frame

3.4.1. Sample Size

The research adopted Stratified random Sampling where target sample was grouped into 3 strata and each stratum had equal questionnaires and randomly sampled. The sample of 120 from respondents was administered to traders and business premises, road

users(pedestrians), cyclist, and cart pullers. Key informants were selected from KeNHA, County of Kajiado Transport and planning department, Kenya railways and academicians. Since the population of the area was large, the following formula was used.

$$\text{Necessary Sample Size} = \frac{(\text{Z-score})2 \times \text{StdDev} \times (1\text{-StdDev})}{(\text{margin of error})2}$$

Where;

Confidence level = 95%

Standard Deviation = 0.5

Margin error = 9%

Z-values of 95% = 1.96

Thus;

$$\text{Sample Size} = \frac{(1.96)2*0.5*0.5}{(0.09)2} = 118.567$$

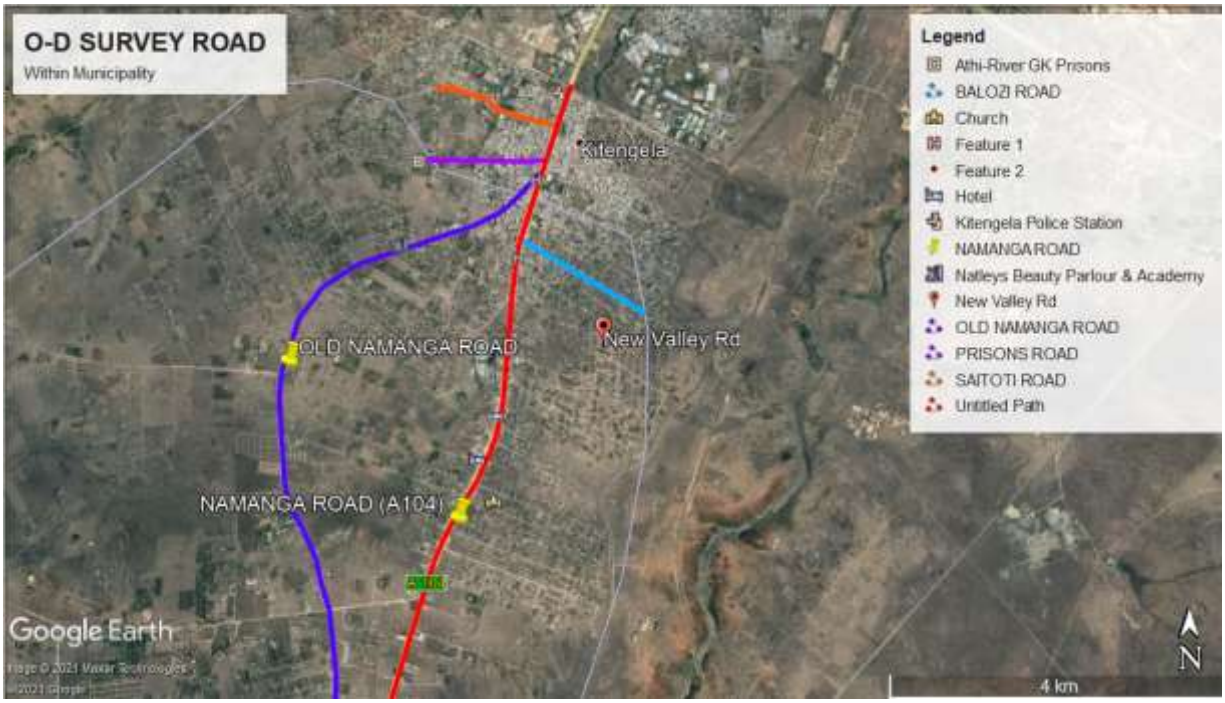
Sample size = 118.567 that is Approximately 120 questionnaires

The sample was then sampled into 3 strata (traders and business premises, road users, cyclists and motorists) 40 questionnaires from each stratum was randomly administered and distributed along 5 major roads and streets selected (Namanga, Old Namanga, Noorkopir, Prisons and Valley roads) each street/road getting at least 8 questionnaires from each stratum. Due to a lot of work involved, the research used trained assistants who happen to be university students to administer questionnaires.

Key informants from KeNHA, Kura, County of Kajiado Transport and planning department and Kenya railways were selected through purposive sampling that select the sample based on knowledge of the key informants. Online form was sent to each key informant and was filled and saved in google online forms.

3.4.2. Origin-Destinations (O-D) surveys

Five (5) roads were selected (Namanga road, Old Namanga, Saitoti, Kitengela Prisons and New valley Roads) that forms key arterials of the township. These roads are characterized by high rate of human and busy in business environment.



Map 1 Road Users Origin-Destinations (O-D) surveys location; Source own creation

3.5. Data Sources, Types and Collection Methods

The primary data was mined by administering questionnaires, field observations, key informants' interviews, taking photographs using a camera, GNNS data mining and digitization of RIMs. Secondary data was done using institutional, government and private sources such as magazines, internet and books

Type of Data	Data Needs for each variable	Data Sources	Collection Methods
	Modal Split	Field Survey	Questionnaire Administering
	O-D surveys	Field Survey	Questionnaire Administering

	Interaction with Land uses, improving business environment, conflict of NMT with land use	Field Survey	Questionnaire Administering
	Footpath Conditions and how they can be improved	Field Survey	Questionnaire Administering, field observations and taking photographs
	Demurrals and opportunities of NMT	Online Research and Interviews	Questionnaire Administering, field observations, key informants' interviews and taking
	NMT stakeholders	Online Research	Interviewing key informants and photography
	Mapping	Office Work	Global Positioning Systems (GPS) and Digitization
Secondary	Key players in NMT	Libraries, internet and journal	Internet, also reading the journals
	Mapping	Survey, Kajiado County, Ministry of	Kajiado Survey District and Ministry of Roads

Table 1 Data Sources, Types and Collection Methods; own source

3.5.1. Key Informants Interviews

Online key informants guide and questionnaires were administered to professionals from KeNHA, KURA, County of Kajiado Transport and planning department, Kenya railways and academicians. Online interviews were adopted du to outbreak of Corona and they helped in understanding the concept of designing urban areas as urban streets rather highways.

3.5.2. Field Observations and Taking Photographs

Study area walks for one week was carried out to document demurrals and growth of NMT and map existing facilities with their conditions. The photographs will be taken to document the existing facilities, their conditions and challenges they are facing the Kitengela township.

3.5.3. Secondary Data

The secondary data was extracted from government and private websites, academicians and researchers who has done research on non-Motorized transport, urban land use and transport planning and university respiratory website. Other sources of secondary data included Kajiado District Surveys and Kitengela Development plans from ministry of lands.

3.5.4. List of research instruments

- Traders/Business/NMT questionnaires
- Interview with key informants
- Field Observation
- Participatory transect walk
- Taking Photographs

3.5.5. Spatial Data

The research deployed use of maps and sketches that shows existing land uses and they interact with NMT in the township. Raw data and maps were collected from Kajiado lands office and PDP from County Government of Kajiado, Ministry of Roads and through GNSS observations. Use of ArcGIS and AutoCAD was used for processing.

3.6. Analysis of data

The data that was collected from field was grouped into;

1. Quantitative data- was analyzed using SPSS, Pie and bar charts and tables
2. Qualitative data- Was analyzed as per questions posed during interviews
3. Photographs were analyzed using Paint software
4. Spatial data was analyzed using maps and sketches

3.7. Interpretation of data

The research used software's such as Ms Excel and SPSS to analyze quantitative data. ArcGIS software was used to produce maps that were a representation of ground survey Pie and bar charts, tables and photographs were used to assess variables between land use and NMT within Kitengela Area. Further analysis was done by cross tabulation and excel. The research deployed use of Microsoft Word for reports word interpretations, recommendations and conclusions of the analysis.

3.8. Data Need Matrix

	OBJECTIVE	DATA NEEDS	DATA TYPES	DATA SOURCES	COLLECTION METHODS	ANALYSIS METHODS	PRESENATTION METHODS	EXPECTED OUTPUT
1	To assess the current NMT modes, facilities, challenges and opportunities in Kitengela	Facilities condition Design of streets challenges NMT modes Opportunities	• Qualitative. • Spatial data. • Descriptive data.	Field visit	Observation Questionnaires Mapping, Key informant guide	SPSS GIS mapping	Maps, Pie charts graphs and design	NMT Infrastructure map, Land use map
2	To assess the existing Urban Land Uses in Kitengela Township	Residential, Commercial, Public purpose, public utility, Industrial, recreational and transportation land uses	•Land use map	Document's review. Field visit	Analysis of land uses	ArcMap	Maps	Report and design Land Use Map
3	To investigate how NMT interacts and conflicts with Urban Land Uses	Interactions with NMT Conflicts with NMT	•Quantitative. • Qualitative. • Spatial data. • Descriptive data.	Document's review. Field visit	Observation form, use of Questionnaires interviews. Key informant guide	SPSS	Tables, illustrations, pie charts and graphs	Reports, Designs, urban land use map
4	To come up with NMT Planning Interventions in Urban Areas	Open spaces NMT facilities NMT furniture, Reducing conflicts, Increased Road path, Security of NMT Street Land Scaping etc	• Qualitative. • Spatial data. • Descriptive data.	Field Visit	Questionnaires interviews. Key informant guide	SPSS	Tables, illustrations, pie charts and graphs	Recommendations and strengths. Urban Street Design, Land use Maps

Table 2 Data Matrix; Owner creation

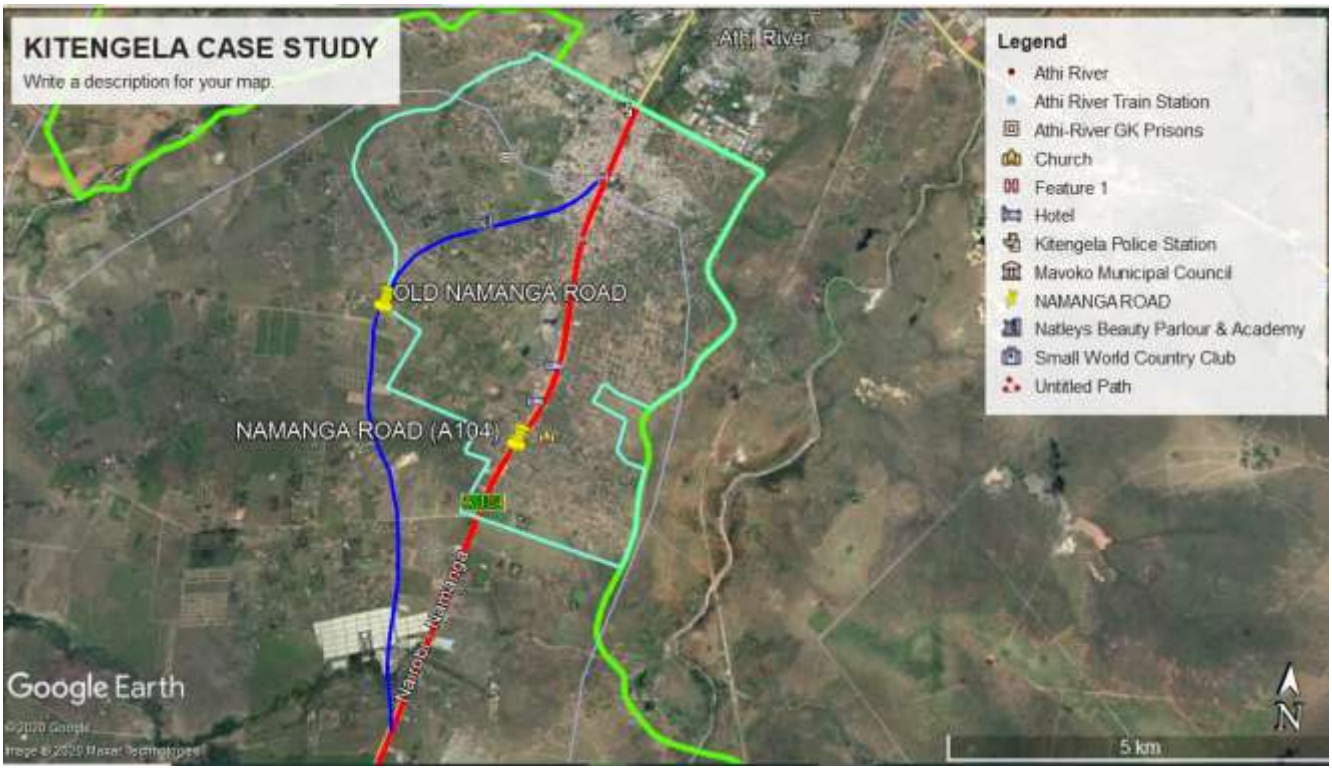
4. RESEARCH STUDY AREA

4.1. Introduction

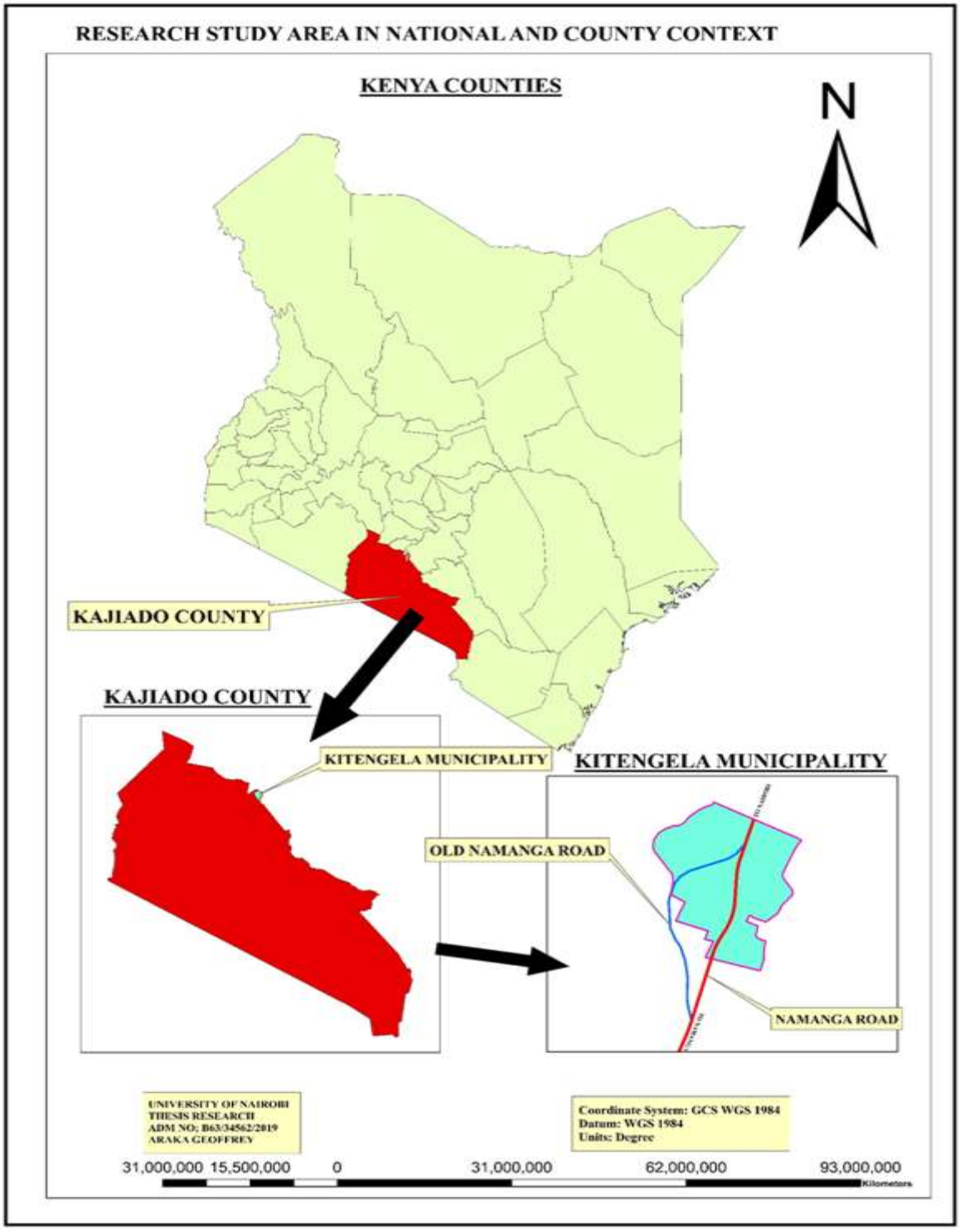
Various characteristics of the research area were discussed in this chapter such as Regional and local context, population statistics, climatic conditions, topography, hydrology, soils, social and physical infrastructure.

4.2. Regional, National and Local location

Kitengela Town is located in Africa as a continent, Kenya country in East Africa region which borders Uganda, Tanzania, South Sudan, Ethiopia and Somali. It is found in Kajiado County that borders Machakos, Nairobi, Makueni and Narok Counties and forms a major town with the entire County. The area of study is of fairly flat topography and sloping gradually towards the Athi River GK Prison and extends to main Kitengela- Namanga Highway. It can be accessed using Jomo Kenyatta Airport, Standard Gauge railway and through road via A104 that spans from Busia to Namanga.



Map 2 Google Earth Image of study area; Author's creation



Map 3 Research Study Area; Source Author creation

4.3. Population Statistics

Kitengela town is dominated by Maasai community since it was originally a Maasai ranch. Due to demand for space, migration from other towns has made Kitengela a cosmopolitan township with several tribes. Urbanization of the town has grown rapidly with growth of the town due to space demand. Early 1980's Establishment of Economic Processing Zone (EPZ) was a factor for industrialization of the town. KNBS data released shows that in 2019 population census, Kitengela has a population of 147,097. This is over triple digits that was released in 2009 that has 58,167 people. In 1999, there was 17,347 people and only 6,548 people in 1989 (GOK, 2001). Kitengela township has a total area of 89.19^{km2}, with about 1650 people per square kilometer.

Urban Centres	2009			2019		
	Male	Female	Total	Male	Femal	Total
Kitengela	30,088	28,079	58,167	71,793	75,300	147,097

Table 3 Population Comparisons; KNBS

4.4. Climatic Conditions

Climate changes affect transportation infrastructure through higher temperatures, storms and flooding. Storm surges affect the reliability and capacity of transportation systems. Climate change impacts increase the cost of the nation's transportation systems. As per Nairobi weather station, the climate in Kitengela is warm and temperate. The temperature has an average of 16.7 °C and 865mm for precipitation. The wet month as per weatherman is on April, November and December while driest month is depicted on July. The figures below present summary of climate data for Kitengela area.

Figure 4 Mean Monthly Rainfall; **Source: weather-and-climate.com 2016-Kitengela**

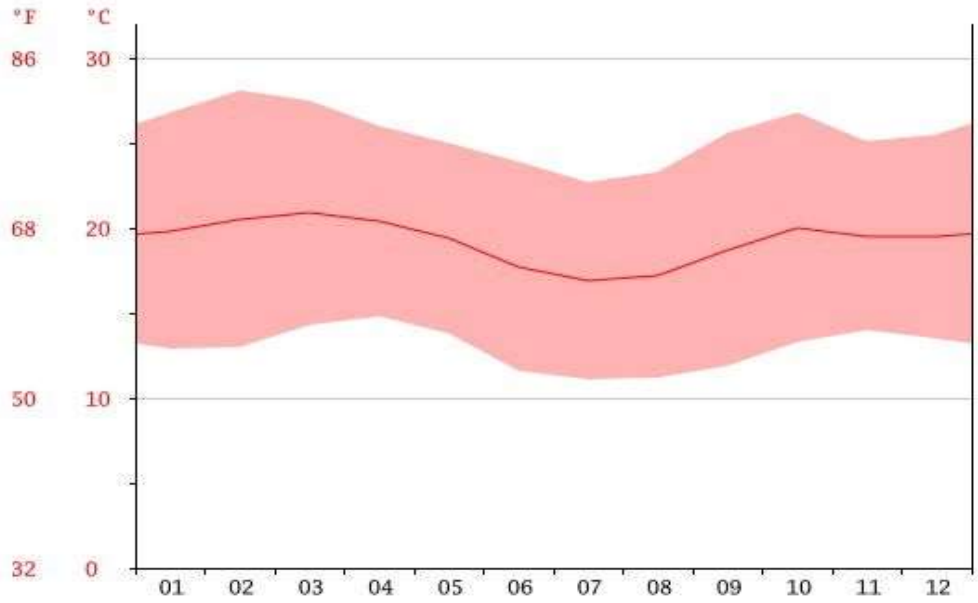
4.4.1. Rainfall

April is the most wet month followed by November with average of 865mm rainfall. June, July, August and September have the lowest precipitation.

4.4.2. Temperature

The hottest month is depicted on March as per the records obtained with an average of 20.9°C while the coldest month is on July with average temperature of 16.9 °C.

Figure 5 Mean Monthly Temperature; Source: weather-and-climate.com 2016-Kitengela



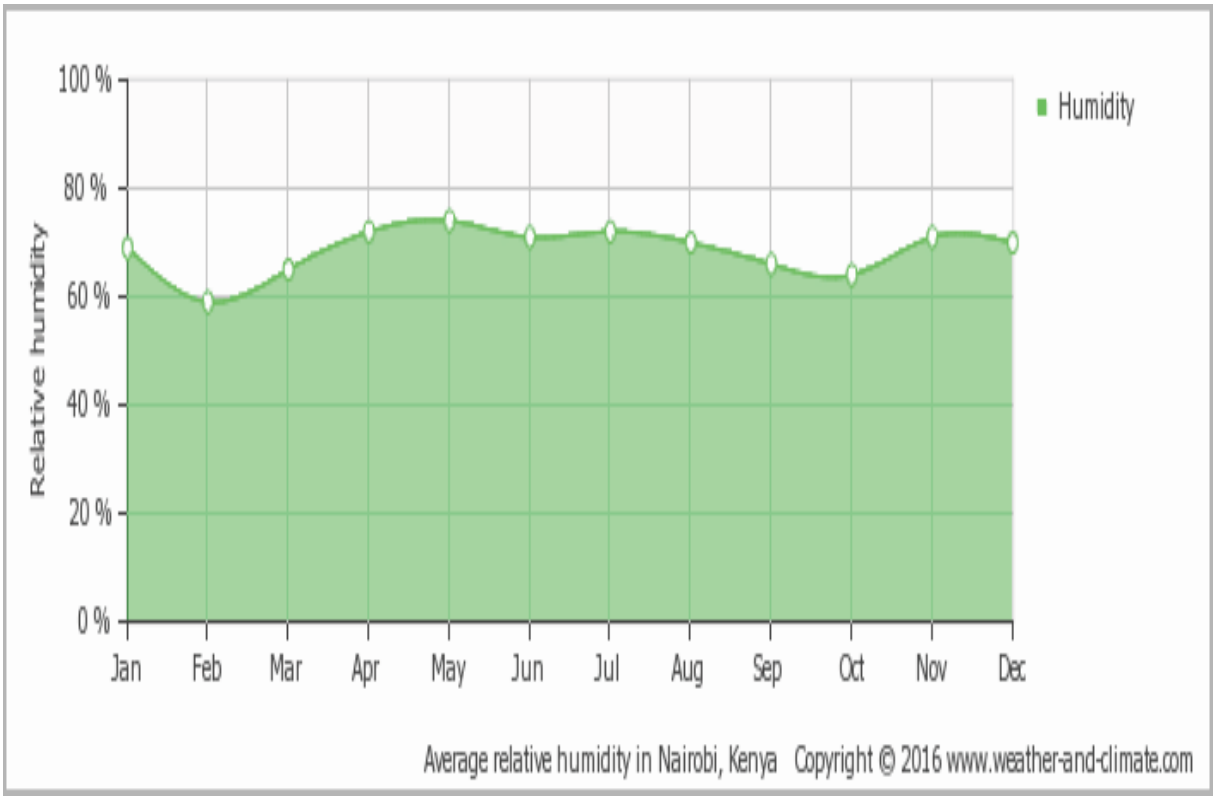


Figure 6 Average humidity over the year; Source: weather-and-climate.com 2016-Kitengela

4.5. Topography and Physiographic Features

Natural features influence the structure, cost and feasibility of transport network. Topography complicates, postpone and prevent transport activities such as hilly areas or swampy areas. Transportation networks are influenced by the topography, as highways and railways tend to be impeded by grades higher than 10% and 1%, respectively.

Research area is characterized by plains, valleys and hills that averages an elevation of 500 metres near Lake Magadi to about 2500 metres in Ngong Hills below sea level. The area has three regions namely Rift Valley, Athi Kapiti Plains and Central Broken Ground. The Rift Valley spans from North to South and forms the lowest part of the County. It is characterized by steep faults giving rise to plateau, scarps and structural plains that give rise to physical features like Mount Suswa and Lake Magadi where soda ash is exploited.

The Athi Kapiti Plains is characterized by gently undulating slopes and hills such as Ngong hills. The hills act as a source of water for River Athi which has its source from Mbagathi and Kiserian tributaries. Central Broken Ground spans for 20-70 kilometers wide from the north-eastern to the southwest.

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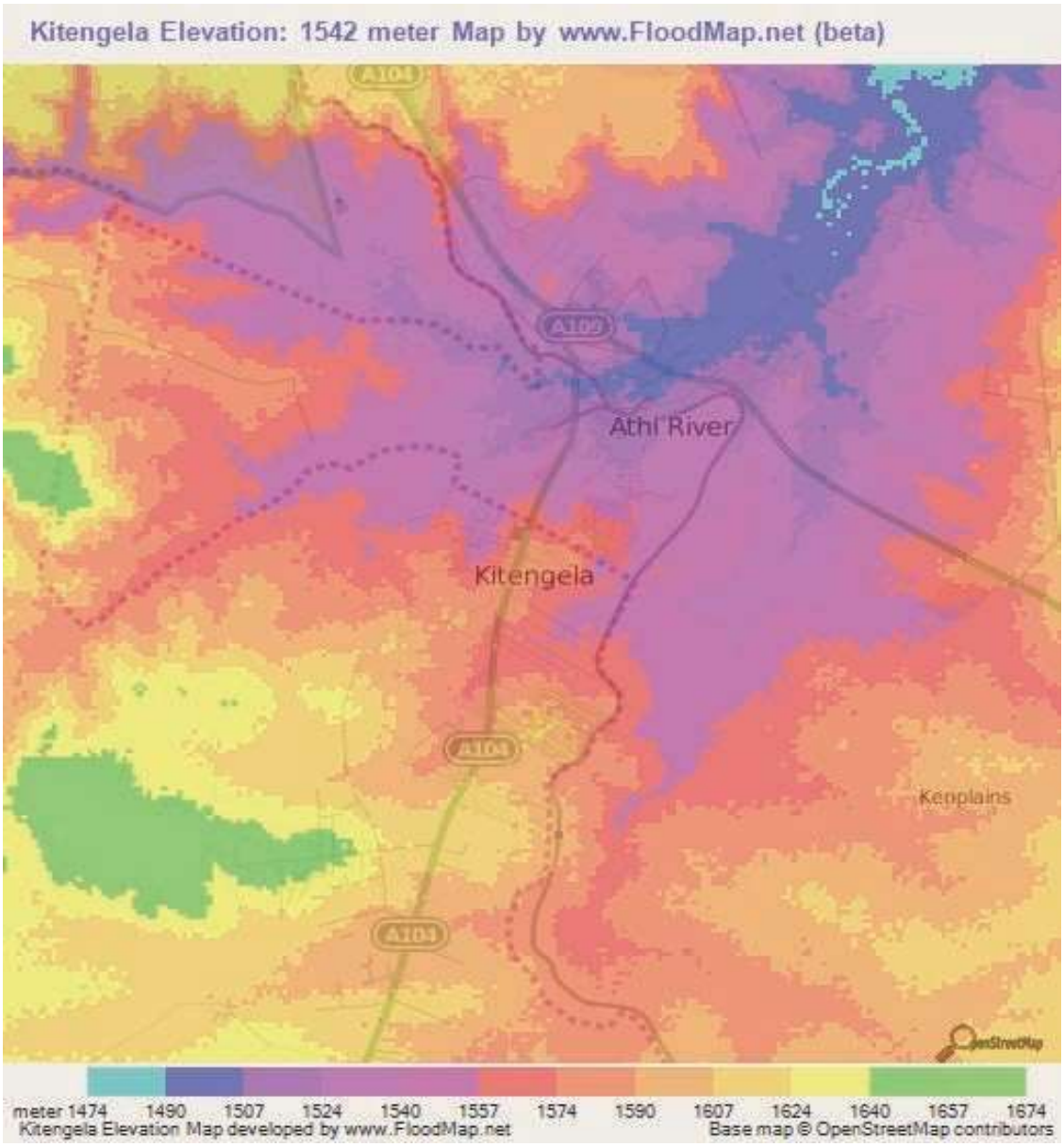


Figure 7 Elevation map of Kitengela; Source NASA

4.6. Hydrology

Water is life and it affects the distribution of important transport industry. Kitengela township has no perennial rivers and it is characterized by seasonal rivers that flood during rainy seasons. Water is mostly sourced from boreholes, Athi Water and Sewerage Company and from water vendors.

4.7. Geology and Soils

Geologically, Kitengela township lies at the rift valley basin and it's characterized by volcanic rocks consisting of sediments and Lake Beds, Athi Tuffs and Kapiti phonolite. The depth of the volcanics vary and decrease towards the south. Geotechnical carried out various firms shows that below it, there exist Mozambique Belt rocks that consist of Gneisses and Schist.

- Upper Athi Series
- Kapiti Phonolites

4.8. Economic and Social Characteristics

Efficient Transport network increases economic and social interactions of the given area. Economic benefits of an efficient transportation systems increase efficiency and capacity. Kitengela which was a group ranch in early 1980's has now been developed in a robust commercial and residential hub in the whole of Kajiado County which acts a source of revenue for National and County Governments

Urban to urban migration has been on rise as more people were looking for cheap and proximity land near capital city Nairobi. This led to relocation of people to Kitengela, Rongai, Ngong and Kiserian respectively. Expansion of Namanga Road in 2010 and Expansion of EPZ led to mobility and water to be easily accessible that led to growth of the town.

4.8.1. Local Economy

The economy of Kitengela is mainly through livestock farming from nearby large Maasai farms, horticulture from greenhouses within neighborhood and industries such as EPZ that provides employment to Kitengela residents. Mining and Quarrying has been evident due to to available raw materials characterized by quarry within the township that supply aggregates to the city and neighboring counties. Presence of malls and supermarkets, open air markets and small commercial shops and banks has led to the growth of trade within the township making it

attractive to residents. There are heavy large industries that manufacture steel products which offers employment and generate revenue.

Livestock farming is characterized by presence of grazing land and ready market Kenya Meat Commission for meat and milk for residents. Residents of Kitengela rear cattle, goats, sheep and donkeys. There is growth of real estate business characterized by high rise commercial and residential housing others in gated community which offers housing solutions within the township. There is presence of cement manufacturing industries such as Blue Triangle, Simba, Bamburi, Savana among others within the vicinity that offers employment locally

4.8.2. Social Infrastructure

There are various social facilities and infrastructure that include; educational, health religion, public space and institutions that create social welfare. There are several primary and secondary institutions within the township both private and public. A few examples are the famous Kitengela International School. and Kitengela Prisons Primary School. There are several private and public health facilities within the township such as Aga Khan Hospital, Meridian Hospital and Kitengela Medical. There exist several churches are for both Catholics and Protestants, mosques for Muslims and there no temple for Hindus. There is no public space for leisure and social halls

4.9. Physical Infrastructure

Kitengela Township joins Nakuru, Kisumu, Eldoret and among other towns that has a presence of a trunk rod that passes through them. Class A road (A104) that spans from Uganda border through Eldoret, Nakuru, Nairobi, Athi River, Kajiado and finally Namanga in Tanzania Border acts as a link of the town towards regional status. Its proximity to A2 road that connects to Mombasa Port makes Kitengela a hub to international trade. It’s also closed to Jomo Kenyatta Airport and Standard gauge railway line. Kitengela township is characterized with poor roads where only 38.4% of the roads are good and fair. Kitengela township, only one bus terminus is currently in use and already its overcrowded. There is no open or closed market thus most hawkers and traders sell along the right of way thus obstructing crucial NMT corridors. There is a TATA Chemicals railway line which is maintained by the same firm that connects Magadi Lake and Athi River terminus but there is no Terminus within Kitengela Township. The town has no proper sewerage services since each households uses septic tanks for effluent storage.

5. PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

5.1. Introduction

Data presentation and analysis are discussed in this chapter. Data included questionnaires targeting traders, road users (NMT) and cyclists, cart pullers, observation schedule and key informant's schedule. The quantitative data was analyzed using SPSS and analyzed using tables, pie and bar charts. Qualitative data was analyzed through question-based results.

5.2. Demographic Information

Research deployed one hundred and twenty questionnaires to randomly selected traders, road users and cyclists, motorists, cart pullers along Namanga road, Old Namanga road, Valley Road, Prisons Road and Noorkopir road in Kitengela and also held three focus discussions besides undertaking interviews with key informants who included Kenha officials, County planner, Minister of roads in County government of Kajiado among others.

5.2.1. Respondents Rate

As per table 5.1 below the respondent's rate was 94.17%. Out of the 120 administered questionnaire by research assistants, only 113 questionnaires were fully responded and analyzed only 5.83% was not fully responded and not analyzed.

Table 5. 1 Response Rate. (Source; Author 2021)

Response Rate	**Frequency**	**Percentage**
Responded	113	94.17%
No response	7	5.83%
Total	**120**	**100%**

5.2.2. Name of the road distribution

As indicated in the chart below the road distribution rate was 27.43% for Noorkopir Road, 21.24% for Prisons Road, 21.24% for Old Namanga Road, 11.50% for New Valley Road and 18.58% for New Namanga Road (A104). The gap between the roads is caused by the missing or not valid questionnaires. The chart clearly shows even distribution of questionnaires within the study area.

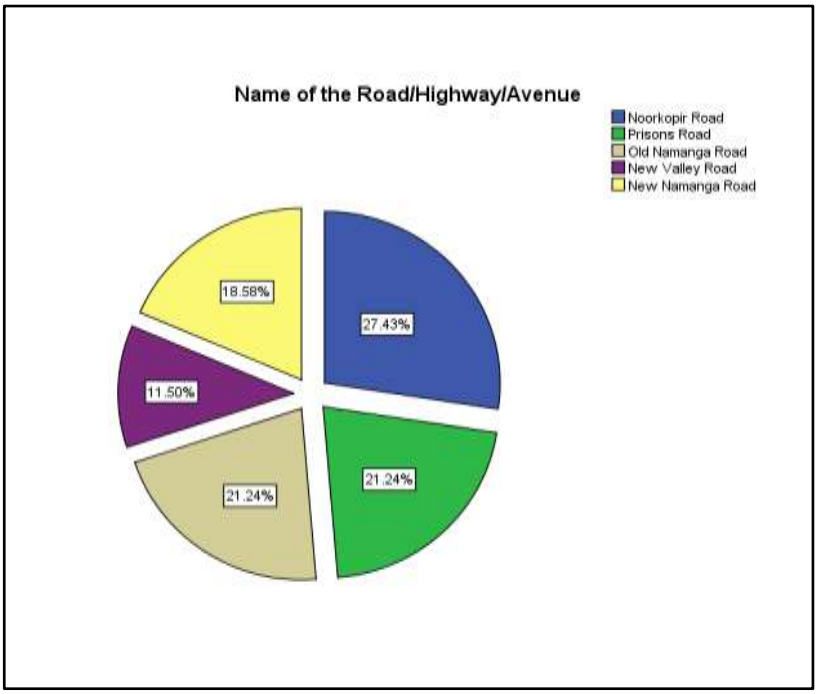


Figure 5. 1 Road/Highway Name; (Source; Author 2021)

5.3. Demographic Characteristics

5.3.1. Gender and Marital Status of the respondents

As per table 5.2, 56.64% of the respondents are male and 43.36% are Female. This shows that there is no much gap in gender within Kitengela Township. Those are single constitute 34.5% with men being the highest at 56.4% and women at 43.6%. Married respondents are the highest with 60.2% of total respondents with men having 57.4% and women 42.6%. Those divorced and separated has 2.7% respectively.

Table 5. 2 Gender and Marital Status of Respondents. (Source; Author 2021)

Gender	Marital Status of the Respondent				Total %
	Single	Married	Divorced	Separated	
Male	56.41%	57.35%	66.67%	33.33%	56.64%
Female	43.59%	42.65%	33.33%	66.67%	43.36%
Total	**34.51%**	**60.19%**	**2.65%**	**2.65%**	**100%**

5.3.2. Age Distribution Rate

The table shows age distribution within the study area. 74.34% of the respondent age between 18-36 years, 22.12% between 37-55 years and 3.54% are over 55%. This shows that Kitengela has majority of working labor that comprises 96.5% of the total respondents. The old age constitutes of partly 3.5% in daily activities of Kitengela Township.

Table 5. 3 Age Distribution. (Source; Author 2021)

Age of the Respondent		
Age	**Frequency**	**Percent**
18 - 36	84	74.3
37 - 55	25	22.1
Over 55	4	3.5
Total	**113**	**100.0**

5.3.3. Level of education

The table and histogram show the level of education in the study area. Generally, 99% of the respondents have at least gone to school. Only one person had no formal education but can interact well. 6.2% of the respondents have primary education only, 36.3% of the respondents have secondary education, 28.3% have tertiary college education, 26.5% have university and only 1.8% have polytechnic education. The level of literacy is 99.1% which clearly shows that Kitengela has majority of people who can write and read without any major issues. From the histogram, majority of respondents have secondary education, followed by Tertiary college, University level, polytechnic and primary level in that order

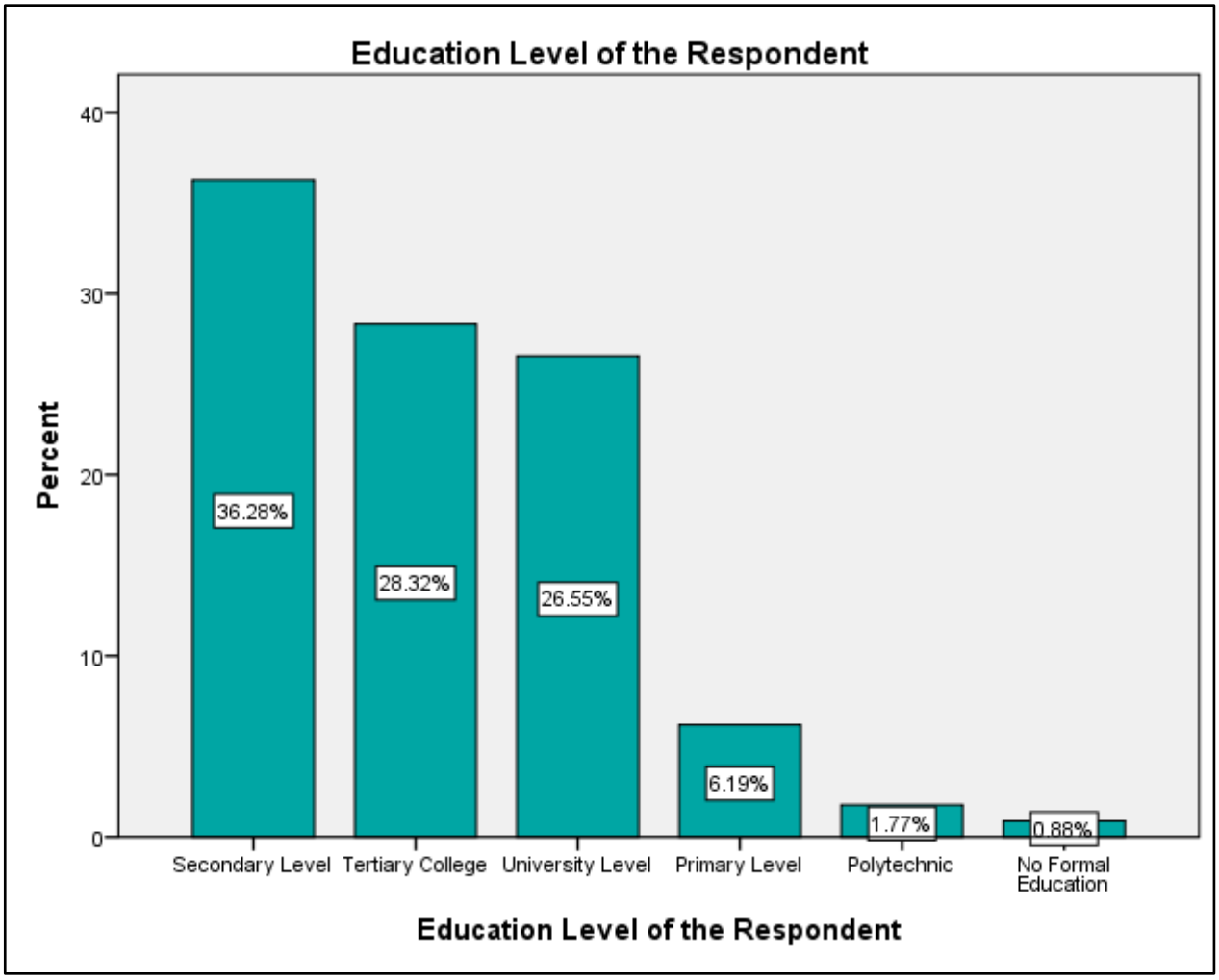


Figure 5. 2 Level of education. (Source; Author 2021)

5.3.4. Occupation of respondents

As per field surveys, 18.6% of the respondents re formally employed either in public or private sector, 66.4% are self-employed (business), 9.7% do manual labour and 5.3% are either not working or students. This shows that majority of people in study area are business oriented.

Table 5. 4 Occupation of the respondents. (Source; Author 2021)

Occupation	Frequency	Percent
Formal Employment	21	18.6
Self employed	75	66.4
Manual Labourer	11	9.7
Others	6	5.3
Total	**113**	**100.0**

5.4. Non-Motorised Transport (NMT)

5.4.1. Current and Preferred modal Split in Kitengela

As per field surveys, 41.59% of the respondents walk to the study area which takes the highest in modal share in the area followed by motorbikes that takes 35.40%, private cars 14.16%, Matatu 5.31% and 3.54% is taken by cycling. This shows that there is need to plan for walking people and cyclists that take 45.1% of modal share. The field data shows that 57.52% prefer using motorbikes due to its convenience and lack of walking facilities within the study area. Among the respondents, 23.01% prefer to walk to various destinations. This is despite lack of walking facilities and amenities. 11.5% prefer using private means, 4.42% using public transport. This shows that's the public transport sector has not been integrated or it has unwanted publicity. Only 3.54% prefer cycling which is environment pollution free

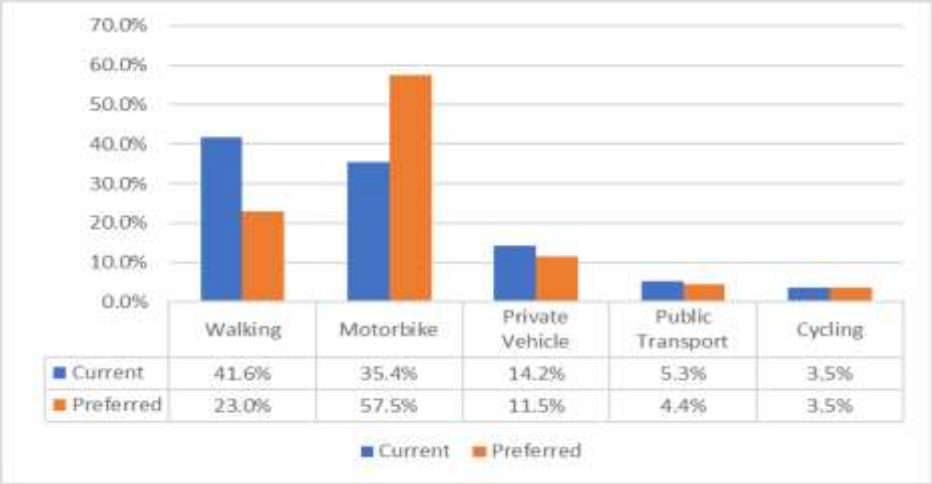


Figure 5. 3 Current and Preferred modal split

5.4.2. Origin - Destination and Trip Purpose in Kitengela

As per field surveys, 77.88% of the residents in Kitengela live within the township, 5.31% come from Kajiado town, 6.19% Athi River and 10.62% from other areas. Majority of the respondent's trip in Kitengela is work and business related that consist 38.05% and 42.48% respectively, 10.62% end up in various schools with 7.96% go for shopping and others consist of 0.88%. Their destination is summarized as 93.8% end up in Kitengela while 9%, 1.8% & 3.5% end up in Kajiado, Athi river and Nairobi respectfully. This study shows that there is a need for planning interventions within Kitengela Township that takes care of the residents in terms of transport, security and road networks. The huge percentage of origin-destination among residents is a clear of the boom in business and economic activities that need to be addressed in terms of mobility.

	Purpose of the Journey					
Place of Origin	Work	School	Shopping	Business	Others	**Total**
Kitengela	76.74	83.33	100.00	72.92	100.00	**77.88**
Kajiado	6.98	0.00	0.00	6.25	0.00	**5.31**
Athi River	4.65	16.67	0.00	6.25	0.00	**6.19**
Others	11.63	0.00	0.00	14.58	0.00	**10.62**
Total	**38.05**	**10.62**	**7.96**	**42.48**	**0.88**	**100.00**

Table 5. 5 Origin-Trip Purpose. (Source; Author 2021)

5.4.3. Trip Duration

As per field study, 44.2% of respondents take between 1-20 minutes to complete their trips which accounts as the highest in the study carried out followed by 30.1% who take between 21-40 minutes to reach their destination. 21.2% take between 41-60 minutes and only 4.4% take over one hour to complete their trip. Among the respondents, 42.5% are satisfied with the time with 57.5% dissatisfied. Among those dissatisfied, 50.7% list inadequate public transport system as the reason why they are not satisfied while 49.3% list lack of good roads as the reason

5.4.4. NMT Facilities

i. Footpaths Condition

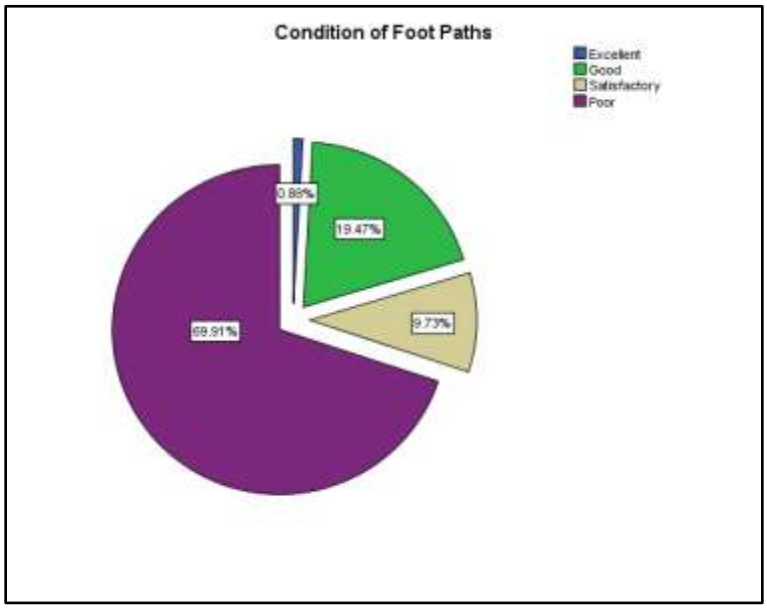


Figure 5. 4 Condition of footpaths (Source; Author 2021)

As per field study, 69.91% of the respondents believe that footpaths are in poor state as compared to about 0.88% who believe they are excellent. 19.47% believes footpath are good and 9.73% believe they are satisfactory. 90% of the respondents who believes footpaths are good are users along prison road which has newly built footpaths as compared to other case study roads. There exist no footbridges and pedestrian crossing facilities, no designated pedestrian crossing points thus pedestrians cross at any point causing risks among road users. The high poor approval rates shows that there is a need to look at pedestrian facilities as a priority.

Image 1 Lack of Footpaths; Field Galley

Image 2 Footpaths on one side; Field Galley

ii. Cycle Tracks

Cycle tracks in Kitengela has a high poor rating of 86.73% with only 3.54% giving it a good rating. 9.73% gave a satisfactory rating. Generally, Kitengela lacks cycle tracks as

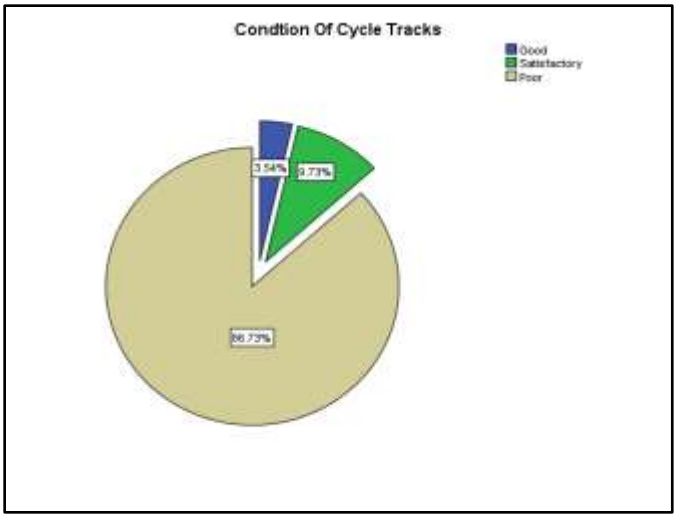


Figure 5. 5 Condition of cycle tracks (Source; Author 2021)

they compete with motorists in using main carriage and pedestrians in using shoulders that were meant to be for pedestrians.

5.5. Urban Land Uses in Kitengela Township

5.5.1. Residential Land Use.

Residential includes low, medium and high-density units. Residential percentage in Kitengela township constitute of 64.32% of the total area. This shows that there is high rate of human traffic that need to planned for in terms of mobility.

5.5.2. Industrial Land Use

This category is characterized by manufacturing, assembly and processing factories and plants. Also included ae juakali artisan and other light industries. Key Industrial Land Use in Kitengela Area is Light Industries. The percentage of Industrial Area in Kitengela is 2.11%. The industries include;

i. Karsam Ramji LTD that deals with aggregates
ii. Mabati Rolling mills within the CBD
iii. Juacali Artisans

5.5.3. Educational Land Use

This land use is characterized by presence of public and private schools, colleges, universities and training centers. Education sector takes 9.4% of the total acreage in the township. The walking students to and from schools need to be planned for.

5.5.4. Recreational Land Use

This land use involves recreational facilities and parks that are open to public use. Facilities such as hotels and motels are not mapped under such category. Recreational land uses take 0.15% which is too minimal for a township against a recommended average of 5.1% as per planning hand book.

5.5.5. Public Purpose Land Use

This includes land uses such as health facilities, police stations, administrative areas such as chiefs camp, prisons, churches, library, fire stations, market etc. Kitengela has a percentage of 4.9% against average of 12.2% as recommended by planning hand book.

5.5.6. Commercial Land Use

This a developed high-rise buildings for commercial purposes. Also included are semi commercial where some parts are meant for commercial purposes and also local shops that offer commercial activities. These areas have a high percentage of impervious surface coverage.

i. Commercial Strip Development

It is found along major highways such as Namanga Road. It's characterized by;

- Motel accommodations
- Car dealers
- Fast food services

This is evident along Namanga Road, Old Namanga Road, Prisons roand and Norkopir road with majority of the area having commercial services with residential above.

ii. Hospitality Services

These facilities are characterized by accommodation, food and drinks services around the commercial center. Kitengela has several resorts and other hotels along A104 road.

5.5.7. Public Utility Land Use

Public utilities land use involves services that are important to human survival and are offered by various stakeholders and government agencies. They include; Athi water and sewerage company, Kenya Power for supply of electricity, Kajiado county garbage collection unit, Safaricom and Airtel communications depicted by various boosters and other service providers. In Kitengela township, the public utilities constitute to about 0.84%

5.5.8. Transportation Land Use

The transportation land use includes roads network that connects different areas and communication routes. It is characterized by utilities such as sewage lines, power substations, and communication facilities. These areas generally have low infiltration due to its impervious surface coverage. Key Transportation Land Uses are;

1. **Highway and Major Roads**

Major Highway within Kitengela is Namanga Road (A104) that bisects the town into two. It has a right of way of 60m with no provision of surrender for slip roads and majority of building has not observed building lines and setbacks. The reserve serves as parking, slip roads, NMT, main carriage way and utilities such as electricity line and sewer. Other major roads include Old Namanga road that is not fully utilized. Kitengela-Rongai Road C444 which is not graveled passes at the boundary of the town. Only Namanga Road links Kitengela to Kajiado town, Namanga Border, Machakos County and Nairobi Counties. This is evident with heavy traffic experienced.

2. **Railroad Facilities**

Railway facilities include railroads. Kitengela has a Railway Line that Connects Athi river to Lake Magadi and is operated by Tata Chemicals but no passenger terminal.

3. **Bus Terminals**

Kitengela has bus/matatu terminal along Namanga Road which acts as the recipient of majority of NMT users.

5.5.9. Undeveloped Land Uses

This land use comprises of not agricultural and differed land or land bank for future expansion. It constitutes of 10.37%

Kitengela Urban Land use	Area in Ha	Area in %
Commercial	159.23	5.46
Education	203.80	6.98
Industrial	61.62	2.11
Public Purpose	143.43	4.91
Public Utility	24.65	0.84
Recreational	4.28	0.15
Residential	1877.00	64.32
Transportation	141.54	4.85
Undeveloped	302.71	10.37
TOTAL PLANNING AREA	**2918.26**	**100.00**

Table 5. 6 Existing Land Use Area (Source; Author 2021)

Map 5 1 Existing Land Uses in Kitengela; (Source; Author 2021)

5.6. NMT interactions and conflicts with Urban Land Uses

5.6.1. NMT Interactions with Commercial Land Use

Among the respondents, 67.6% confirmed that NMT bring customers close to their business including hospitals, restaurants and others. Among those interviewed, 21.62% had a different opinion that it does not bring customers instead it destroys and only 10.81% believe NMT brings insecurity in terms of thuggery and mugging along streets. The statistics shows that people buy goods and once those facilities are constructed near business premises, they bring more income.

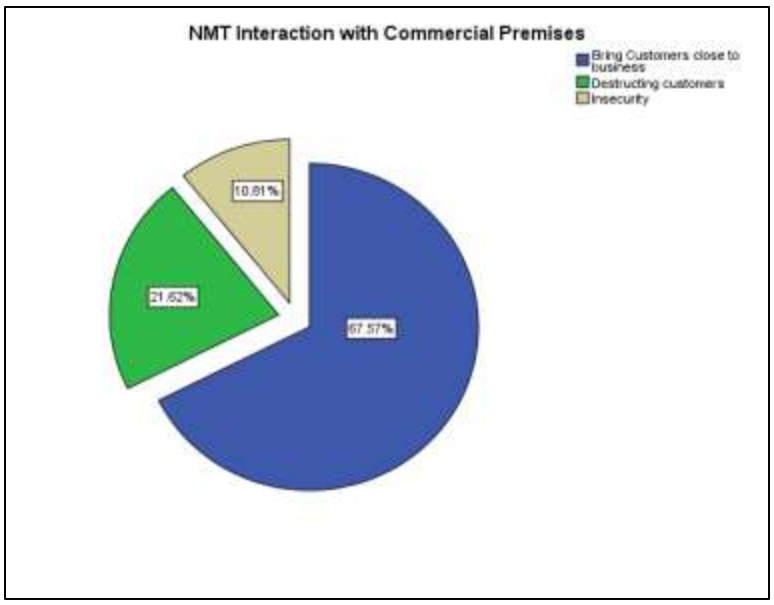
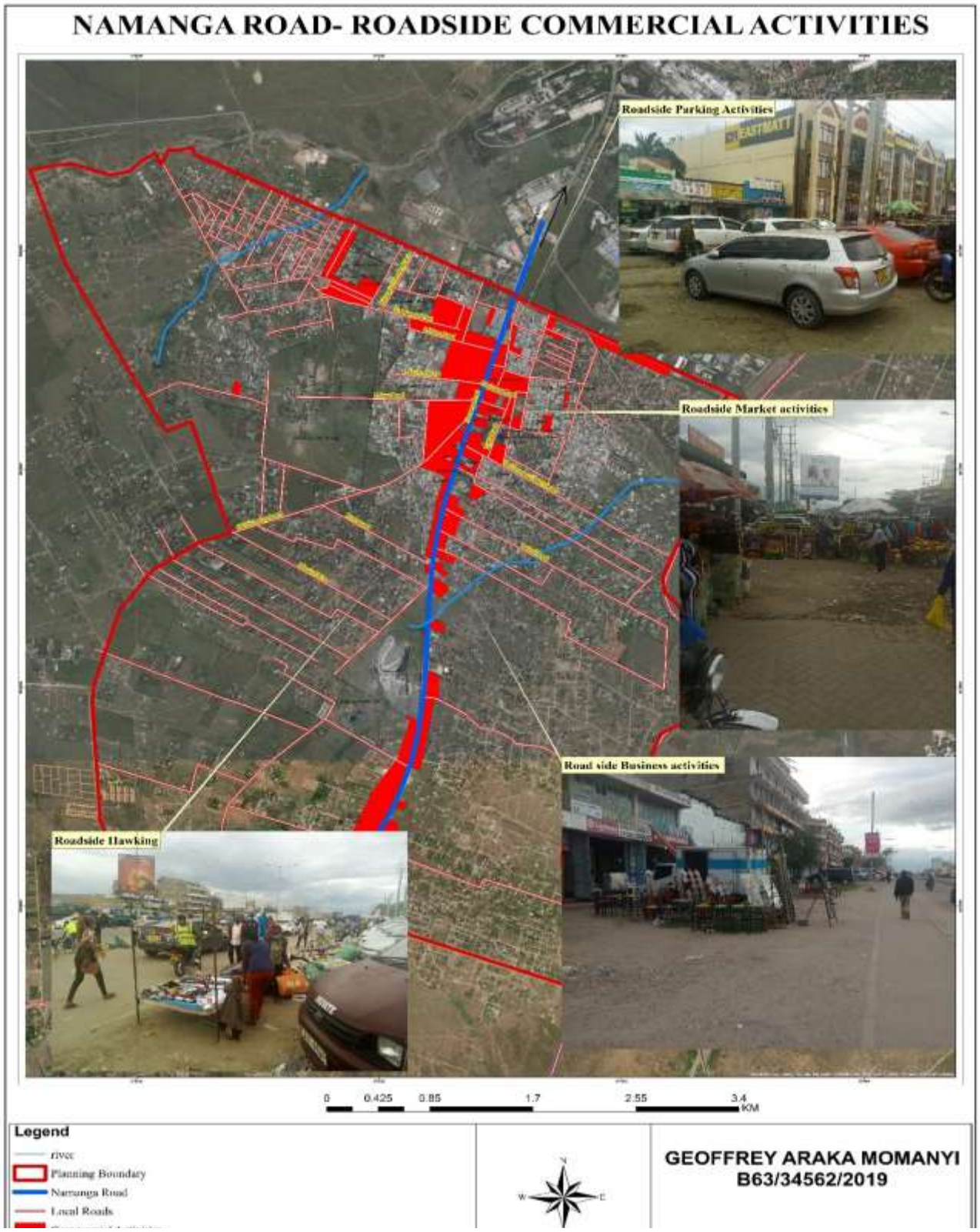


Figure 5. 6 NMT Interactions with Commercial Land Use (Source; Author 2021)

5.6.2. NMT conflicts with Commercial Land Uses

Roadside traders, hawking, roadside parking and other activities were listed and mapped to be the key commercial activities that block NMT facilities such as footpaths and linking facilities. Kitengela lacks an open or closed market thus all traders tend to line along the space meant for NMT for trading purposes. Sand sellers also contribute to the conflicts that are experienced between NMT and commercial land uses that are evident along Namanga Road. This is characterized by conflicts by cattle and motorcycle parking along NMT corridors, manufacturing activities that block NMT, lack of continuous NMT corridors and roadside *juakali* industries.



Map 5. 2 Namanga Roadside Activities; (Source; Author 2021)

Map 5.3 Conflicts Along Namanga Road; (Source; Author 2021)

Among the respondents, 89.19% of traders confirmed that car park along NMT corridor blocks their business not be seen by customers. This rating shows that there is need to establish NMT corridors near to business premises. Only 5.41% does not complain about impacts brought by car park along NMT corridors. A further 5.41% complained about congestions that has been brought by blocked NMT routes.

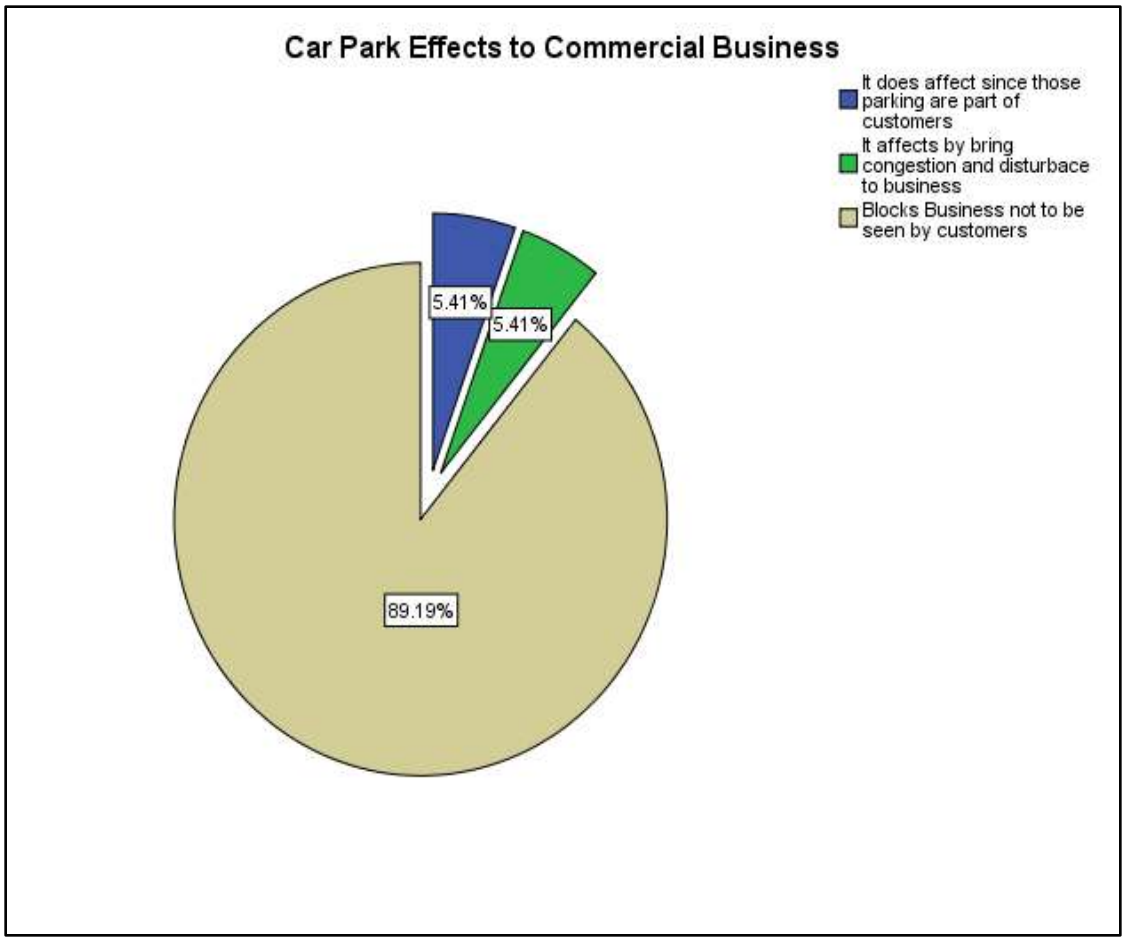


Figure 5. 7 Car Park Effects to Commercial Business (Source; Author 2021)

5.6.3. NMT Interactions and conflicts with other Land Uses

Key interactions between NMT and other land uses were mapped out and identified. NMT need a continuous link between residential areas, recreational areas and public purpose land uses through transportation land use. Various conflicts were identified and mapped in key roads.

i. Noorkopir/Commercial Road.

It lacks NMT and has poor drainage system. The key conflicts include limited right of way and narrow carriage way without shoulders thus NMT are forced to share carriage way with vehicles and motorbikes. This conflict causes accidents and anxiety among the NMT users. Poor road conditions pose a challenge during rainy season due to muddy road and stagnant water that is impassable and also dust during dry season that irritates the NMT users

ii. Prisons Road

Characterized by high number of carts and oxen driven NMT, water vendor carts, human traffic and roadside traders. It serves high residential areas and Kitengela Prisons. The NMT corridors are under construction but with limited space that cannot accommodate other NMT users. The conflicts include carts sharing carriage way with vehicles and thus leads to accidents.

iii. Old Namanga Road

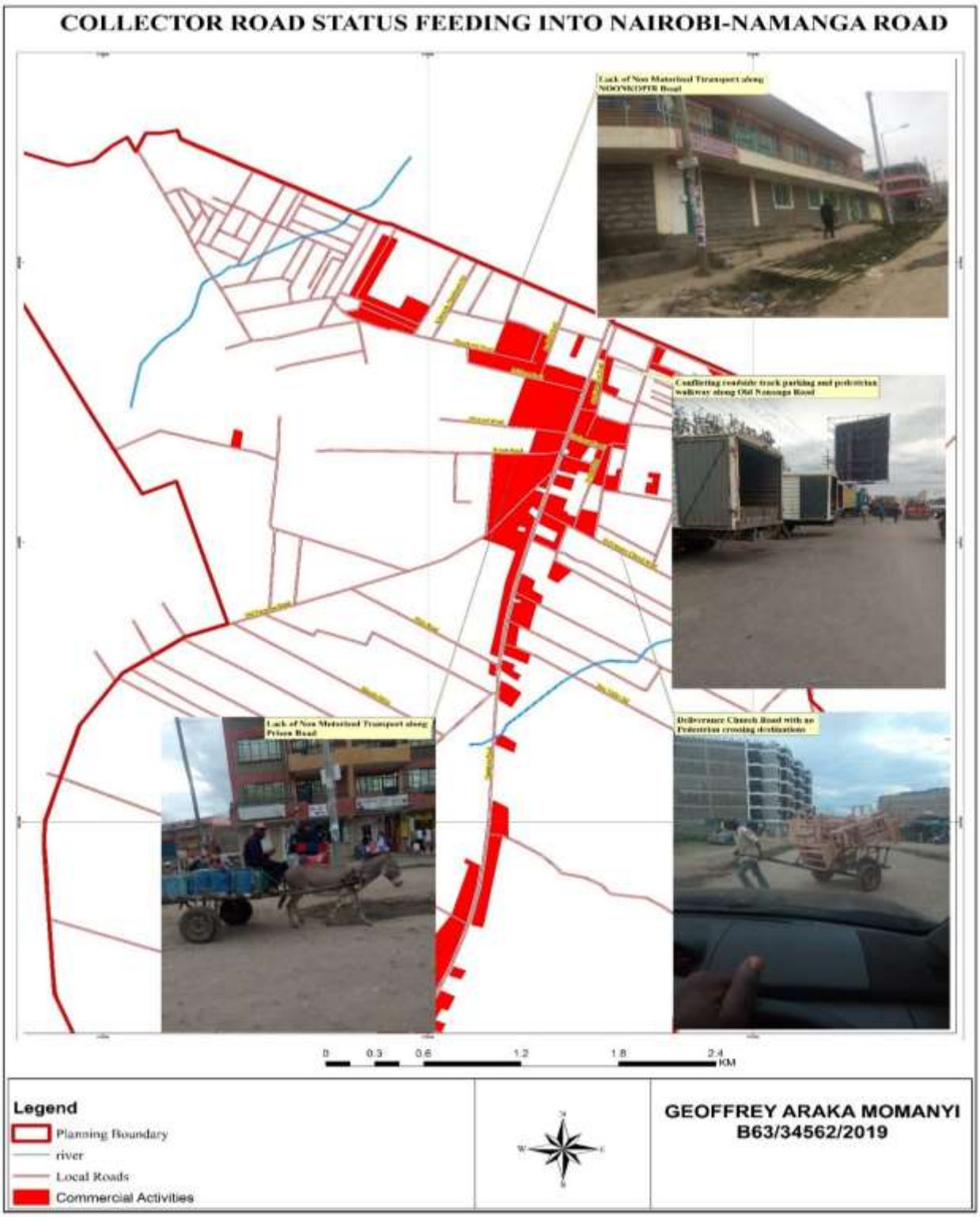
It's characterized by roadside traders, oxen driven carts, dust, high human traffic, encroachment by commercial and residential land uses due to neglect of the road that is owned by Kenya National Highways Authority. The key conflicts include lack of NMT facilities such as footpaths thus sharing with carriage way users. This leads to accidents and anxiety among NMT users. The road also lacks street lights thus not well lit thus poses a high risk to NMT users during night hours due to security lapse. Poor road conditions pose a challenge during rainy season due to muddy road that is impassable and also dust during dry season that irritates the NMT users.

iv. Valley Road

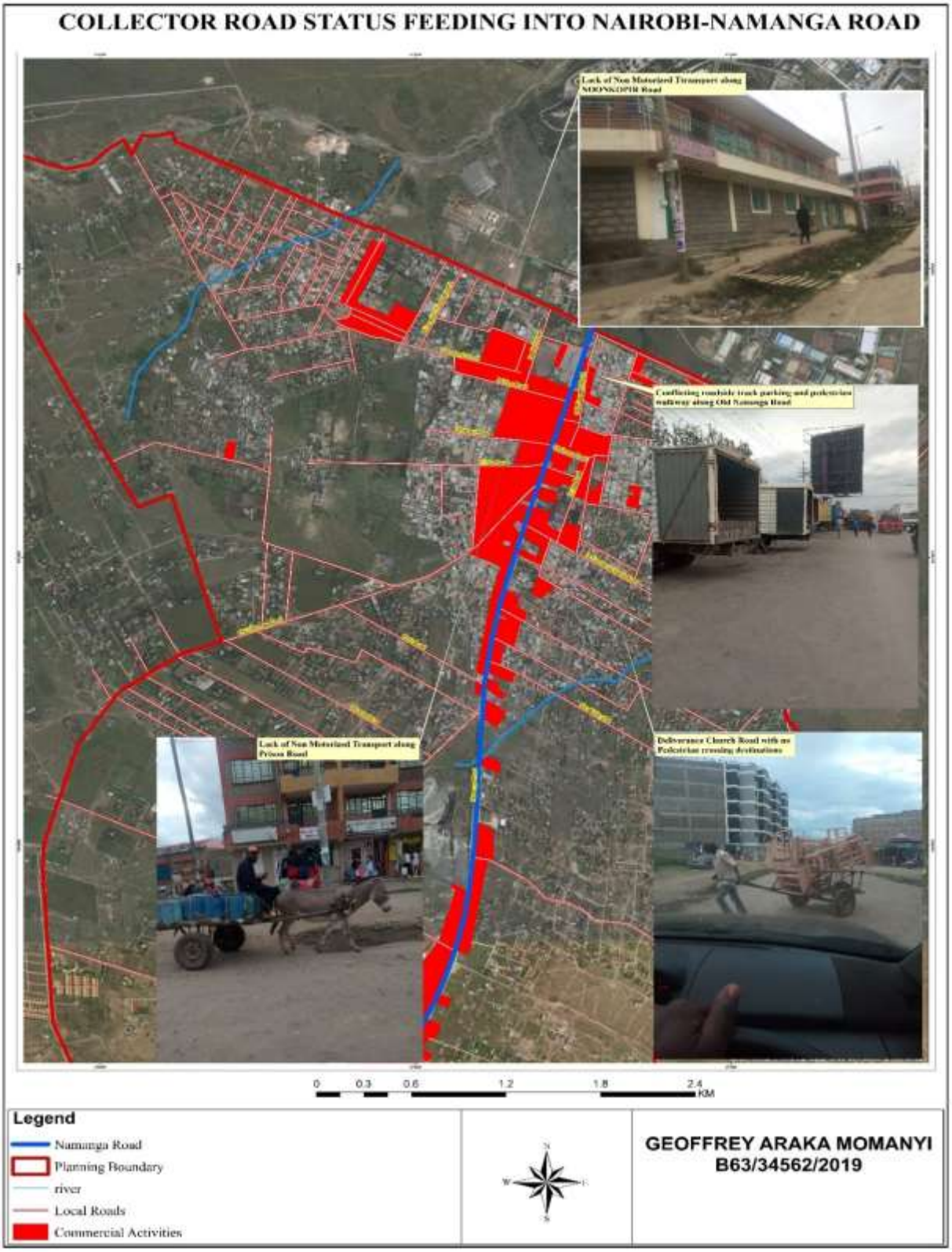
It's characterized by roadside traders, oxen driven carts, dust, high human traffic. Lack of NMT has posed a challenge to residents

Image 3; Road side Business blocking NMT Field Galley

Image 4. Parking Blocking NMT; Field Galley



Map 5.4 Collector Roads Conflicts; (Source; Author 2021)



Map 5.5 Collector Roads Conflicts; (Source; Author 2021)

5.7. Planning Interventions

In most highways that pass through the town center, its characterized by high traffic both human and vehicular that is generated by various land uses within the township and long-distance travelers. According to Catherine O' Brien in 2005, a single mode of transport is not efficient for mobility and it should be an integration of various modes that complement each other. This increases travel markets, utilizes road space and affordability. In narrow right of way scenario, traffic guide and roper designs are paramount in addressing traffic snarl up. Improving junctions, introduction of one-way carriage, introduction of bypasses, improved traffic intelligent systems, clearing of right of way is on the few ways of managing traffic.

5.7.1. NMT provision and usage

a) NMT infrastructure and amenities

The study found that there is inadequate provision of pedestrian and cycle lanes, inadequate crossing facilities, no speed calming measures, and NMT link facilties. Adequate provision of NMT infrastructure and amenities will be the key proposal such as enough footpaths, NMT furniture, footbridges, zebra crossing and other facilities. Develop an Urban Street model that ensures NMT corridors are planned near commercial centers and be integrated in major urban roads. This will improve the business environment.

b) Cycling provision and usage

To encourage the use of NMT County and National Government shall provide an enabling environment and not limited to infrastructure, by partnering with the private sector to create more bike parking spots, bike sharing programs, bike shops, and bike manufacturing. In addition, it will promote cycling for public health, sport, and tourism.

5.7.2. Replanning Urban Land Use

a) Allocating land for the market.

The traders that will be relocated from the highway will have nowhere to sell their market produce. The proposed market will have 70 ha of land to set up an ultra-modern market with latest technology that will cater for all various market needs as shown on the map. The land will be acquired from private owners since it's an idle land.

b) Proposed Parking facility.

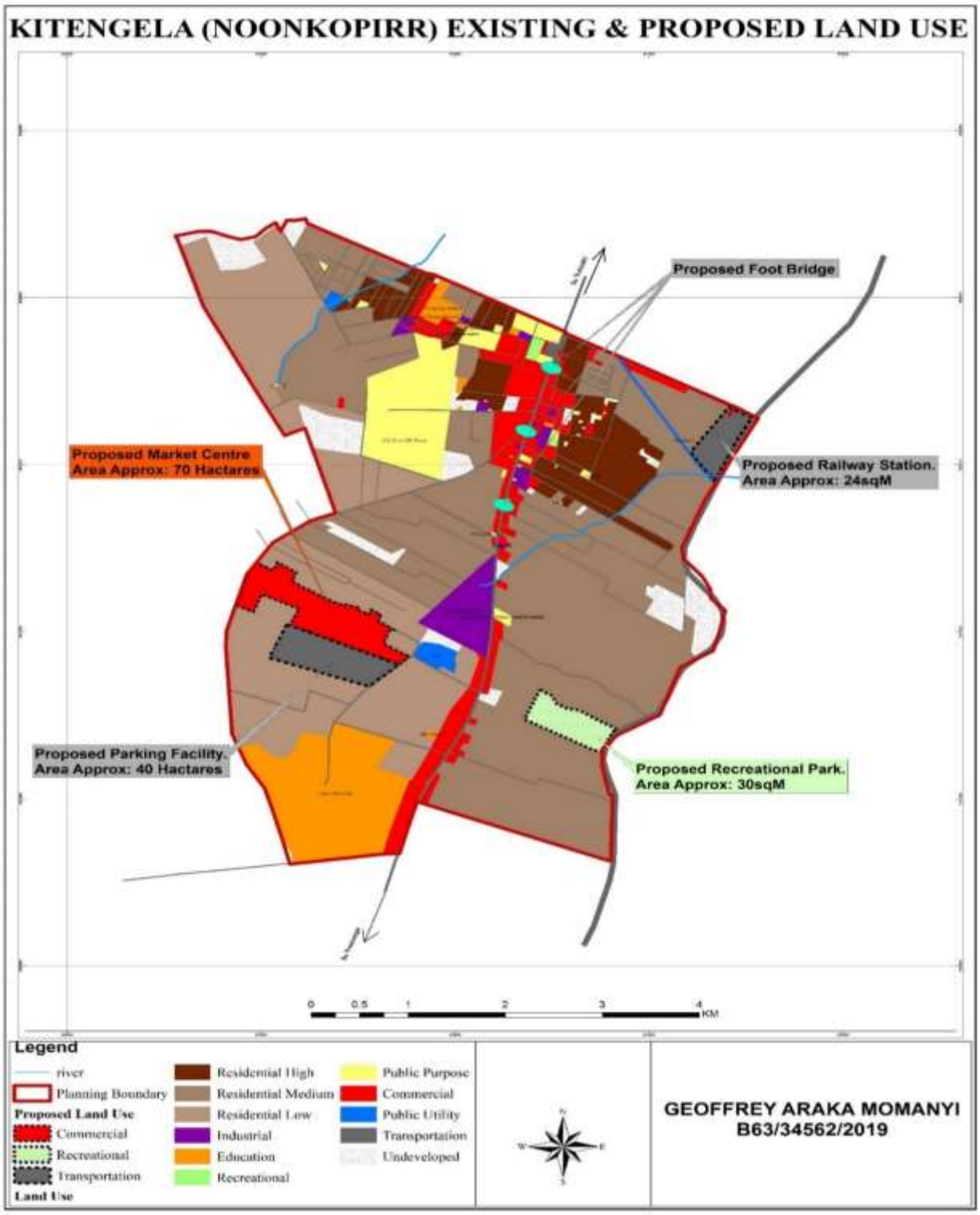
The space provided for parking will not be enough and thus a proposed parking facility was identified and next to the market so that it will attract more customers to the market. The land is 40 ha that will be enough for more than 15000 vehicles per day.

c) Proposed Recreational Park

Despite the township having more than 142000 people, it lacks recreational park. The proposed park will have an area of 30 ha of green space, swimming pool, trees, benches, modern streetlights and other recreational facilities. This will ensure that area under green space has increased significantly.

d) Proposed Railway Station

The traffic congestion that is experienced in Kitengela township will be minimized if the proposed railway station will be brought to reality. Commuting to other towns and Nairobi city will be a relieve to traders and travelers.



Map 5.6 Proposed Land Use. (Source; Author 2021)

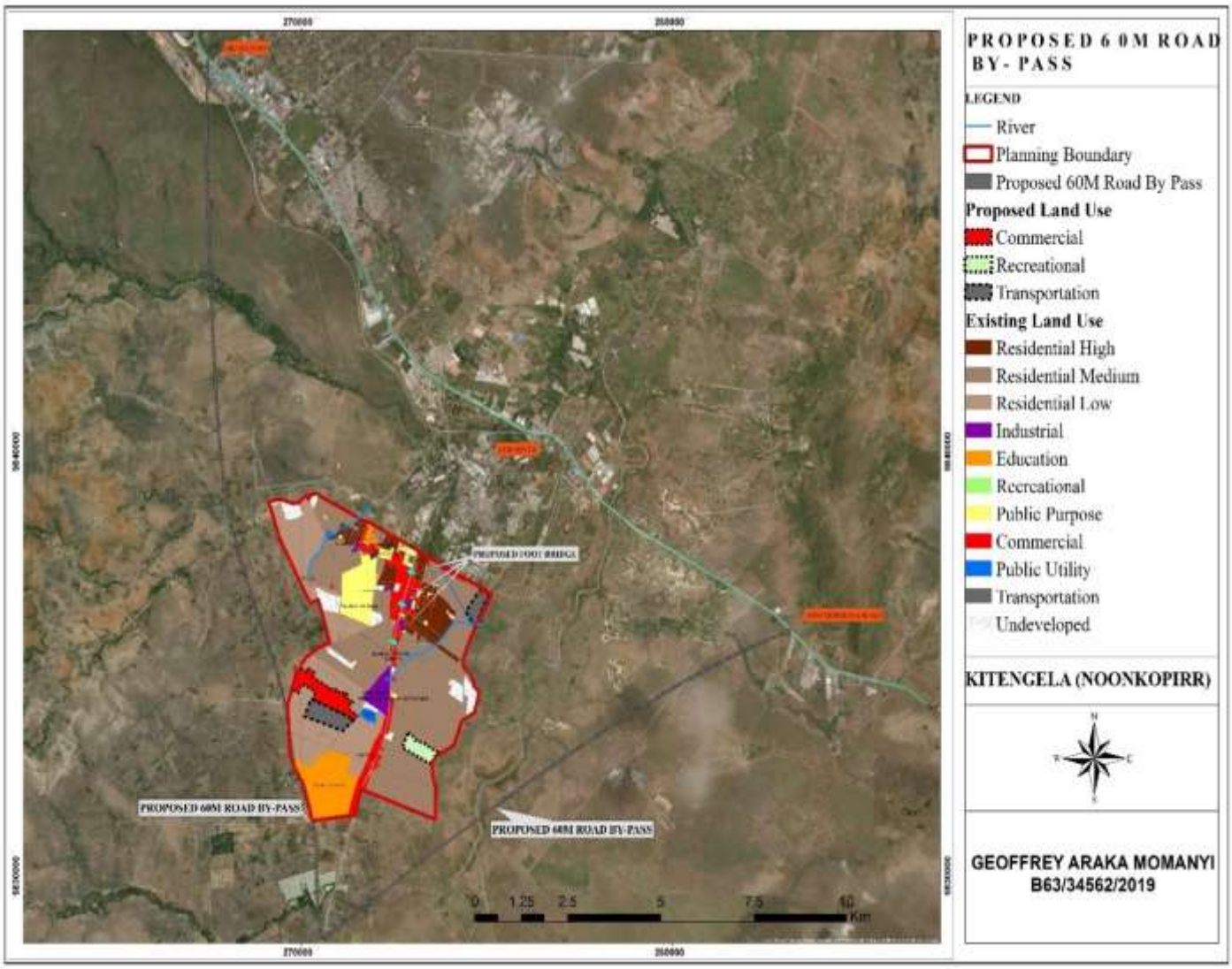
5.7.3. NMT interactions and Conflicts with Land use

An efficient transport system must take into consideration mobility and accessibility. This is achieved by ensuring safety and ecofriendly modes of transportation. Lack of footpaths, footbridges and the encroachment by vehicular traffic and street vendors have forced the those who walk and cycle to conflict with vehicular movement. Lack of green spaces within the township has led to the town being dusty and miss the aesthetic nature of green scenery thus a replanning of the corridor is necessary.

The development of NMT networks to be effective, the existing roads network will be designed and planned to integrate NMT facilities. The design will separate footpaths and cycle lanes from vehicular traffic. The design will involve utilizing the available 60-meter right of way by having one way traffic lanes, vegetated median, flush parking and slip/access roads, dedicated footpaths and footbridges, wider pedestrian lanes, wider cycle lanes and vegetated corridor.

This urban street model aims at improving vehicular movement and reducing human versus vehicular conflicts and improve safety of the users. By designing footpaths near business and lighting improves security and brings customers to the business premises thus more income. For long long-distance travelers who have no business in the town will be given alternatives in terms of bypass that will help to reduce traffic along the replanned corridor.

Figure 8 Proposed Replanned Highway. Source; Author



Map 5.7 Proposed Western & Eastern By Pass. (Source; Author 2021)

6. RESEARCH SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1. Introduction

Research summary, conclusions and recommendations are discussed in this chapter. The recommendations are drawn as per objectives.

6.2. Research Summary

6.2.1. NMT provision and usage in Kitengela Township

As per research statistics about 70% of respondents recognized that there is influx in provision of NMT facilities such as footpaths and walkways. Almost 90% of respondents recognized lack of cycle tracks and cycling facilities within the study area. Despite walking being the main mode of about 46%, only 23% prefer to walk due to lack of NMT facilities and furniture.

6.2.2. Urban Land Uses in Kitengela Township

Urban land uses in Kitengela has been summarize in the table below. The analysis shows that there is insufficient public utilities and recreational land uses as per planning handbook. The ever-increasing population in Kitengela has increased pressure in balancing urban land uses.

Kitengela Urban Land use	Area in Ha	Area in %
Commercial	159.23	5.46
Education	203.80	6.98
Industrial	61.62	2.11
Public Purpose	143.43	4.91
Public Utility	24.65	0.84
Recreational	4.28	0.15
Residential	1877.00	64.32
Transportation	141.54	4.85
Undeveloped	302.71	10.37
TOTAL PLANNING AREA	**2918.26**	**100.00**

6.2.3. NMT interactions and conflicts with Urban Land Uses

Among the respondents about 66% of business owners confirmed that putting NMT facilities such as footpaths and walkways near their premises will bring more customers. About 89.19% of traders confirmed that car park along NMT corridor blocks their business not be seen by customers. The theory that Cars don't buy only people buys was the key in ensuring business. Roadside traders, hawking, roadside parking and other activities were listed as the key commercial activities that block NMT facilities such as footpaths and linking facilities. Kitengela lacks an open or closed market thus all traders tend to line along the space meant for NMT for trading purposes. Sand sellers also contribute to the conflicts that are experienced between NMT and commercial land uses that are evident along Namanga Road.

6.2.4. Planning Interventions

The various interventions include;

i. Provision of NMT facilities and amenities such as footpaths and cycle tracks
ii. Replanning urban land uses by allocating land for market, recreational centre, parking facility and railway station.
iii. Replanning the Namanga highway section into an urban street with provision of green spaces, walkways and vending services included to serve the population accessing Kitengela Township. For those long travelers who has no business within the town will be provided with bypasses that will connect Nairobi and Mombasa Road

6.3. Conclusion

This research brings in the idea NMT in urban environment and how it interacts and conflicts with urban land uses. From other research, NMT has been neglected from planning and implementation platforms thus improving on cycling and walking have been identified, bridge the gap. Therefore, the research has come up with various NMT strategies and models in urban area that will utilize existing land uses

6.4. Recommendations

i. NMT routes should be established in major towns with a minimum of 6m right of way in urban areas where space is available and 3 meters where space is not available
ii. This study also recommends the Urban Street model design that allows NMT near commercial centers to be integrated in major urban roads. This will improve the business environment
iii. Research also recommends small street vendor spaces, benches and green space along NMT routes to be integrated along towns
iv. The research also recommends that proper planning of urban areas should include recreational and public purpose land uses percentage that is recommended by planning hand book
v. The bypass proposed should have strict land use regulation measures to discourage activities along the 60-metre corridor

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APPENDICES

RESEARCH WORK PLAN

Activity	Dates	Outputs
Data Collection		**Filled Questionnaire** **Observation Notes** **Photographs**
Cleaning and Data Entry		**SPPS output** **Observation Reports**
Report writing and Compilation		**Draft study report**
Corrections		**Final Study Report**
PP Presentation		**PowerPoint slides**
Project Present		**Comments**
Final Submission		**3 hard copies and soft copy**

RESEARCH BUDGET

Activity	**Requirements**	**Costs**
Data Collection	• Questionnaires • Stationary • Research Permits • Travel Costs	5000 5000 3000 8000
Cleaning and Data Entry	• Research Assistants • Printing outputs	10000 3000
Research Compilation	• Printing • Binding	5000 5000
Total		**44,000**

B63/34562/2019-ARAKA MOMANYI GEOFFREY

Road Users Questionnaire (NMT)

UNIVERSITY OF NAIROBI

ASSESSMENT OF NON-MOTORIZED TRANSPORT & ITS IMPLICATIONS ON URBAN LAND USE. A CASE STUDY OF KITENGELA TOWNSHIP

ROAD USERS' QUESTIONNAIRE

Please answer the Questions as instructed

Name of the Street……

Demographic details

1. **Name of respondent (Optional)…….**
2. **Age of respondent(years)**

☐ Below 18 ☐ 37-55

☐ 18-36 ☐ 0ver 55

3. **Gender:**

☐ Male ☐ Female

4. **Family status**

☐ Single ☐ Separated

☐ Married ☐ Others Specify……

☐ Divorced

5. **Level of Studies**

☐ No formal education ☐ Secondary level

☐ Primary level ☐ Tertiary

☐ Tertiary college ☐ Village polytechnic

☐ University level

6. **Employment Records**

☐ Formal employment ☐ Farmer

☐ Self-employed ☐ Manual laborer

☐ Others (specify)…….

7. Mode of travel to the study area (Kitengela)

☐ Walking ☐ Motor Bike ☐ Private car

☐ Cycling ☐ Matatu ☐ Others Specify

8. Where is your place of origin?

☐ Kitengela ☐ Kajiado ☐ Nairobi

☐ Isinya ☐ Athi River ☐ Others

9. Where is your destination?

☐ Nairobi ☐ Kitengela ☐ Athi River

☐ Kajiado ☐ Kajiado ☐ Others

10. Trip duration to reach your destination?

☐ (1-20) minutes ☐ (41-60) minutes

☐ (21-40) minutes ☐ (others)…….

11. Trip Duration Satisfaction?

☐ Yes ☐ No

Give reasons……

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12. Trip Purpose?

☐ Work ☐ Business

☐ School ☐ others Specify…….

☐ Shopping

13. Trip Duration Timing?

- 5.00 am -7.00 am
- 7.00 am-9.00 am
- 9.00 am- 11.00 am
- 11.01 am-1.00 pm
- 1.01 pm-3.00 pm
- 3.01 pm-5.00 pm

- 5.01pm -7.00 pm
- 7.01pm-9.00pm

14. Preferred mode of travel?

- ☐ Walking
- ☐ Public transport
- ☐ Cycling
- ☐ Personal car
- ☐ Motor bike
- ☐ Others

15. Footpaths and Cycle tracks rating?

NMT Infrastructure	Excellent	Good	Satisfactory	Poor
Foot Paths				
Cycle Tracks				

16. What do you suggest the Central and County Government can do to improve the NMT within the area?

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17. What are the challenges facing NMT in Kitengela?

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18. Do you think NMT needs a bigger space free from Motorists Encroachment? If yes, what can be done to ensure safety of NMT?

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19. What can you say on Public Transport Sector and what can be done to ensure seamless transport?

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20. What are the potentials of NMT within Kitengela and how can it be exploited?

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21. Stakeholders within the transport sectors and what can they do to promote the NMT.

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22. Do you think Kitengela needs a Railway Station and Bus Rapid Transit?

☐ Yes ☐ No

23. What can be done to decongest Kitengela Town?

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24. While walking, do you shop along the way? If yes, gives reasons

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25. What can be done to Improve Road Side Business?

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26. Do you find Road Side Business Impacting your Movement? If Yes What can be done to improve NMT Movements.?

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27. Do vehicles Parked along Business Premises hinder you from shopping? If yes What can be done to limit such issues?

B63/34562/2019-ARAKA MOMANYI GEOFFREY

Traders Questionnaire

UNIVERSITY OF NAIROBI

ASSESSMENT OF NON-MOTORIZED TRANSPORT & ITS IMPLICATIONS ON URBAN LAND USE. A CASE STUDY OF KITENGELA TOWNSHIP

TRADERS QUESTIONNAIRE

Please answer the Questions as instructed

Name of the Street……

Demographic details

1. **Name of respondent (Optional)…….**
2. **Age of respondent(years)**

☐ Below 18 ☐ 37-55

☐ 18-36 ☐ 0ver 55

3. **Gender:**

☐ Male ☐ Female

4. **Family status**

☐ Single ☐ Separated

☐ Married ☐ Others Specify……

☐ Divorced

5. **Level of Studies**

☐ No formal education ☐ Secondary level

☐ Primary level ☐ Tertiary

☐ Tertiary college

☐ Village polytechnic

☐ University level

6. Employment Records

☐ Formal employment ☐ Others (specify)…….

☐ Self-employed

☐ Farmer

☐ Manual laborer

7. Mode of travel to the study area (Kitengela)

☐ Walking ☐ Motor Bike ☐ Private car

☐ Cycling ☐ Matatu ☐ Others Specify

8. Where is your place of origin?

☐ Kitengela ☐ Kajiado ☐ Nairobi

☐ Isinya ☐ Athi River ☐ Others

9. Where is your destination?

☐ Nairobi ☐ Kitengela ☐ Athi River

☐ Kajiado ☐ Kajiado ☐ Others

10. Trip duration to reach your destination?

☐ (1-20) minutes ☐ (41-60) minutes

☐ (21-40) minutes ☐ (others)…….

11. Trip Duration Satisfaction?

☐ Yes ☐ No

Give reasons……

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12. Trip Purpose?

☐ Work ☐ Business

☐ School ☐ others Specify…….

☐ Shopping

13. Trip Duration Timing?

- 5.00 am -7.00 am
- 7.00 am-9.00 am
- 9.00 am- 11.00 am
- 11.01 am-1.00 pm
- 1.01 pm-3.00 pm
- 3.01 pm-5.00 pm
- 5.01pm -7.00 pm
- 7.01pm-9.00pm

14. Preferred mode of travel?

☐ Walking

☐ Cycling

☐ Motor bike

15. 15. Footpaths and Cycle tracks rating?

NMT Infrastructure	Excellent	Good	Satisfactory	Poor
Foot Paths				
Cycle Tracks				

16. How does NMT influence your business?

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17. What are the challenges the business is facing in terms of human traffic?

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18. Do you think NMT needs a bigger space free from Motorists Encroachment? If Yes, what can be done to ensure safety of NMT and Business Environment?

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19. What can you say on Public Transport Sector and what can be done to ensure seamless transport?

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20. How does car parking near business premises affect your business?

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21. Stakeholders within the transport sectors and what can they do to promote the NMT and Land use?

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22. Do you think Kitengela needs a Railway Station and Bus Rapid Transit?

☐ Yes ☐ No

23. What can be done to Improve your business Environment?

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B63/34562/2019-ARAKA MOMANYI GEOFFREY

Cyclists, Motorcyclists, Motorist's questionnaire

UNIVERSITY OF NAIROBI

ASSESSMENT OF NON-MOTORIZED TRANSPORT & ITS IMPLICATIONS ON URBAN LAND USE. A CASE STUDY OF KITENGELA TOWNSHIP

CYCLIST & MOTORISTS USERS' QUESTIONNAIRE

Please answer the Questions as instructed

Name of the Street……

Demographic details

1. **Name of respondent (Optional)…….**
2. **Age of respondent(years)**

☐ Below 18 ☐ 37-55

☐ 18-36 ☐ 0ver 55

3. **Gender:**

☐ Male ☐ Female

4. **Family status**

☐ Single ☐ Separated

☐ Married ☐ Others Specify……

☐ Divorced

5. **Level of Studies**

☐ No formal education ☐ Secondary level

☐ Primary level ☐ Tertiary

☐ Tertiary college ☐ Village polytechnic

☐ University level

6. **Employment Records**

☐ Formal employment ☐ Manual laborer

☐ Self-employed ☐ Others (specify)…….

☐ Farmer

7. Mode of travel to the study area (Kitengela)

☐ Walking ☐ Motor Bike ☐ Private car

☐ Cycling ☐ Matatu ☐ Others Specify

8. Where is your place of origin?

☐ Kitengela ☐ Kajiado ☐ Nairobi

☐ Isinya ☐ Athi River ☐ Others

9. Where is your destination?

☐ Nairobi ☐ Kitengela ☐ Athi River

☐ Kajiado ☐ Kajiado ☐ Others

10. Trip duration to reach your destination?

☐ (1-20) minutes ☐ (41-60) minutes

☐ (21-40) minutes ☐ (others)…….

11. Trip Duration Satisfaction?

☐ Yes ☐ No

Give reasons……

……

……

12. Trip Purpose?

☐ Work ☐ Business

☐ School ☐ others Specify…….

☐ Shopping

13. Trip Duration Timing?

- 5.00 am -7.00 am
- 7.00 am-9.00 am
- 9.00 am- 11.00 am
- 11.01 am-1.00 pm
- 1.01 pm-3.00 pm
- 3.01 pm-5.00 pm
- 5.01pm -7.00 pm
- 7.01pm-9.00pm

14. Preferred mode of travel?

☐ Walking ☐ Motor bike

☐ Cycling ☐

28. Footpaths and cycle tracks rating?

NMT Infrastructure	Excellent	Good	Satisfactory	Poor
Foot Paths				
Cycle Tracks				

29. How does NMT influence your cycling, driving behavior?

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30. What are the challenges you are facing as a cyclist/motorist in relation to NMT?

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31. Do you think NMT needs a bigger space free from Motorists Encroachment? If Yes, what can be done to ensure safety of NMT?

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32. What can you say on Public Transport Sector and what can be done to ensure seamless transport?

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33. Where do you park your bicycle, Car or motorcycle? Is it Conducive? Give reasons

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34. Stakeholders within the transport sectors and what can they do to promote the NMT and Land use?

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35. Do you think Kitengela needs a Railway Station and Bus Rapid Transit?

☐ Yes ☐ No

36. What can be done to Improve Transport congestion in Kitengela?

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B63/34562/2019-ARAKA MOMANYI GEOFFREY

Key Informant Guide

UNIVERSITY OF NAIROBI

ASSESSMENT OF NON-MOTORIZED TRANSPORT & ITS IMPLICATIONS ON URBAN LAND USE. A CASE STUDY OF KITENGELA TOWNSHIP

QUESTIONNAIRE FOR KEY INFORMANT

Please answer the Questions as instructed

KeNHA Engineer, Planner, County Officials, Matatu Sacco heads, Kenya Railways Enginner……

Respondents Details

1. **Name (Optional)…….**
2. **How does NMT influence urban mobility?**

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3. **What are the challenges facing implementation of NMT in our urban areas?**

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4. **Do you think NMT needs a bigger space free from Motorists Encroachment? If Yes, what can be done to ensure safety of NMT?**

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5. **What can you say on Urban land use and its effects on NMT?**

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6. **How does car parking in township affect mobility? What can you propose to ensure efficient parking?**

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7. **According to you, what can be done to decongest Kitengela and create more space for NMT?**

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8. **Do you think Kitengela needs a Railway Station and Bus Rapid Transit?**

☐ Yes

☐ No

Reasons…….....

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9. **Do you think Namanga Road is sufficient in connecting Kitengela to Namanga and Nairobi? What can be done to ensure alternative routes accessing Mombasa Road and Nairobi without passing through Kitengela Township? Give alternatives**

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10. **The whole of Namanga Road has no footbridges and it has open drains that are deep why? What can you propose to ensure safety of pedestrians?**

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11. **Have you ever heard of pedestrian mall or pedestrianized street as streets or zones that are almost exclusively closed to vehicular traffic and are primarily reserved for the use of pedestrians? What amount of space can you recommend if some streets are devoid of Vehicle traffic? Give reasons.**

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12. **Old Namanga Road has been neglected for long. Do you know why? Give your suggestion how Old Namanga Road can help out in Easing traffic along Namanga-Athi River Road.**

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13. **Give a summary of what can be done in ensuring no conflicts between NMT and Urban Land use**

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